URBAN AGRICULTURE, CITIES AND CLIMATE CHANGE

Edited by

Remi Adeyemo

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Contents

Preface

This publication is a selected refereed research papers from the Humboldt International conference (Humboldt Kolleg), Ile-Ife, 2010 which was sponsored by Alexander Humboldt Foundation, Germany. The original idea of the conference which was to discuss urban agriculture emerged from two research visits to Justus-Liebig University, Giessen, Germany.

It is noted that increasing urbanization in West Africa sub-region is causing dwindling agricultural resources and accelerating deterioration in the quality of life for those living in urban areas. There are urgent and pressing challenges that need an equally urgent and adequate response from city dwellers and national authorities. It is vital that researchers, policy makers and other stakeholders involved in urban agriculture must be aware of the scope of existing problems and future urban development activities. The situations call for improved access of the urban inhabitants to adequate food and fiber, basic facilities and friendly environment. The conference was convened in order to broaden the scope of the research visits.

As it turned out, the conference attracted considerable interest and enthusiasm which was reflected in a large attendance. About one hundred and eighteen papers were submitted and presented during the conference out of which sixty were selected for peer review evaluation This volume contains forty-four selected research papers after subjecting them to review mechanism.

The book is a component in many disciplines; which will be useful to those who have the opportunity to read it especially if considered by agriculturalists, urban researchers, geographers, sociologists, environmentalists, health workers and policy makers.

At this point l gratefully acknowledge the financial support of the Humboldt Foundation without which this publication would not have been possible. Many thanks go to the staff of the foundation for making this publication possible.

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URBAN GOVERNANCE AND RESOURCE MANAGEMENT: REVISITING THE 1976 LOCAL GOVERNMENT REFORM IN NIGERIA

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THE NATURE OF URBAN GOVERNANCE

The term "urban governance" came into vogue in the 1990s as against earlier concern with urban or city government or with urban management. The distinction is between government as "the formal institutional structure and location of authoritative decision making" (Stocker, 1998: 34) and governance which is about the way the power structure of the day and 'civil society' interrelate to produce a civic public realm (Swilling, 1997). Until the 1980s, the predominant assumption was that urban governments planned and managed urban development. As government, it was assumed to be responsible for mobilizing necessary financial resources, providing infrastructure for the efficient operation of cities, delivering services and establishing facilities for the support of productive activities and allowing private enterprises to operate efficiently. Urban governments were also expected to develop human resources within their jurisdictions, improve their productivity and raise their standard of living whilst regulating private-sector activities that affect community welfare and the health and safety of the urban population (Davey, 1996: 47).

The acceleration of changes in two areas of international life has impacted dramatically on this approach to the administration of cities. The first is globalization; the other is the influence of neo-liberal economic thinking. Globalization has been important because of the influence of transnational corporations in promoting the importance of capital markets and private-sector organizations especially in the area of infrastructural development in cities and within nations. It has also been transformative because of the world-wide impact of information technology on popular perception of development resulting in the emergence of broad social movements demanding increased political participation for the population. Neo-liberal economic thinking, on its part, fuelled the movement for reducing the conventional role of the state in the provision of services and infrastructures and re-directing it to concentrating on providing the enabling environment for the effective operations of markets in the national economy.

The changes in the realms of political economy made it increasingly difficult to continue to mange cities effectively in the conventional made as the population appeared no longer as compliant as previously. Nation of governance efficiency thus began to turn to ensuring greater participation of residents in the decision making process of their cities. Greater concerns began to be shown for inclusiveness and equity of all groups especially those traditionally disadvantaged In the decision-making process such as women and the poor. Such concerns extended to a growing demand for greater efficiency in the delivery of services to all and sundry, and most importantly, to greater effectiveness, transparency and accountability in the collection and management of the financial resources from residents by those running the affairs of the city. These nations, along with a few others such as respect for the rule of law, periodically open and competitive free elections for the governing elite, security and the promotion of shared vision of local economic development, came to be received as the cardinals for good urban governance.

Participatory democracy is thus central to the concept of urban governance. The structure of such participation involves paying greater attention to the neighbourhood and occupation organizations of city as well as to other organs of civil society such as the media, academia, trade unions and particularly the private sector, both formal and informal. It is thus of interest that when the system of "participatory budgeting" was being initiated in Porto Allegre, Brazil in 1989, it was a result of her initiatives of the Union of Neighbourhood Associations. Participatory budgeting, perhaps the most effective way of promoting participatory democracy, entails organizing residents of the city from their different neighbourhoods and socio-economic backgrounds into committees to assist the local governments in the planning and preparation of the yearly capital budget. Abers (2001: 140) examining the participatory budget process In Brazil emphasized that it came to promote tremendous and widespread democratic learning. This system of participatory democracy in action had by 2004 been adopted by over 130 municipalities in Brazil as well as in many other Latin American countries and even in Europe (Cabannes, 2004: 28).

This is why in recent times increasing emphasis is being placed on participatory democracy especially at the level of local governments. Brazil, in fact, now operates a system in which municipalities are given the right to establish councils of stakeholders (termed in English "municipal boards" or "community councils") comprising unelected representative of community groups which deal with such important matters as urban development, education, the environment, health and sanitation (Montgomery et al., 2003: 372). An effective way of establishing a participatory system of governance in a city is thus to create a forum that brings together the leadership of all the neighbourhoods in a city for periodic consultation and deliberation on matters concerning the social welfare of citizens and the economic well-being of the whole city. Along with such neighbourhood leaders could be included the leaders of different occupational and informal sector trade associations in the city, representatives of the local chamber of commerce, leaders of women and youth associations, religious and traditional leaders as well as representatives of non-governmental organizations in the city. Such a group constitutes a consultative Assembly to which the municipal authorities make annual reports of their performance and solicit support to achieve greater efficiency in revenue mobilization or in levying new taxes.

Clearly, urban governance with its emphasis on participatory democracy is a desirable outcome to which national and local governments should strive in trying to improve the management of cities. Since the year 2000, the UN-Habitat as well as the UNDP and the World Bank have all joined in launching the Campaign for Good Urban Governance in both the transitional and the developing regions of the world. Ten years later, it is still true that very few African countries are committed to the realization of these goals of good urban governance. One of the notable exceptions has been the Republic of South Africa. Since the beginning of the post-apartheid era, South Africa has been engaged in promoting a number of reforms towards the attainment of the goals of good urban governance. The 1998 Municipal Systems Act of South Africa, for instance, requires that municipalities establish systems of participatory governance to complement their systems of representative democracy. The Act, in fact, spells out in some detail when and how municipalities must communicate and consult with residents and involve them in various structures and processes of local governance. This emphasis on participatory democracy has encouraged local governments to engage in various innovative strategies to ensure that they carry their communities with them in major decisions about the development of the area. Such participation is in fact central to the City Development Strategy and has become important in dealing with problems of crimes, violence and security in those local governments where the residents are encouraged to participate in the governance capacity of the government in managing the resources of the urban community. Participatory democracy at the local government level has thus become critical in fostering accountability and dealing with issues of corruption and maladministration. It has also promoted greater concern with the quality of services to residents.

Another country where some tentative steps in this respect have been taken is Cote d'ivoire. Here, the experience of Adjame, one of the ten communes of Abidjan is instructive in respect of what local governments stand to gain by mobilizing their neighbourhoods and involving citizens in participating in the neighborhoods management committees and to endow them with an administrative budget as a way of enhancing citizens' participation in their own governance. Each neighbourhood management council was provided with an annual budget equivalent to US$4,500 to cover the costs of the local office. The effect of this level of participatory neighbourhood involvement in governance was remarkable.

It is obvious that for urban governance systems which incorporate such a wide rearrange of actors beyond governments and their agencies to be able to function effectively, municipal capacity need to be strengthened, resources need to be greatly enhanced and bureaucratic processes made a lot more efficacious. All of these are not likely to happen unless there is greater concern with decentralization as against the centralization that has been the prevailing governance paradigm in most African countries especially since political independence. Centralized planning was pursued vigorously in most African countries since the 1960s as the best way of maintaining maximum feasible control over national economics and promoting rapid economic development. Disillusionment with the poor results from such over-centralization fuelled the current movement for decentralization in some countries and a growing appreciation of both the critical importance and the accompanying difficulties of establishing a system of dispersed political and economic power in a polity.

URBAN RESOURCES AND THEIR MANAGEMENT

Yet, without such decentralized, urban resources cannot be effectively managed. Urban resources refer to all those localized attributes of a city that together serve to define the level of economic prosperity and social welfare of its citizens. These resources can be categorized into five broad groups. These are demographic, environment, physical, fiscal and social capital resources. The demographic resources of urban centers relate not simply to the size or number of its population but especially to their attributes in terms of age and sex, level of education, skill and entrepreneurship as well as organizational capabilities. The environmental resources are those of site comprising the land, air, water and vegetation of the city environs as well as those of location whether the city is on the sea front, on the bank of a major river, on a hill or mountain top or on the plain. The physical resources include such man-made facilities as houses, factories, office blocks, different types of market malls, sport stadia, ornamental parks as well as infrastructural facilities such as roads, rail, airport, electricity, gas and water supply systems. In a situation of growing urban agriculture and peri-urban development, it may be necessary to add availability and easy access to cultivable land to the physical resources of a city. The fiscal resources, in turn, relate to the tax revenue, the investments, the bonds and the other financial assets the city while the social capital resources are essentially a moral attribute inducing citizens from a strong sense of social identification to voluntarily contribute financial resources to their city of origin or sojourn.

One of the most important factors that determine the effectiveness of managing these resources is the quality of the information infrastructure available to the city. This information infrastructure relates to the land parcel-based system of housing and buildings whose physical agglomeration defines the urban centre. Although individual ownership of such parcels has been a common feature of land in many other societies, Africa has been unique in that until the colonial period land was held as communal asset, access to which was defined largely by kinship relationship. Urbanization during the colonial period was thus responsible for initiating the process of individualizing building plots. Indeed, it was the colonial administration that began the process of registering transfer of ownership from communal proprietors to individuals. Except in areas of white settlements, this system of registration was not linked to property taxation or to the effective management of the resources of the urban centre or the better monitoring of service delivery to its inhabitants. In fact, in most cities especially of sub-Saharan Africa, not only are streets still not named but houses are not numbered even if the parcel of land on which they are built are surveyed and registered in the land registry. Since the mid-1980s, the World Bank had provided financing for street addressing initiatives in several sub-Saharan African countries. More than 15 countries have applied this concept and its specific tools to their capital cities. Moreover, beginning in 1999, meetings to promote an international exchange of ideas have been organized fostering a deeper understanding of how to make street addressing initiatives more effective (Farvacque-Vitkovic et al., 2008)

The problem of providing data-bases and information infrastructure for managing the resources of African cities became more confusing and compounded with their rapid growth and the spread of shanty-towns and slum dwellings in the post-independence period. Today, it is claimed that nearly 72 per cent of total urban population of sub-Saharan Africa live in such slum areas, usually on land for which they have no title. The UN-Habitat in 2002 mounted a global campaign for granting most occupiers of such slum areas secure tenure to the land which they occupy. But the effectiveness of this campaign is undermined by the fact that many existing house-owners in African cities that are not poor still have difficulties in having secure tenure to the land on which their houses are built.

At any rate, the important point is that in many developed countries where the register, often with a map, of land or house ownership has been a constitutive part of land development, all of such information is taken for granted in the governance of urban centre and their management of urban resources. Known as a cadastre, such records of land parcel ownership date back many centuries and are recognized and respected as providing security against any contention, serving as a majpr fiscal; tool and, in modern times, providing a veritable source of capital. Cadastres help to promote the necessary trust that has become the cornerstone of the growth of urban land markets. More importantly, they have become a useful tool for city planning, the delivery of vital services like electricity, water, sewerage, waste management as well as the management of its environmental resources against pollution and general degradation. Thus, a focus of planning and environmental management was added to the application of the cadastre as a fiscal; and a land transfer tool.

Few African cities have such informational infrastructure to facilitate effective urban governance and resource management. Indeed, there has been a tendency especially among international donor agencies to downplay the importance of such infrastructure on the grounds that their results are not immediately evident as promoting growth in the gross domestic product of the country. If the development of African countries is to be laid on a firm and sustainable foundation such information infrastructure must be accepted as necessary for effective and efficient urban governance. Fortunately, innovations in the information technology field make ir possible to undertake such infrastructural project relatively cheaply. The advancement in technologies such as the Global Positioning System (GPS), satellite imaging and remove sensing have all made the capture of digital spatial data relatively quick and easy. Indeed, the Australian and New Zealand Land information Council (ANZLUC, 1995) found a benefit-cost ratio of 4:1 for overall data usage.

Yet, for urban centres to be able not only to develop but also to use their information infrastructure for effectively managing their resources, power must be decentralized to them. For decentralization to be effective and sustainable, three categories of responsibilities must be transfers to the urban government. These are: political, administrative and fiscal responsibilities. Decentralization of political responsibilities entails the transfer of policy and legislative powers especially in respect of functions for which local knowledge and local preferences are important in determining the economic and social impact of government actions. Such functions include urban planning, urban transport, land management, infrastructures and public facilities like parks, markets, bus stations, abattoirs, solid and liquid waste management, air and noise pollution. Administrative decentralization involves the transfer of substantial planning and implementation responsibilities including the power to hire and fire staff as well as set their salary scales. These are responsibilities which go to determine the local capacity to not only govern but also promote social and economic development at those levels of societal organization. Consequently, the caliber of officers deployed to promote decentralization in a country would greatly determine the effectiveness of the process. For many countries in Africa, the tendency has been to assume that local or urban governments need less qualified staff than the central government. The result has been both psychological and practical leading to incapacity of government in most urban centres.

Fiscal decentralization requires the transfer of substantial authority to raise their own revenue and determine their own expenditures. Indeed, it is increasingly recognized that only with such transfer of fiscal responsibilities can the whole process of decentralization and effective management f urban resources be sustainable. When local or urban governments do not have the responsibility for raising their own revenue but rather depend upon revenue being passed down from a higher level, a situation of gross fiscal irresponsibility is bound to be prevalent. Individuals who do not have to be accountable for the imposition of taxes, fees and charge are likely to be less accountable in terms of the manner in which they expend the resources available to them. This is so palpably true in a country like Nigeria where the relatively ample financial resources from petroleum export allows the transfer of substantial funds from the Federation Account to local governments to be easily misappropriated through various forms of corrupt practices.

In general, therefore, decentralization in most African counties has often done no more than encumbered municipalities and local governments worth increased burden of responsibilities that are not compensated for by an increased share of national revenue. This is particularly true for by an increased share of national revenue. This is particularly true for many francophone countries where local government budgets represent less than 1 per cent of GDP. Indeed, according to UN-Habitat whilst expenditure by local governments per head of population in the relatively richer capital cities such as Abidjan and Dakar averages US$20, for most other African capital cities the figure is no more that $4-6. It is estimated that most local governments in West Africa spend on average no more than 1/100th the amount per capita as their European counterparts (Niang et al., 1997).

Fiscal decentralization must this be seen as critical for effective management of urban resources since it creates the conditions for urban governance to take advantage of globalization trends especially with respect to the role of the private sector in infrastructural and service delivery. The enhanced capacity for mobilizing local resources and being responsive to local demands arising from such fiscal decentralization allows the authorities of cities to forge close partnerships between government, business and the citizens. Experience reveals that such partnerships between government, business and the citizens. Experience reveals that such partnerships have fostered greater access of urban centres to the local capital development. It has also enhanced their capacity to enter into various forms of agreements with private sector providers ranging from service contracts and concessionairing to rearrangements for the latter to build-own-operate or build-own-transfer infrastructural facilities in the city.

THE CHALLENGE OF THE 1976 LOCAL GOVERNMENT REFORM

The 1976 Local Government Reform in Nigeria recognized local governments as the third tier of governmental activity in the nation and arbitrarily divided the country into 299 local government areas. Each of these was to serve a total population of between 150,000 and 800,000. There was provision for the establishment of "subordinate councils" to which the local governments could delegate specified functions but such councils would not enjoy Federal Government recognition or finance. In launching the system, the then Chief of Staff, Supreme Headquarters, claimed that the reform was to ensure that local governments "do precisely what the word government implies I.e., governing at the grass roots or local levels"

This so-called reform, in spite of its claims to fostering participatory democracy and political responsibility at the grassroots, was essentially concer5ned with working out a demographic principle that size of population determines the efficiency of a local government. The arguments in support of this emphasis would seem to hang on the assumed "economies of scale" which a fairly populous local government could bring to bear on the delivery of most of its services. In the words of the Guidelines, it was an attempt "to establish an effective relationship between the scale of operations of local authorities and their responsibilities, or to take adequate steps to ensure that they had the means, financially and in respect of staff organization, to do what was expected of them". In consequence, the country was divided into 299 Local Government Areas.

In terms of urban governance, what this reform did was to break up large urban centres such as Lagos, Ibadan, Kano, Kaduna, Onitsha and so on into multiple local governments whilst compounding medium to small urban centres into some amorphous local government entities. Thus, while Ibaden, for instance, came to be divided into 13 local governments, a number of small to medium urban centres in southern Oyo Division were lumped together to form what was Afijio Local Government. The name "Afijio" is, in fact, the acronym of the major urban settlements lumped together. A thus stands for Awe and Akinmorin; F stands for Fiditi; I for Ilora; J for Jobele: the second I for Ilawe and the O for Olorunda. Each of these settlements, except for Jobele, is still a sizeable urban centres but today its administration and resource management is left in the indeterminate hands of a local government whose headquarters is a compromise rural settlement of Jobele.

This situation of splitting large settlements into smaller local governments and merging small and medium size settlements into an amorphous entity has made it very difficult to provide comprehensive physical plan either for the larger or the smaller urban centres. It has also made it virtually impossible to effectively manage their resources especially the environmental resources which are not bounded by the artificial administrative boundaries. To make matters worse, the present situation made no provision for metropolitan planning and transportation authorities which could have brought some coherence to the physical development of our bigger cities. Indeed, when a former Governor of Kano State decided that such an overarching planning authorities was imperative, the local government councils challenge his power to curtail their constitutional powers.

That the demographic criterion was not a most appropriate basis for defining and creating local governments became obvious almost as soon as the system was established. Agitations were mounted by communities after communities to have their own local government. When the civilian administration came in 1979, the State governments created their constituent settlement units. The return to military rule under Major-General Buhari in1984 regarded this development as part of the prevailing national indiscipline syndrome and forced the country back to the *status quo ante* of 299 local government system. He was, however, compelled to set up the Dasuki Panel to investigate the basis for most of these demands. The panel conceded that most of the claims were legimate but proposed the creation of "area committees" to take care of them. Not unexpectedly, agitators for new local governments refused to accept such a sop. The Babangida military administration that succeeded the Buhari regime in 1985 had to bow again to widespread demands and artificially raised the number of local governments to 589, this time based on no particular criteria except political lobbying. This became even more so under the Abacha regime when the number of states and local governments was increased on the basis of no particular criteria. Thus, a State like Kano which had all the time had roughly the same population and the same number of local governments as Lagos was split into two and the number of local governments in the residual Kano state increased arbitrarily to 44 whilst the new State of Jigawa was given 26 local governments whilst Lagos was left at 20 local governments. Today, the total number of local governments in the country stands at 774 with four development areas within the Federal Capital Territory.

MANAGEMENT INCAPACITATION OF NIGERIA CITIES

For most other countries of the world local governments relate to particular settlements especially towns and cities. These towns and cities usually have a mayor or someone of that status who is responsible for the management of the affairs of the government of the settlement. In some countries, even the smallest settlement ahs a head, sometimes as in Brazil also called a mayor. The status of town or cities is officially designated and mayors of such higher-order settlements are recognized as of much greater administrative significance. The absence of such official designation in Nigeria is one reason why it has always been difficult for the country to be effectively represented at any international conference of mayors of cities or metropolitan centres. Of course, it is claimed that every Chairman of a Local Government in Nigeria is a mayor but since their territorial jurisdiction is neither an urban centre nor a metropolitan district, the physical area of their responsibility is poorly defined. This is also why whenever a local government is to be created, the concern is always where the headquarters will be properly managed. Rather, it is to ensure that any projects or investments by the State or Federal Government are concentrated in that single settlement. And this is why in local governments with equally competitive urban centres such as AFIJIO in Oyo State, the factor of competition results in the decision to put the headquarters of the local government in the most obscure or relatively inconsequential settlement in the group. The situation in Ekiti West Local Government is also a case in point. Here for years Efon Alaye went, as it were on strike and refused to have anything to do with the new headquarters. After years of determined protest, Efon Alaye was constituted a local government on its own.

The failure of the Nigerian local government system to relate to particular settlement entities such as town and cities also denies urban governance the benefit of leveraging on the social capital of citizens. Social capital is describe as 'networks and local associations that … might support collective action, enforce norms, generate expectations or reciprocity, or foster feelings of mutual trust (Putnam, 1993: Kawachi, Kennedy and Glass, 1999). Such social capital is what many hometown voluntary associations in Nigeria leveraged to secure resources for developing the physical and social infrastructures in their towns and cities. Indeed, many Nigerian cities boasts of schools, town halls, palaces, post offices, markets, roads, hospitals, clinics and so on deriving from the social capital mobilized voluntarily by their citizens (Honey & Okafor, 1998; Traeger, 2001). It still continues to be invoked by the informal local government system represented by the traditional authorities in most cities. It is, of course, of interest that in a country like China such social capital is responsible for a large part of the donations contributed by individuals and enterprises of the "off-budget" revenue of cities (Montgomery et al., 2004: 375). Indeed, it has been claimed that as much as 40% of funding of all urban infrastructures in some Chinese cities in the late 1990s derive from such social capital.

More directly, the present local government system in Nigeria effectively negates urban governance and makes it difficult to promote serious management of any of the five groups of resources indicated above. The governments of our cities hardly have anything to do with its population. It is hardly responsible for the health or education of its citizens and can hardly be made to strive to improve on current performance on critical health or educational indices. Issues like climate change or environmental pollution or the need to respond locally to Agenda 21 on improving the quality of the environment hardly resonate in the management of our cities. The maintenance of roads, public buildings and other public amenities enter into the calculations of municipal responsibilities nor the effective planning of land use which would have taken cognizance of the growing demand for the land for urban agriculture. Rather, the Town Planning Division of most Local Governments make heroic effort to monitor housing development but corruption and influence peddling have undermined the effectiveness of their interventions, sometimes resulting in the growing demand for land for urban agriculture. Rather the Town Planning Division of most Local Governments make heroic effort to monitor housing development but corruption and influence peddling have undermined the effectiveness of their interventions, sometimes resulting in the growing phenomena of collapsed buildings.

Management incapacitation makes it difficult for local governments in Nigerian cities to mobilize significant fiscal resources beyond the statutory allocation from the Federation Account. Because of the defective structure and the alienation of most citizens from the structure, it has been difficult to effectively prosecute the collection of local revenue especially of tenement rates. Indeed, there is a prevailing realization that the local government system in the country has not served the purpose for which it was established. It has not made for efficient delivery of services nor has it operated in a transparent and accountable manner. It has not enhances participatory democracy at the grass-roots nor has it been able to substantially raise the level of local revenue such that it can provide the services needed by its citizens. Instead, it has itself resisted being asked to deliver such services as primary education to its citizens and has come to depend almost wholly on statutory transfers from the Federation Account and from the State Governments for its revenue. Corruption at this level of government has become proverbial and the venality of local councilors a bye-word among the citizens. Nowhere in the country has the local government system been an instrument either for good governance or for participatory democracy or for economic progress.

The application of the Presidential system to this third tier of government has tended to make matters worse. It has helped to create a situation where local government chairmen fritter away the scarce resources of subvention from the Federation Account on the grounds of employing friends and cronies as Special Advisers. Although this situation is not country-wide, it is sufficiently widespread as to compound the overall ineffectiveness of most local governments in service delivery to their citizens. The position is not helped by the manner in which most State Governments operate the Joint State and Local Government Accounts usually to the disadvantage of the latter. It was the fact for many state Governments this account provide some slush funds that has made it difficult to promote a reform of the local government system during the Obasanjo administration and which leaves the country with a tricky constitutional anomaly.

On one hand, the 1999 Nigerian Constitution (Section 7(1)) concedes to State Governments the power to make a Law for the "establishment, structure, composition, finance and functions of local governments. On the other hand the Constitution (First Schedule) proceeds to list the existing 774 local governments and make it difficult for State Governments to exercise their powers to establish local governments without recourse to Federal Government approval. The situation whereby the Federal Government refused to accept the new local governments created by the Lagos State government underscores the nature of this constitutional anomaly. This refusal highlights the difficult of reforming the present system especially as some state governments continue to derive unfair fiscal advantage by the arbitrary nature in which the 774 local government system was arrived at.

THE WAY FORWARD FOR EFFECTIVE URBAN RESOURCE MANAGEMENT

The relevance of the demographic weight or size on which the whole system was initially based is, however, easily challenged by the lessons of experience from other countries. It would be appropriate for the audience assembled here today to encourage more detailed studies of the history of development of the local government systems in most developed countries to appreciate many of the points being raised in this paper. One of the strongest points that would emerge from such studies will be the high degree of historical continuity in governance at this level. This long history has made possible the accumulation of a huge stock of social capital which has become a major factor in the sustained viability of government at this level. It has helped to ensure their level of efficiency in service delivery and the management of the available resources and to guarantee for them a high degree of transparency, accountability and democratic participation.

I was privileged to take note of the system of local government in the State of Maine in north-east United States sometime in the summer of 1992. Hers, every settlement, irrespective of size, constituted a local government. Some settlements have population of under 100; others of over 1,000. Irrespective of their size, the government comprises always only of THREE selectmen, the title they give to their councilors. Because of the variety of functions to be performed, a selectman may wear more than one hat. The Chairman of the council could double as the Plumbing Inspector; the Town clerk as the Tax Collector; and the Treasurer as the Fire Chief. Where the council is too small to purchase the necessary vehicle, refuse collection is contracted out to private enterprise which in turn delivers on contract to the landfill of some larger community. The local government does not have to own is own school, if it is not big enough to do so. Since education, however, is its responsibility, it can pay the fees of its children who are made to attend schools in neighbouring communities. The same goes for ambulance service and primary health-care delivery. In every case, the emphasis is that the citizens receive the services they require; not that the Council expend the revenue it couldn't raise. At least once a year, there is a statutory Town meeting on an appointed day such as the first Friday i9n March. This is when the results of the previous year discussed and agreed upon. Clearly, the system takes care of economic reality of varying community sizes whilst allowing for ample opportunities for participatory democracy.

If Nigeria is to institute a true system of urban governance, it is clear the way forward lies with a constitutional review that does not define States on the basis of their local government but on their territorial boundaries. Secondly, such a review would include a fiscal reform that uses the same criteria as were used for Federation Account. This will do away with the need to insist on 774 local governments and will allow State to reconstitute their local governments on the basis of definable settlement entities either urban or rural. This will, Indeed, make it possible to truly meet the terms of Section 7(2) of the 1999 Constitution which stipulates that "The person authorized by law to prescribe the area over which a local government council may exercise authority shall: (a) define such area as clearly as practicable; and (b) ensure, to the extent to which it may be reasonably justifiable, that in defining such area regard is paid to: (i)the common interest of the community in the area; (ii)traditional association of the community; and (iii) administrative convenience.

It is indeed the absence of common interest or traditional association among the communities lumped together in many of the existing local governments in the country that makes it difficult for them to achieve any effectiveness or efficiency in the delivery of services to their constituents. It is thus clear that until the present system is reviewed and reformed, the prospect that it can promote an efficient system of resource mobilization or management at the local government or urban governance level is very dim.

At the same time, for the very large cities there is an urgent need to provide a constitutional amendment that allows such settlements to have a metropolitan authority that can at least engage in their co-ordinate planning and transportation provisioning. Such an authority would have helped to consider issues of operational efficiency of the whole urbanized areas as well as effective resource management. It would also have been able to plan for many of the issues indicated in the theme of this conference. Certainly, any city that is covered with more than two local governments can be up-graded to the level of a metropolitan centre. And it may be that whilst we continue to reserve the designation "chairman" for the political head of existing local governments, we may designate the political head of metropolitan centres as "mayors".

CONCLUSION

The present situation with respect to urban governance in Nigeria is certainly far from re-assuring. Indeed, one can ask: what opportunities for effective urban governance are provided for the citizens in the present system of local government in Nigeria? Given the incongruous amalgam of different communities that a local government area currently harbours, what stock of social capital is being accumulated? What repertoire of collaborative achievements do our local governments have to shoe over the years? What instances of real participatory democracy (as distinct from the episodic electoral democracy) can be offered for analysis and evaluation? Clearly, for most local government areas in Nigeria the answers to all of these questions are still very much in the negative. There is limited opportunity for civic engagement across local government area and very little collaborative activities. Real participatory democracy is hardly encouraged and social capital accumulation is fragile in the extreme. No wonder councilors feel disoriented and responsible to nobody in particular. The lack of transparency and accountability, the corruption and venality of the councilors, all are inherent in a system founded in such a non-social variable as population size.

The theme of this Conference, however, expects urban governance that can respond not only to the productive and reproductive need of their citizens but is also able to contain and manage the looming environmental hazards especially from climate change. Such hazards in some cases can be expected to easily accelerate to attain disaster proportions if cities are not able to feed their population or provide them adequate service against infectious diseases and epidemics. Some media commentators have already drawn parallels to the virtual helplessness of the urban government of the capital city of Haiti in the face of the recent earthquake disaster it experienced which was further compounded by heavy flooding. The situation portends what could happen in situations where urban governance is disempowered and alienated and is unable to mobilize and manage resources for the majority of its population.

More than this, the prevailing process of globalization is fuelling the rate of urbanization especially in many developing countries. Already, many countries in Africa are moving towards having between 40 to 50 per cent of their population living in cities. Nigeria, for instance, is estimated as likely to reach this half-way point by 2015. Yet, there is little indication that the standard of urban governance in the country is ready to absorb such large increases of persons without simply condemning many more of them to living in squalid, peri-urban settlements. Globalization also underscores the fact that an urban centre that is well governed can easily access most of the benefits of modern urbanization. This is possible if its financial resources management is of a standard that enables such a settlement to be able to operate on the capital market or encourage wide-ranging public-private partnership in the development of its infrastructures or the delivery of services to its residents.

Unfortunately, on the numerous occasions when constitutional reforms are being undertaken in the country, the issue of governance at the local level hardly ever gets the attention it requires. This, of course, is not unexpected given the fact that much of the financial resources available to all three tiers of government in the country come virtually as "windfall" from the petroleum market rather than as tax revenue mobilized from the citizens. It would appear therefore that until such a time when urban governance depends on the capacity to effectively mobilize a high proportion of fiscal resources from resident citizens, it may not be easy to expect that it will be able to develop the capacity to effectively manage the many varied resources with which most cities are blessed.

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THE ROLE OF PRIMARY AGRICULTURE IN PROCESSING AND NUTRITION IN URBAN FOOD SECURITY IN DEVELOPING COUNTRIES: THE NIGERIAN EXPERIENCE

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INTRODUCTION

Food and nutrition security is a major challenge facing most developing countries; unfortunately, it appears no serious attempts have been made to bridge the gap between supply and demand. Incidentally, human security is intrinsically linked to food security as food shortage threatens human security. The state of food insecurity arises from defects in the entire food chain, starting from production to the point the food gets to the consumer table. Most developing countries are mainly agrarian in nature, yet it has been extremely difficult to ensure food security. The state of food insecurity is further compounded by wars, internal strives, climate change and low level of technology, both for food production, processing and distribution. Most developing countries, especially Nigeria currently depends heavily on food importation and hence the scarce foreign exchange earned is ploughed back into food importation.

In some of these countries, there have been increasing tends of urbanization which has been reflected in the transformation of rural communities into urban settlements. Unfortunately, these transformations are done haphazardly without holistic plans for food supply to the emerging urban settlements. In this paper, urban food security in developing countries is critically examined from the Nigerian perspective. Since the focus is urban food security. It is important to examine the pattern of urban development with reference to Nigeria.

Urban development is a multifaceted structure that could be analyzed through social, economic and environmental components with the definition of urban as settlements having minimum concentration ranging from 200 to 50,000 inhabitants. Thus, the word "urban" is having varied definitions with each nation being allowed to determine its own specific definition that is acceptable to its policy makers and government. Nigeria's classification of urban center was at the 1963 National Population Census figure which fixed it as a settlement with population of more than 20,000.

Historical Antecedents of Urbanization in Nigeria

The urban development across the length and breadth of Nigeria are similar in characteristics. In the pre-colonial days, urban centers were the trade centers where there were inter and intra tribal markets, which later also housed the international trade. The urban centers were also the Kingdom's headquarters. In the colonial days urbanized towns or cities developed mostly at the kingdoms' headquarters.

Many of the urban centers in post independence developed through the colo0nialurban setting which embraces the planning and building of the governmental institutions that include the educational institutions and hospitals. Thus, rural dwellers were attracted to the new urbanized settings for economic, health and social reasons, thus post independence urban development anchors on institutional development and economic reasons.

The oil boom era transformed Nigeria, from its agrarian nature which was primarily rural to preference of urban "white collar" settings, jobs and life styles. This contributed to population increases and socio-economic development in the urban settings such as local government headquarters, state capitals, the nation's capital city and industrial towns.

Urbanization Trends in Nigeria

The urbanization trend in Nigeria aligns with the trend in most developing economics. There has been population growth in Nigerian urban settings as compared to the rural settings[4] while the urban population trend between 1985 and 2004 has been increasing, even with the poverty trend.

Urban development has positive and negative implications. It is surmised that the rural-urban drift in Nigeria was a product of the oil boom witnessed in Nigeria that took the Nigerian economy away from being an agrarian society[5]. Even though migrants to urban settings are attracted for socio-economic reasons but "the urban area in Nigeria are known to be sites of concentration of wealth as well as problems and solutions, and high incidence of poverty"[6,7]. Poverty is implicated in environmental problems[7] (WCED, 1987).

The urban development of Nigeria is witnessing environmental insecurity. The urban areas are donned with solid waste materials, polluted water, and land and air bodies. The portable water supply in many of the urban settings in Nigeria is not readily available for all the urban residents because of failed and ineffective institutional management.

Urban development has led to increased slums development in most of the urban centers. It is posited that urban development driven by poverty with no availability of jobs leads to increase in numbers of slums dwellers in urban centres with the health and environmental conditions of the slums in doubt.

FOOD SECURITY

Food Security refers to the sustained availability and sustainability of good quality food. A household is considered food secure when its occupants do not live in hunger at the risk of malnutrition and starvation[8]. Two commonly used definitions of food security come from UN's Food and Agricultural Organization (FAO) and the United States Department of Agriculture (USDA):

Food security exists when all people, at all times, have access to meet their dietary needs and food preferences for active and healthy life[9].

Food security for a household means assess by all members at all times to enough food for an active, healthy life. Food security includes at a minimum (1) the ready availability of nutritionally adequate and safe foods, and (ii) an assured ability to acquire acceptable foods in socially acceptable ways (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)[10].

In discussing the thrust of the paper, urban food security, it is pertinent to critically examine production, processing and nutrition security in the urban setting in Nigeria.

PRIMARY AGRICULTURE IN NIGERIA

Primary agriculture refers to a farming practice in which raw agriculture produces are obtained with little or no processing. Primary agriculture provides employment to over 75% of the country labour force and the livelihood of over 90% of the entire population working mainly in small-holdings using basic tools[12]. Together with livestock raising it provides a third of gross domestic product[13]. Farming is simply the way of life of a sizeable proportion especially the rural populace which probably one of the largest industries in Nigeria; and in fact in most national economics.[14, 15]

Nigeria occupies a land area of about 92.4 million hectares stretching between latitude 4^0-14^0 N and longitude 2^0 – 15^0 E, 70% of which can be used for agricultural purposes.[11] The physical (soils) and the climatic features of the country have culminated in a parallel vegetation and ecological zones, ranging from the mangrove swamps of the coastal areas with almost no distinct dry season (>60mm rainfall even the driest months of the year) in the extreme south east to extreme north east where the prevalent vegetation is Sahel Savanna with over five months of dry season (rainy season of only 69 days between July-September).[16] These variations have allowed cultivation of a wide variety of food crops including: root and tuber crops of tropical rainforest, cereal of semi arid areas (Sorghum and millet) and subtropical crops (potatoes and vegetables of various varieties), including cassava (of which Nigeria is the largest world producer), millet sorghum and maize. Rainfall is the most important weather factor that influences crop yield, distribution and production within the country.[16]

Traditionally, the farming system is based on clearing pieces of land out basically with hoes and cutlasses, while axes are used for felling big tress which were of less economic importance while economic trees were selectively protected. Fire is major tool in land clearing operation and the system is often referred to as "slash and bum" system.[16] Thus the vegetation was minimally disturbed and the soil was left in-situ and low input technology was involved in the entire production system which was in most cases sustained by fallow and shifting cultivation system. Subsistence level farming was central to the lives of most families and family members formed the bulk of the farm labour. Nigeria traditional farming systems are variables and complexes. It is a dynamic process that evolves in response to changing environment.[17] The nature of the soil, cultural practices, family size, population per square kilometer all greatly influence the farming systems practiced in each regions or agro-ecological zone. More than 55% of the farms were less than 4 hectares and farm sizes were relatively small characterized with low input technology and low level of inorganic fertilizers application. Farm size per farming family was relatively small in the southeast mostly compound-farming and size increases as we move northwards due to open vegetation.

Role of Primary Agriculture in National Food and Nutrition Security

Primary agriculture, amongst others, serves the following purposes:

- Creation of employment opportunities for people. e.g. Middlemen and Retailers of agricultural produce are gainfully employed through primary agriculture.
- Enhancement of means of livelihood for the transporters of agricultural products from the rural areas to urban centres.
- Urban-based low- and medium- scale food processors obtain their raw materials from primary agriculture.

Examples: Cassava roots for gari, fufu, and lafun processing: plantain for plantain chips; yam tubers for yam flour and poundo yam; palm kernels for palm oil; fresh vegetables and meat for informal catering outlets (canteens and bukaterias), etc.

- Urban-based households also obtain food materials from materials from agriculture for their family survival and food security.

Examples: Yam tubers for pounded yam; vegetables for soup; meat, pepper, tomoto, onion, etc. for stew; plantain for dodo; bananas as a dessert; etc.

- Produces from primary agriculture are rich in nutrients that help Urban Dwellers live a healthy life and fight against nutrient deficient diseases.
- Elimination or reduction of nutritional health problems among urban urban dwellers can therefore enhance their productivities at work and less patronage of hospitals.

FOOD SUPPLY AND AVAILABILITY IN NIGERIA

The source of food supply has not changed dramatically over the years. Primary agriculture, through subsistence farmers still predominates, especially for the supply of plants foods. Although, attempts were made at large scale mechanized farming, especially during the era of oil boom, most of these farms set up by individuals and corporate organizations witnessed a collapse. To date, Nigerians still heavily on food supply from the subsistence farmers. It is therefore imperative, therefore, to critically evaluate food supply and availability in Nigeria over the years.

Pre-Independence and Oil Boom Era

The Nigerian agriculture, before independence was focused at producing export crops such as cocoa, rubber, groundnuts, palm-oil, cotton, etc. in spite of this focus, Nigeria was self-sufficient in food production.[18] Food crops like maize, yam, cassava, cocoyam, beans, etc were produced in abundance. Furthermore, because of the relatively lower cost of food crops, most Nigerians were apparently well-fed.[19]

Consumption pattern of the two classes of food items (plant and animal products) was found to depend on the location. In the southern parts, the staple food was yam, while little food of animal origin was consumed. Intakes of legumes, nuts, green leafy vegetables and fruits were higher than everywhere. In other locations, especially in the northern parts, staple foods were millets and sorghum, supplemented with more meat, fish or dairy products

The oil boom (1970 – 1980) was an era that witnessed a phenomenal increase in the cost of living and purchasing power of Nigerians with a drastic change in the taste of consumers. The period formed the genesis of the decline in agricultural production – affecting both food and export crops.

The oil-boom encouraged a steady drift away from rural to urban areas in search of white collar jobs. These trends led to inadequate food productions, which resulted in an increase in food prices, which rose by between 85% and 125%.[19]

Bridging the gap between supply and demand

Between 1970 and 1980, food production increased at a rate of 2% per annum, while the corresponding demand stood at 4.5% as a means of bridging the gap between supply and demand, part of the export earnings from oil was diverted to food imports rather than encouraging or improving food production. For instance, in the period 1970-1977, food imports grew at an estimated rate of 19% per year in real terms. Food import bill stood at #1,020.7million in 1978, while by the end of 1981, it had risen to #2,115.1million. in 1960, the expenditure was #24million while by 1970 it rose to #1,246.1milliom.[19] It was therefore evident that a country which was 80% agrarian was importing an increasing amount of food.[18, 21]

Industrial Development and Food Availability

The need for the food and allied industries to source for raw materials within the country has stimulated agricultural production. Prices of food crops such as maize, sorghum and cassava have gone up astronomically due to increasing demands by the relative industries. The direct consumers of these staple food crops have been edged out in the ‘price war’ as they could no longer afford these commodities at sufficient quantities needed to meet their nutrient requirements. This trend may continue for some time unless attempts are made to increase food production and available food on consumer’s table.

Future Trends

It's apparent from all indications that Nigeria has not been able to produce enough food to feed her teeming population and the materials for the industries. This is evidence by the massive importation of grains and other food items to meet internal demand. In analyzing future prospect for national food supply and demand, Nigeria cannot be isolated or immuned from international or world determinant factors since in the last couple of years, Nigeria has depended heavily on imported food items.

THE FOOD PROCESSING INDUSTRY

Processing is an operation or action carried out to cause a change (i.e.) Physical, Chemical, Biological) on plant or animal food materials or any other materials use for food with basic aim of archiving one or more of the following objects:

- Preservation and reduction of post-harvest losses
- Extension of availability of food product over a longer period, thereby reducing the hunger-gap between the harvest periods, when prices of food shoot up and put many people at nutritional risk.[22]
- Improvement in the food's nutritive value as well as availability to the body.
- Improvement in the food's digestibility thereby making it easier for the body to break down the food.
- Improvement in the food's hygienic quality thereby making it safer to eat as a result for the elimination for unwanted part, harmful micro-organism or toxic substances.
- Creation of desirable flavors which are pleasant to take.

In Nigeria, like in most developing countries, the food industry consist of the large- backed companies (Multinationals); the governments owned or sponsored companies and the medium-scale, the small-scale and the very small space (as small as one person) enterprises owned by indigenous operators.[23]

The large-scale food industries in Nigeria are located predominantly in urban areas where their impact is greatest. They are involve mainly in brewing and beverage production, flour milling, production of complementary foods, sugar refining and production of sugar confectionery, milk and dairy products processing, vegetable oil refining, and production of biscuits and other bakery products, condiment and flavorings.

The small-scale food industries include those involved in root and tuber processing, especially cassava and yam processing, cereal and legume processing, baking, fruit and vegetable processing,, brewing and beverage production , flour milling, and production of condiments.[23] By generating employment opportunities in the rural areas, small-scale food industries reduce rural-urban migration and the associated social problems. They are vital to solving the problem of unbalance between the rural and urban areas and are crucial to reducing post-harvest food losses and increasing food availability. Unfortunately, rapid growth and development of small-scale food industries in Nigeria is hampered by the adoption of inefficient or inappropriate technologies, poor management, inadequate working capital, and limited access to banks and other financial institutions, high interest rates and low profit margins.[21] Local processing at village level offers employment to many as an important off-farm income-generating activity.

FOOD HANDLING, SALE AND DISTRIBUTION

Food handling is an integral aspect of food production and processing and as such, the manner in which food for human or animal consumption is treated is an essential feature of food management.

The channel of distribution for processed foods and beverages in Nigeria varies for different products and from one location to another.

One major setback of food supply to urban areas is the fact that in transporting processed foods, the industry depends solely on local transport. There are no special trucks and transport services for distributing specific food or beverage product. Food distribution or marketing are prone to the vegaries of the local or national transport network. The major transport system is by road as rail system has been paralyzed for more than twenty years. With poor road network and reliance on aged and badly maintained vehicles with constant break down and high rate of accident, not only raw materials (agriculture materials) but also processed food distributions are adversely affected. This has led to significant losses and a-times, contamination at accident or break down sites; this is another feature of processed foods in the course of distribution.[24]

URBANIZATION AND CHANGING FACET OF FOOD CONSUMPTION IN NIGERIA

The Nigeria food industry and consumers have been witnessing a trend synonymous with patterns in developed and some developing country. Due to urbanization, there has been increasing dependent on street and fast food by consumers. This development is band to have significant impact on the demand for basic raw materials to be sourced through primary agriculture or through importation.

Street foods

According to FAO "Street Foods are ready-to-eat foods and beverages prepared and/sold by vendors and hawkers especially in street and other similar public places". The equity policy center (EPOC) add the further qualification that street food are sold on the street from "publicants or basket or balance poles, or from stall or shops having fewer than four permanent walls".

One major factor that has contributed to increasing dependence on street foods is migration to urban center. Other factors are: change in house hold structure and family structure and family demand of office or job situation and improvement in transportation system which as encourage more people to be on the road for one reason or the other.

Fast Food

Fast food is any food that is quick, convenient and usually inexpensive. Fast food is sold just about any where: in restaurant, at franchised outlet, by street vendor and inconvenient stores. Fast food includes salty French fries, beef burger, fried chicken, buns, doughnuts and pizzas with a thick cheese covering. Africa dishes have been incorporated into the menu of fast food restaurant.

The fast food industry has been growing since the 70's and as a result the industry is healthy, the growth is due to urbanization, relative increase in average disposable income; a decrease in the cost different between eating out and cooking at home and increasing hectic life style, especially in urban area. In the Nigerian setting there is the informal sector (consisting of largely non-premises based units, such as kiosks, stalls, mobile vans, bicycle) and the formal sector (consist of premises based outlet). The Nigerian organized fast food restaurant industries is currently worth about ₦190billion ($760million) with potentials for growth.

Urbanization and Nutritional Status

Nutrition has been simply defined as the study of various nutrients in relation to their effect upon the human body. Quality of life is therefore highly dependent on diet. Food, in additional to proving energy and nutrients, has outstanding healing and disease preventing power, Hence, many common health problems can be prevented or alleviated with healthy diets.

Hunger and Malnutrition

In most urban cities in Nigeria, the nutritional status of urban dwellers varies depending on the economic or purchasing power of the family. The consequences of low purchasing power and low food intake lead to hunger which can cause serious physical injury to the body injuries like brain damage and physical defects. Children suffer the most. The effects of hunger on children are classified as stunting, underweight and wasting. A higher proportion of children in developing world suffer from under-nutrition resulting from a combination of inadequate food intake, and culminating into diseases, such as diarrhea, which prevents proper digestion of food. Various nutrient deficiency symptoms accompany consumption of imbalanced foods. The right combination of foods is a principle of great importance both in sickness and also a preventive measure.

The major causative factor of malnutrition in the urban setting is hunger which is prevalent in slums of urban cities. Those who live in slums are usually overcrowded. They have unhealthy living conditions; there is high poverty and most people are without job. A larger percentage of people living in slums are in developing countries which explains a high level of malnutrition in such countries.

Nutritional Status of street and Fast Foods

As presented in above (6.1 and 6.2) street and fast food have emerged as major sources of food supply in urban areas. However, there are attendant heaths and nutrition related problems. For instance, it has been reported that in 2006 and 2007, there were 1, 134, 726 and 1, 376, 668 respectively reported cases of food borne diseases in Nigeria. Some of these have been linked to consumption of contaminated street vended foods as a result of toxicological, microbiology and other contaminants.

Nutritional studies have also shown that the fast foods contain the following: high energy density; high fat, high saturated fat, high salt, high sugar, low micronutrients, low fiber and high monosodium glutamate. The resultant effects include increase in body weight and consequently obesity; insulin resistance: high incidence of atherosclerosis and other related cardiovascular diseases and cancer of the colon. Furthermore, monosodium glutamate has been found to interface with the proper functioning of the enzyme in glycolysis and tricaboxylic acid cycle.

STRATEGIES FOR IMPROVED FOOD AND NUTRITION SECURITY IN URBAN CITIES IN DEVELOPING COUNTRIES

It is clear that urbanization in most developing countries, especially in Nigeria; is highly uncoordinated. Increasing trend of urbanization if not given proper planning would lead to a high level of malnutrition and its consequences it is imperative therefore, that sustainable strategies for food supply be put in place and adequately implemented to ensure effective urban development in developing countries. These strategies are presented in the following:

Planned Development

There is a need for ordered development of urban cities with relevant food supply sources to be incorporated. In Nigeria, most urban towns rely heavily on rural areas for food supply through primary agriculture and small-scale processors, especially for traditional foods and beverages which from almost 90% of intakes by Nigerians. It is imperative therefore to ensure that food sources should be an integral component of urban planning and development, just like municipal supplies (I.e. water, electricity, etc)

Economic Development

Economic development has been defined as the development of economic wealth of country or region for overall wellbeing of its inhabitants; it is the process by which a nation improves the economic, publicly and social wellbeing of its people.

Economics policies should be put in place to increase purchasing power in order to stem increasing trends of malnutrition, especially among the low income groups in urban areas. In achieving the above, there is a need to ensure effective and consistent government programmes and policies.

Exploitation of Underutilized Food Crops:

There is a wide range of underutilized but highly nutritious food crops, the production and consumption of which need to be encouraged. These include potatoes (Irish and sweet), cocoyam, breadfruit, amaranth grains and a wide range of other legumes and oilseeds. Popularizing these food crops would lower the demand for conventional staples and consequently a reduction in the costs of production hence food availability.

Quantity and Quality:

The nutrient needs of the individual are met through food consumption in quantity and quality. The quality parameters out-weigh quantity parameters. This is because a selection and combination of nutrients in the right proportion will ensure that the daily needs are met in terms of calories, proteins, vitamins and minerals. Presently, the issue of food quality has been de-emphasized as a large proportion of the population subsists mainly on energy giving food. Availability of animal products at affordable prices should be ensured through thriving livestock industry.

Appropriate Technology for Food Production, Processing and Manufacture of Foods of Convenience

Adoption of emerging technologies such as biotechnology for food production should be encouraged. Sustainable food processing technologies for small-scale food processors should be introduced.

It is imperative that low cost processed foods be developed using simple and appropriate technologies. Availability of foods of convenience at affordable prices would go a long way in meeting food and nutrient needs of urban dwellers.

The nutritional and aesthetic values of traditional foods and beverages could be enhanced through adequate processing and preservation techniques, and also through fortification or supplementation of high carbohydrate groups with high protein sources, vitamins and minerals.

Increased Consumption of fruits and Vegetables:

The nutritional requirements for balanced human nutrition are the provision of adequate amount of calories, protein, vitamins and minerals, fruits and vegetables as a class help to meet both of these requirements, depending on their specific composition and on the quantities in which they are eaten. Unfortunately, consumption of fruits and vegetables in developing countries like Nigeria is minimal. In fact a high percentage of harvested fruits and vegetables is lost after harvest. It is imperative therefore to educate and encourage increased consumption of fruits and vegetables in developing countries (Nigeria inclusive) as a means of ensuring a balanced diet, especially amongst the urban dwellers.

Improved Infrastructural Facilities

Provision of portable water, uninterrupted electricity supply and good roads are sine-qua-none for the development of the Nigerian food industry. This should also improve the health status of urban dwellers and consequently their nutritional status. Furthermore, it would encourage bulk purchase, storage and home preparations of foods. Distribution of processed foods at minimal cost to the consumer would be ensured. The cold chain industry in Nigeria which is already at the verge of collapsing should be reactive in meeting the needs of the urban dwellers for animal-based food products, fruits and vegetables, etc.

Controlled Population Growth

It is desirable to regulate population increase through well coordinated family planning programmes. More food but with even more people does not offer a situation to our food storage. Furthermore, as population grows, urban and industrial users complete with agriculture for scarce water and other resources.

CONCLUSION

Food and nutrition insecurity are the fundamental threats to human welfare and economic growth in Africa and other developing countries, most developing countries rely heavily on agriculture, it is imperative therefore to develop agriculture in these countries. Agricultural development promotes income security, plays a major role in political security and has a wider role than food production. The agro-allied industries, including the food industry must therefore be fully developed as means of reducing urban poverty and hence ensuring food and nutrition security.

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CLIMATE CHANGE AND BUILDING GREEN PRODUCTIVE CITIES

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INTRODUCTION

At the global level, the Intergovernmental Panel on Climate Change Working Group I identified four major aspects of climate change relevant to cities in its synthesis report (IPCC, 2007). First, heat waves are very likely to increase in frequency over most land areas. Second, heavy precipitation events are very likely to increase in frequency over most areas; available data suggest that a significant current increase in heavy rainfall events is already occurring in many regions. Specifically, in the coming decades, climate change is expected to exacerbate the risks of disasters, not only from more frequent and intense hazard events but also through greater vulnerability to the existing hazards (ISDR, 2008). The resulting risk poses challenges to urban society, physical infrastructure, and water quantity and quality. Third, the area affected by drought is likely to increase. There is high confidence that many semi arid areas will suffer a decrease in water resources due to climate change. Drought affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors, including food production, water supply, energy supply and health. Fourth, it is likely that intense tropical cyclone activity will increase. It is also likely that there will be increased incidence of extreme high sea level.

Whereas mitigation has traditionally been the essential approach in meeting the challenge, adaptation to the effects of climate change is now acknowledged as necessary for responding effectively and equitably to the impacts of both climate change and climate variability. In recent years, adaptation has become a key focus of the scientific and policy-making communities and is now a major area of discussion in the multilateral climate change process. Adaptation has been implicitly and explicitly linked with development-focused action, particularly as the IPCC has underscored that developing countries are disproportionately vulnerable to climate change and lack adaptive capacity. Development processes and trajectories will be affected by the rate of climate change, and this is especially important for developing countries with growing economies. Adaptation is recognized as a crucial response because even if current agreements to limit emissions are implemented, they will not stabilize atmospheric concentrations of GHG emissions and climate. Particular attention will therefore be needed to be paid to the management of water and other natural resources, agricultural activities, and the sources and generation of energy. Given the high level of vulnerability of today's cities, there is need to make the cities green and productive to make them more liveable and more importantly as a major tool for mitigating and adapting to the current problem of climate change. These are the issues examined in this paper. The paper is divided into seven sections. Following this introductory section, the second section examines the need to address the vulnerability of settlements to climate change. The third section addresses the need for green productive cities while the fourth section analyses the major attributes of green cities using relevant examples from across the world. The fifth section looks at the various infrastructures that would make cities green while section six is specifically devoted to urban agriculture, a major component of a productive city. The conclusion of the paper is provided in the last section.

WHY THE CONCERNS ABOUT THE VULNERABILITY OF SETTLEMENTS TO CLIMATE CHANGE?

The third thematic area focus of IPCC is on human settlements owing to their importance. The IPCC Third Assessment Report (IPCC, 2001) concludes that settlements are among the human systems that are the most sensitive to climate variability and change. For example, projected changes in climate extremes could have devastating consequences for human settlements that are vulnerable to droughts and wildfires, floods and storm surge, heat waves, land slides and windstorms. While specific changes in these extreme conditions as a result of climate change cannot yet be predicted with great certainty, climate change is expected to increase the frequency and severity of some if not all of these types of events in different regions.

The impacts and vulnerability of settlements to climate change are most visible in the urban areas. The condition of the world's cities has often been described in terms of 'urban crises', implying complex problems, frequent breakdowns in services and a general lack of policy, programmes or funding. Indeed cities can be seen as crucibles of hazards that, without good management, generate extreme situations of vulnerability and risk for very large populations. In developing nations, problems are commonly associated with rapid growth, social inequalities, volatile flows of corporate investment, demographic change and environmental neglect. Natural disasters simply exacerbate the existing social, physical and economic problems (Bull-Kamanga et al, 2003).

Cities in developing countries are particularly vulnerable to climate change impacts, especially changes in rainfall (Vogel 2000), because of the exposure to extreme weather events and dependence on natural resources (Vogel, 2002). The vulnerability situation, the present and predicted impact of climate change on urban areas is particularly worrisome. According to Satterthwaite et al (2007), the scale of the devastation to urban populations and economies caused by extreme weather events in recent years highlights their vulnerabilities. Worldwide, there has been a rapid growth in the number of people killed or seriously impacted by storms and floods and also in the amount of economic damage caused; a large and growing proportion of these impacts are in urban areas in low- and middle-income nations. Climate change is likely to have been a factor in much of this, but even if it was not, it is proof of the vulnerability of urban populations to floods and storms whose frequency and intensity climate change is likely to increase in most places. Climate change will also bring other less dramatic stresses such as heat waves and, for many urban areas, reductions in freshwater availability; and sea-level rise for coastal cities. Without major changes in the ways that governments and international agencies work in urban areas, the scale of these impacts will increase.

The long term horizon of climate change and current scientific uncertainties pose special challenges. Strategies that address challenges recognise that there is no best solution. In this sense, climate change provides new incentives for the need to plan ahead and to anticipate extreme events and trends. (Zevenbergen, et al, 2008). Understanding how different societies adapt, and how successful adaptations can be facilitated, are critical for sustainable and equitable policy, practice and livelihood security (Burton *et al*., 2002; Adger *et al.*, 2003). According to Rodriguez (2009), all cities and catchments with their specific topographical, environmental and meteorological conditions are different. It is therefore necessary to carefully assess individual situations in the area of interest and while utilizing existing knowledge consider the local circumstances by careful adaptation.

Hitherto, local town planning authorities conceived of physical planning in a parochial and environmentally neutral way. Consequently, emphasis is not on growth management with sensitivity to environmental issues, but on the physical layout of human settlements and often an indiscriminate issuance of development permits without a legal basis. The problems of urban floods in Lagos, Ibadan and Benin are partly attributable to poor development control practices and environmental insensitivity. Since physical planning is often perceived by local town planners in terms of ad hoc physical solutions to human settlement problems, it has tended to accentuate the problem it is supposed to ameliorate (Izeogu 1986).

As a result of the above situation, the Nigerian urban areas exhibit many of the characteristics associated with urban decay which makes them some of the most highly vulnerable cities in the world as evidenced by the frequent negative impacts of environmental emergencies and extreme weather events. It is in this regard that this study becomes very important and relevant.

Addressing the challenges of evolving twenty first-century human settlement patterns demands a clear understanding of the vulnerabilities shaping such extreme events and also those factors that 'drive' everyday or 'chronic' environmental stresses. Importantly, there is a growing realization that more needs to be understood about how vulnerabilities – and their impacts – are configured by a range of causal mechanisms and how risks are shifted across the landscape differentially between groups of cities in the global periphery and emerging urban cores, as well as between rich and poor within individual cities (Bulkeley and Betsill 2003).

THE NEED FOR GREEN PRODUCTIVE CITIES

The vital economic contribution of urban regions is anchored by the major cities they encompass, which provide the constant stream of creative activity, interaction, specialization, and diversity that is essential for innovative ideas, methods, and products to develop and thrive. According to Weiss (2001), cities function primarily in seven distinct and essential ways to generate regional and national prosperity. These are: *centers of innovation and services, including advanced and highly specialized services, centers of culture, sports, entertainment, conventions, and tourism, centers of education, research, and health care, centers of transportation and trade, centers of manufacturing and technology development, market and centers.*

While cities cover is less than 1 percent of the Earth's surface, yet the activities that take place within their jurisdictions generate an estimated 80 percent of global greenhouse gas emissions. Cities are also responsible for 75% of global energy consumption. Within ten years the world will have nearly 500 cities of more than 1 million people and by 2020 nine cities - Delhi, Dhaka, Jakarta, Lagos, Mexico City, Mumbai, New York, São Paulo and Tokyo - will have more than 20 million residents (Ward, 2007).

The goal of building green, productive cities is to make these cities sustainable. The concept of sustainable cities includes a number of fundamental objectives, that is: minimization of the use of non-renewable resources; achievement of the sustainable use of renewable resources; and staying within the absorptive capacity of local and global waste absorption limits. Action to attain these objectives provides the link between the natural and the built environment, or between the green and brown agendas (Hovorka and Lee-Smith, 2006).

WHAT ARE 'GREEN CITIES'?

The "greening" of cities may represent a rare opportunity to address the troubling poverty and unemployment that continue to plague neighbourhoods in and around cities. A growing number of cities are on the vanguard of addressing climate change issues. They are creating new mechanisms to simultaneously reduce energy waste, cut carbon emissions and create new economic opportunities. Best described as a loose association of cities focused on sustainability, the emerging "green cities movement" encompasses thousands of urban areas around the world all striving to lessen their environmental impacts by reducing waste, expanding recycling, lowering emissions, increasing housing density while expanding open space, and encouraging the development of sustainable local businesses (Moulton, 2009).

Perhaps the archetypal green city is Curitiba, Brazil. When architect and urban planner Jamie Lerner became mayor in 1972, he quickly closed six blocks of the city's central business district to cars, delighting residents and business owners alike. Today the pedestrian-free zone is three times larger and serves as the heart of the bustling metropolis. Lerner also put in place a high-tech bus system, greatly reducing traffic, energy usage and pollution; the move also encouraged density around transit hubs and thus preserved open space in other areas that would have likely turned into suburbia. Today the bus system still goes strong, and three-quarters of the city's 2.2 million residents rely on it every day.

Another green cities leader is Rekyjavik, Iceland, where hydrogen-powered buses ply the streets and renewable energy sources - geothermal and hydropower - provide the city's heat and electricity. London, Copenhagen, Sydney, Barcelona, Bogota and Bangkok, not to mention Sweden's Malmo, Ecuador's Bahia de Caraquez and Uganda's Kampala, also score high for their green attributes and attitudes.

Green cities abound in North America, too. In 2005, Portland, Oregon became the first U.S. city to meet carbon dioxide reduction goals set forth in the landmark Kyoto Protocol, an international agreement forged to mitigate the threat of global warming. Seattle, Washington also committed to meeting Kyoto's goals and has persuaded 590 other U.S. cities to do the same under the U.S. Mayors Climate Protection Agreement. In addition, Vancouver, British Columbia draws 90 percent of its power from renewable sources while its metro area boasts some 200 parks and more than 18 miles of accessible waterfront.

San Francisco is a leader in green building, energy efficiency and alternative energy, and has been on the forefront of the battle to reduce plastic usage. Austin, Texas is fast becoming a world leader in solar equipment production and has made great strides in preserving open space. Chicago has invested hundreds of millions of dollars revitalizing its parks and neighbourhoods, and has built some of America's most eco-friendly downtown buildings. It is also working to provide affordable clean power to low-income families. Of course, many would argue that New York City - with its densely packed housing, reliance on mass transit and walking, and recent green policy moves by Mayor Bloomberg - may be the greenest of all.

While there is no formal green cities organization, per se, many groups have sprung up to help urban areas achieve their sustainability goals. Green-Cities Events, for one, hosts conferences around the U.S. at which local experts, policymakers and business leaders share ideas for greening their region. And International Sustainable Solutions takes urban planners, developers and elected officials on tours so they can check out some of the world's greenest cities to glean first-hand what works and what can be applied back home.

GREEN INFRASTRUCTURE

Green infrastructure has been defined as the network of natural environmental components and green and blue spaces that lie within and between our cities, towns and villages and provide multiple social, economic and environmental benefits (see: http://www.greeninfrastructurenw.co.uk/climatechange). Green infrastructure provides a range of services that make a substantial contribution towards climate change adaptation and a limited but important contribution towards climate change mitigation. In addition to climate change mitigation and adaptation, green infrastructure also provides a range of other benefits (www.nwda.co.uk/PDF/EconomicValueofGreenInfrastructure.pdf) making it a desirable way to combat climate change.

Mitigation refers to reducing greenhouse emissions and concentrations in order to limit the severity of future climate change. The mitigation role of green infrastructure is limited but important, and includes:

Carbon storage and sequestration - storing carbon in soils and vegetation.

- ***Fossil fuel substitution*** - replacing fossil fuels with sustainably managed biofuels.
- ***Material substitution*** - replacing materials such as concrete and steel (which involve high fossil fuel consumption in their production) with sustainably managed wood (and other natural materials).
- ***Food production*** - reducing food miles and altering agricultural practices (such as organic farming) to reduce carbon emissions.

Reducing the need to travel by car - providing local recreation areas and green travel routes to encourage walking and cycling.

Adaptation recognises that there is now some inevitable climate change locked into the system. It seeks to build capacity and take action to respond to the likely impacts.

The **adaptation role of green infrastructure is perhaps more significant**. It includes:

- ***Managing high temperatures*** - particularly in urban areas, where evaporative cooling and shading provided by green infrastructure can ensure that towns and cities continue to be attractive and comfortable places to live, work, visit and invest.
- ***Managing water supply*** - green infrastructure can provide places to store water for re-use, allows water to infiltrate into the ground sustaining aquifers and river flows, and can catch sediment and remove pollutants from the water, thereby ensuring that water supply and quality is maintained.
- ***Managing riverine flooding*** - green infrastructure can provide water storage and retention areas, reducing and slowing down peak flows, and thereby helping to alleviate river flooding.
- ***Managing coastal flooding*** - green infrastructure can provide water storage and retention areas, reducing and slowing tidal surges, and thereby helping to alleviate coastal flooding.
- ***Managing surface water*** - urban green infrastructure can help to manage surface water and sewer flooding by reducing the rate and volume of water runoff; it intercepts water, allows it to infiltrate into the ground, and provides permanent or temporary storage areas.
- ***Reducing soil erosion*** - using vegetation to stabilise soils that may be vulnerable to increasing erosion.
- ***Helping other species to adapt*** - providing a more vegetated and permeable landscape through which species can move northwards to new 'climate spaces'.
- ***Managing visitor pressure*** - providing a recreation and visitor resource for a more outdoors lifestyle, and helping to divert pressure from landscapes which are sensitive to climate change.

The potential for green infrastructure to mitigate and adapt to climate change impacts should be explored by individual cities. Some of the stages would involve the following, among others: Climate change, risks, opportunities and priorities, evidence base of research, policy and delivery, green infrastructure climate change assets, detailed study of strategically important areas and climate change action plan.

CASE STUDY: GREEN ROOF POLICY – BASEL, SWITZERLAND

Basel boasts the highest densities of green roofs in the world, covering approximately 23% of its flat roof area. This is the result of financial incentives and compulsory building regulations, and was driven by energy saving and biodiversity conservation goals. In the early nineties, 4% of customers' energy bills was put into a fund which was used to support energy saving projects, including providing subsidies for green roofs to reduce the energy consumption of buildings. Following on from the success of this and subsequent research into the biodiversity benefits of green roofs, the Building and Planning Act was amended in 2002. As a result, green roofs must be constructed on all new buildings with flat roofs. In addition, on roofs of over $500m^2$, the substrates must be composed of appropriate native regional soils and be of varying depths in order to be of most value for biodiversity. The green roof on the Basel Exhibition Centre demonstrates the value of different substrate depths. It also includes solar panels which provide additional microclimates for species. In turn, the panels are kept cooler by the presence of the green roof and thus operate more efficiently.

www.urbanhabitats.org/v04n01/wildlife_full.html

www.greenroofs.org/grtok/policy_browse.php?id=63&what=view

URBAN AGRICULTURE

Urban agriculture forms an important strategy for local economic development,

poverty alleviation, social inclusion of low income families living in and around cities and the provision of recreational and eco-educational services to urban citizens. It enables cities to better manage stresses and shocks to urban food security caused by shifts in the prices and supplies of food and the effects of climate change. However, if left unattended and unmanaged by policymakers, urban agriculture may also have negative effects on public health and the urban environment Thus, if fundamental climate change mitigation and adaptation goals are to be met, agriculture needs to be included in the strategies to be developed (IFPRI, 2009). Innovations in urban agriculture can play an important role in mitigating the impacts of climate change, and are also an effective tool for adaptation. Urban agriculture itself is characterised by innovation and adaptation to specific urban needs. These innovations include micro-gardens, which can provide an emergency food source in the context of disaster risk management; green rooftops, which represent a built environment adaptation to climate change impacts; planting of trees, which serve as green "lungs" contributing to improved air quality; and rainwater harvesting systems, which can help lessen the effects of flooding.

Urban agriculture can keep environmentally sensitive and dangerous urban lands from being used for illegal residential development. It mitigates the adverse effects on the urban poor of financial and food crises through job creation; offers opportunities for small-scale income generation; increases food security and enables self sufficiency; and improves nutrition and health. The World Meteorological Organization has suggested that more urban farming should take place as a response to the ongoing climate change and as a way to build more resilient cities (WMO press release December 7, 2007).

Increasing food security

By growing food and raising livestock, the urban poor can improve their access to nutritious food and enhance the nutritional quality of their diets. For many cities, urban agriculture provides a major share of perishable products like leafy vegetables, poultry and dairy products (van Veenhuizen, 2007). Moreover, household food expenses are reduced, since poor urban households spend 60-80 per cent of their household budgets on food, while additional income is generated through the sale of products.

Food production can be promoted in and around homes, by applying “low-space, no-space” technologies in front- and backyards or on rooftops, on windows sills, fences, etc. Urban agriculture can also support the sustainable management of green open spaces, water bodies and risk-prone land and other land not suitable for construction, e.g., flood zones, earthquake-prone zones, buffer zones, steep slopes, roadsides, river banks and water harvesting areas (while at the same time impeding flooding and erosion) by applying well-adapted production techniques and optimising productive and multi-functional land use (e.g., “productive parks”). For example, a growing number of Casablanca’s citizens combine buying fresh vegetables from small farmers with picnicking in a field.

Emergency food supply

Urban agriculture can also ensure food availability during times of natural disasters, when transportation and communication links may be disrupted, or in the event that supplies are cut off due to armed conflicts or high fuel prices. This may be of increased importance as cities, and their poorer residents in particular, are affected by various climate change impacts. In Sierra Leone, the residents of Freetown are still well aware of the importance of local farming, as many of them would have starved during the decade-long civil war if the city had not become a breadbasket for itself.

Employment and income generation

Employment and income-generating activities related to urban agriculture can include commercial food and ornamental plant production, development of small agro-food industries, marketing of agricultural products, input supply, and waste recycling enterprises. Such micro-enterprises may be initiated by the producers themselves or by other non-farming families and groups, especially by young unemployed persons in the same area. In Charlottesville (USA), institutions are looking for opportunities to source a higher proportion of their food needs locally, which enables the creation of micro- enterprises to meet this demand.

Maintaining green areas and buffer zones

Urban agriculture can also help to improve the environment and increase green buffers. Green spaces contribute to economic and energy savings, by improving the microclimate in a city (urban vegetation can have a significant cooling effect due to direct shading and increases in evapo-transpiration, and can reduce the energy consumption of buildings). Green spaces also help control storm water flows (by increasing infiltration). To create and maintain riparian buffers, especially given possible changes in river water tables, several cities have decided to protect the flood zone from urbanisation and maintain it as an attractive multifunctional area for (peri) urban agriculture, nature and recreation. Examples include Rosario, Argentina, Zwolle (in the Netherlands), and Shanghai, China. Cities whose flood zones cannot be sufficiently protected from legal or illegal housing development often suffer the consequences through flooding – as is the case in Pikine-Dakar, which failed to protect the Niayes Valley for agricultural production.

Preserving biodiversity

Without proper legislation or zoning, construction will rapidly take over urban farmland, green spaces, forest areas and water bodies. The loss of green space threatens ecological biodiversity. For example, in Beijing fewer than 10 types of natural plants were found in densely built areas, and fewer than 50 types of plants in urban parks, while in peri-urban parks, 287 types of plants were counted. Maintaining (urban) agricultural biodiversity and thus protecting a wider base of plant and animal genetic diversity are important strategies for both rural and urban farmers to adapt to changes in climate.

Reducing the ecological footprint

Cities are including urban agriculture in their mitigation strategies, reducing their ecological foot- (and food-) prints and CO2 emissions, since urban agriculture uses less energy than conventional production (less transport, less cooling, more fresh products sold directly to consumers) and enables cyclical processes and effective use of wastes (use of urban organic wastes as compost or production of animal feed, use of excess heat of industry in greenhouses). Locally grown and prepared food can reduce fuel use ("food miles") and make it easier to identify and support environmentally benign food production methods. Locally grown produce is also less likely to be associated with the greenhouse gas caused by recent land conversion. Seasonal food need not be imported, does not require energy-intensive conditions such as heated greenhouses, and reduces the likelihood of energy-intensive methods of storage and transport such as refrigeration and air-freighting. Urban producers are thus in a unique position to provide consumers fresh foods with low carbon footprints.

Community building and adaptive learning

In addition to its contributions to environmental and economic resilience, urban agriculture also strongly supports social (human) resilience. Community gardens and urban farms can become places of adaptive learning and civic engagement, as people of different ages, ethnicities, races and income levels come together to grow food, learn new gardening skills, encounter new foods or engage in problem-solving and collective action for the benefit of the garden and the gardeners. The benefits go beyond simply providing food. Urban agriculture also provides occupation, work, income, increased self-esteem, and may contribute to improved governance.

CONCLUSION

Growth of cities puts a significant pressure on natural resources resulting in drastic reduction of green open spaces, depletion of trees, floods, heat island effects and other natural disasters further aggravated by the effects of climate change. These challenges can be better handled by giving proper attention to the potentials of urban forestry and agriculture which contribute to urban greening, heat reduction, storage of excess storm water and maintaining flood plains free from construction. By combining public management of parks and other open green spaces with private agricultural activities, a more sustainable management of the urban and peri-urban landscape can be realized. Issues of competition for natural resources (water, soil, land) between agricultural production and other priority urban needs (drinking water, housing, etc.) need to be properly addressed by local authorities, especially by giving attention to available win-win solutions (e.g. increased recycling of wastewater for use in agriculture to avoid use of drinking water; location of agriculture in zones that should be kept free from construction to avoid competition between agriculture and other uses, etc.).

As stated and reinforced by a number of urbanists (DeKlerk, 1999; Lootsma, 2002), contemporary cities are now characterised by polycentric web-like sprawls where infrastructure and material flows are more significant than static political and spatial boundaries. In these urban conurbations, the emphasis is now on processes that facilitate networks across regional and global space. These new cities, while dispersed and diffuse, are at the same time 'infinitely enabling' (Wall, 1999). However an important component has been left out of these new infrastructure-rich and enabling cities, namely new forms of rural/urban space that synthesize agriculture, nature conservation, infrastructure and communities. This considering the fact that, if the physical and programmatic functions of new urban form are resulting in designs that are rebuilding and intensifying the city, how then do we similarly reconfigure rural space –'new green' - in and around our cities? What shape can the new forms of 'green' space take? Can landscape designers apply similar principles and strategies suggested for cities, for example, 'thickening', 'folding', 'non-programmatic use', and 'impermanence' (Wall, 1999)?

Green infrastructure provides a number of services which can help us to mitigate and adapt to climate change. Whilst we can take actions to provide a particular service, it is essential to exploit the multi-functionality of green infrastructure wherever possible and to work in partnership across sectors and disciplines in order to achieve this. Green infrastructure should be seen as a critical infrastructure, like roads or waste disposal, and, as such should be well planned and maintained, and viewed as integral to new development.

• To achieve the energy savings and green job opportunities possible through green buildings, cities must retrofit through systems that can achieve scale.

• To create green-collar jobs at scale, cities must re-engineer their local economic and workforce development systems.

• To spur more equitable transit-oriented development, cities need to reorient their local real estate markets.

None of the above is easy. While there is room, and in many cases necessity, for incremental progress and piecemeal solutions, larger visions and sustained political commitment at the local level will be required to seize this moment of opportunity.

Since the relationship between urban agriculture and poverty, the question as to whether urban farming is really capable of reducing poverty at household level is important. A number of factors clearly have to be considered including land, of which the poor generally have little. Urban farms, most especially the commercial ones also offer a substantial opportunity for the modernization of agriculture due to their proximity to markets as well as information (Hovorka and Lee-Smith, 2006). There is however, the need to explore the details of how urban agriculture protects households against poverty.

It is however pertinent to note that in the entire scheme to build green productive cities, the nexus relating urban planning to urban agriculture is central to sustainability (Agbola, 2002). This is because issues of changes in the intensity of land use in and around the city, development and conservation as well as the degradation of urban lands have to be well attended if there would be progress in the role of urban agriculture. Urban planning needs to encompass agriculture through a carefully balanced set of rules and regulations which should range from the advisory to the coercive and could also invoke such actions as eviction, demolition of structures, legal prosecution for various urban related litigations (Agbola, 2002).

Some countries have already been moving in this direction, as they formulate urban agriculture policies. Cuba, Argentina and Brazil (Zero Hunger Campaign) are well known examples of countries where substantial government support is given to the development of urban agriculture. Other countries such as Botswana, Zambia, Benin and China are preparing policies favourable to urban agriculture, often as part of a broader strategy. An increasing number of city governments has or is formulating policies and programmes on urban agriculture (Rosario in Argentina, Kampala, Dar es Salaam, and Bulawayo in Zimbabwe). A useful policy guideline of this emerged from the typology of urban farmers in Kampala. The application of policy in Dar-es-Salaam, which allows for virtually unregulated backyard farming (for the rich) and open space farming (for the poor) deserves emulation (Lee-Smith, 2010). In all, key policy implementation strategies suggested in Lee-Smith (2010), which is very relevant for Nigeria and other third world countries includes: encouraging backyard farming; making parcels of land available specifically to poor and women-headed households; providing extension and other support services, especially for livestock production; supporting depots for livestock waste for use in co-composting, and for food and other organic waste for livestock feed and co-composting; supporting and promoting marketing of urban agriculture products and; monitoring and evaluation policy outcomes, especially the extent to which poor, marginalized and female-headed households have improved their health and incomes.

The concrete steps towards facilitating access to land for urban agriculture according to Agbola (2002), would then include:

- Making an inventory of the available vacant open land in the city (through participatory methods and GIS) and analysing its suitability for use in agriculture (as in Cienfuegos, Cuba; Piura, Peru; Dar es Salaam, Tanzania).
- Creating a Municipal Agricultural Land Bank which brings those in need of agricultural land in contact with landowners in need of temporary or permanent users (as in Rosario, Argentina).
- Stimulating owners of open vacant land (including institutional owners) to give this land on medium-term lease to organised farmer groups, by providing a tax reduction to land owners that do so (as in Rosario, Argentina) or by levying municipal taxes on land laying idle.
- Formulating a City Ordinance that regulates the (temporary) use of vacant land in the city (as in Cagayan de Oro, the Philippines)
- Providing vacant municipal land to organised groups of urban farmers (as in Cagayan de Oro, Lima, Peru)
- Taking measures to improve the suitability of available tracts of land, eg. by removing debris or providing access to irrigation water
- Demarcating zones for urban agriculture as a form of permanent land use and integrating these into city land use planning (as in e.g. Dar es Salaam, Tanzania; Kathmandu, Nepal). Such zones normally are more sustainable if located in areas that are not well suited for construction or where construction is not desirable, as on flood plains, under power lines, in parks or in nature conservation areas. Effective guidelines are developed with active farmer participation regarding the management practices to be adopted by urban agriculture in the various locations (eg. the consultative workshops held in Rosario, Argentina and Kampala, Uganda).
- Providing assistance to reallocate urban farmers, especially urban farmers who are poorly located and therefore may have serious health and/or environmental risks due to these locations.
- Including space for individual or community gardens in new public housing projects and slum upgrading schemes.

Thus, urban agriculture will contribute immensely to the building of green productive cities if its potential for multi-functional land use is recognised and fully developed. The sustainability of urban agriculture is strongly related to its contributions to the development of cities that are inclusive, food-secure, productive and environmentally-healthy.

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RECENT TRENDS IN AGRICULTURAL GROWTH IN AFRICAN COUNTRIES: A CASE FOR LEVERAGING URBAN AGRICULTURE

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Abstract

Since the early 1990s, countries in Africa have recognised the contribution that agriculture can and should play in achieving the first Millennium Development Goal (MGD1) targets of halving poverty and hunger by 2015. The African Union, New Partnership for Africa's Development's (AU/NePAD), Comprehensive Africa Agricultural Development Programme (CAADP) has called for countries to target achieving an accelerated agricultural growth rate of at least six per cent per annum by 2015. A challenging question is whether, while the agricultural sector and the rural economy are yet to be sufficiently integrated with the increasingly populous urban economy, attaining and maintaining the six per cent growth rate will result in achieving the MDG1. This study assesses the recent trends and progress towards achieving the CAADP target in selected African countries and makes the case for leveraging urban agriculture, as agriculture performs poorly in most countries

INTRODUCTION

The Millennium Development Goals (MDGs) have refocused attention on the persistence of poverty. Specifically, Millennium Development Goal One (MDG1) requires developing countries to pursue the target of halving hunger and poverty by 2015 through commitments to a number of continent-wide and regional initiatives. These initiatives have reinvigorated the search for agricultural growth strategies that can make a measurable contribution to the reduction of rural poverty.

Since the early 1990s, countries in Africa have recognised the contribution that agriculture can and should play in achieving the MGD1 targets. To this end, they have set a number of targets under different initiatives to harness the role of agriculture in reducing poverty and hunger by enhancing economic and household income growth. One main continent-wide initiative is the Comprehensive Africa Agriculture Development Programme (CAADP). Run by the Africa Union New Partnership for Africa's Development (AU/NePAD), this programme has a target of achieving an agricultural growth rate of at least six percent per annum by investing at least ten percent of national budgets in agriculture under the Maputo Declaration (AU/NePAD, 2003). The regional initiatives include the Regional Indicative Strategic Development Plan (RISDP) of the Southern Africa Development Community (SADC) (SADC, 2003), the Economic Community of West African States (ECOWAS) Agricultural Policy (ECOWAP), etc. Either prior to, or to supplement the Africa-wide and regional initiatives, each country in the region (with the exception of South Africa) has subscribed to a poverty reduction strategy paper (PRSP) through a process initiated by the International Monetary Fund (IMF) and the World Bank in 1999 (IMF, 2005).

Meeting these targets is a daunting task, however, and so monitoring agricultural growth performance needs to receive consistent attention in order to show stakeholders the progress being made towards achieving the targeted growth rate, and thereby stimulating discussion on the policy responses that may harness the potential of agriculture in economic growth.

This study analyses the recent trends in the African countries' agricultural sectors, in terms of agricultural value added, to assess the countries' progress towards the targets of a six percent annual agricultural growth rate, with the aim of showing whether each country is on course.

To achieve this, the study draws on the World Bank database which allows for cross-country comparisons. Besides the usual policy recommendations for improved agricultural performance in Africa, this study contends that one of the main and long standing problems of agricultural performance in Africa, is the lack of transportation and marketing infrastructure that creates distance between the agricultural sector and the rural economy, and the increasingly populous urban areas where most of the produce is needed. Hence the study makes the case for leveraging urban agriculture as agriculture performs poorly in most countries.

The paper continues in Section 2, with trend analysis and an assessment of progress towards the CAADP target. Section 3 presents a theoretical empirical overview of the role of agriculture in economic growth and food security, and makes the case for leveraging urban agriculture as a poverty reduction strategy. The report presents its conclusions in Section 4.

PROGRESS TOWARDS ACHIEVING THE TARGET OF SIX PER CENT ANNUAL AGRICULTURAL GROWTH

One of the four pillars of the AU/NePAD's CAADP is increasing food supply and reducing hunger through achieving and maintaining at least a six percent annual agricultural growth rate as a percentage of gross domestic product (GDP), in the form of agricultural value added to economic growth. In this section, we present the trends and patterns of agricultural growth estimated in the selected African countries.

The relationship between each country's agricultural value added, as may be reflected in household income and poverty reduction, is important in these countries as most of the population depends on agriculture for its livelihood in the form of employment and food security (Chilonda, Olubode-Awosola and Minde*,* 2008). In these countries, the degree to which agriculture grows by providing profitable jobs, supplying raw materials to the growing industrial sector, feeding the increasing urban population (lessening expenditure on food imports) and contributing to growing regional and world agricultural trade (exports), is expected to be reflected in the value added in agriculture.

In economies where the predominant economic activity is agricultural production, producers can increase their incomes by adding value through becoming members of food companies that process and market agricultural products to consumers. As globalization increases the market for value-added products it is necessary for producers to use technological advances to produce what consumers and processors desire, thereby increasing their share of the food price. Hence, a country whose agricultural sector supplies enough food to feed the population and raw materials for the industrial sector, and generates substantial foreign exchange earnings from exports, will have higher GDP values. They will also have more labour released into the fast growing non-agricultural industries as the gains from these industries are ploughed back into agriculture to increase the efficiency of resource use in agriculture.

Agricultural value added is often used as an indicator to measure the performance of the agricultural sector in an economy. Agricultural value added is a measure of revenue generated from economic activities that change the current place, time and form of agricultural products to what is preferred in the marketplace. While agricultural GDP is expected to reduce in proportional terms as an economy develops, its value is expected to rise in absolute terms depending primarily on the total factor productivity (efficiency and technical change) in agriculture. The data used is this study is the annual growth rate of agricultural value added, based on constant local currency of individual countries. This data was obtained from the World Development Indicators Online, as this allows for comparison between countries. The results are presented in the remaining part of this section.

Which countries are on course?

There were substantial amounts of missing data for most West African countries compared to the southern Africa countries (Table 1, Figure 1). Using the scant data, only Nigeria has exceeded, on average, the target of six percent annual growth in agriculture between 2003, when CAADP was introduced, and 2007 which is the last year for which data is available for this country. What is promising, however, is that agriculture in Nigeria has been growing at a rate above the target since the early 2000s, and this growth has been consistently increasing, from 6.65% in 2000-04 to 7.40% in 2007. It is also promising that the other countries' agricultural sectors have also been growing, though they have yet to reach the six percent target.

Table 1: Annual growth rate for agricultural value added in West Africa (Based on constant local currency; 1990-2009)

Country	1990s	Average 2000-04	Average 2004-09	2007	2008	2009
Benin	5.26	4.95	5.05	-	-	-
Burkina Faso	5.99	4.79	3.89	-	-	-
Cape Verde	1.23	0.76	2.55	5.15	4.20	4.36
Cote d'Ivoire	2.99	2.95	2.18	1.79	0.54	4.00
Gambia, The	3.25	5.05	4.84	2.00	4.64	4.25
Ghana	2.89	3.04	5.24	2.40	5.10	5.70
Guinea	4.52	14.50	2.98	2.80	3.61	-
Guinea-Bissau	3.87	3.49	4.86	3.30	3.50	-
Mali	2.90	2.06	2.77	2.44	-	-
Niger	3.32	3.19	-	-	-	-
Nigeria	-	6.65	7.05	7.40	-	-
Senegal	1.75	0.76	3.46	-5.99	19.65	1.97
Sierra Leone	-10.89	-	5.28	4.10	6.10	6.60
Togo	3.81	1.22	3.46	-	-	-

Source: Own computation based on World Bank Development Indicator Online (2010)

What do these trends and patterns mean for poverty reduction in West Africa? The countries in West Africa, especially the ECOWAS countries, cover 17% of the African continent, being the most populated regional and economic community in Africa. The region had an estimated population of about 290 million in 2008, of which 57% and 43% lived in rural and urban areas respectively. Agriculture contributed immensely to food production, wealth creation, jobs, income provisions and regional exports. This region has also had a reduction in its average dollar a day poverty rate since 1990 when it stood at 57.2%, to 48.7% in 2009. This rate of reduction is faster than the other two regions, though it started from a lower regional rate and is now estimated to have a higher poverty rate than the Common Market for Eastern and Southern Africa (COMESA) region (Omilola *et al,* 2010).

Of the eight East and Central African countries included in this study, only Eritrea and Ethiopia have exceeded, on average, the target of six percent annual growth in agriculture (Table 2, Figure 1). Agriculture in Eritrea has the best performance with an average 19.1% annual increase in agricultural value added from 2004 to 2007. Ethiopia's agricultural sector has also performed well, having achieved a 10.7% average annual growth rate, though at a decreasing rate. Seven of the countries are below the target rate. Kenya and Uganda recorded inconsistent growth rates from 2007 to 2009 while Comoros, Rwanda and Sudan have a consistent and increasing growth rate. Burundi has had a consistently decreasing agricultural contribution to its economy ever since the 1990s. An encouraging pattern in this region is that most of the countries have had substantial growth in 2009, with the exception of Uganda which plunged from 2008's huge growth in agricultural value added. In the same vein, it is interesting to understand what this trend means for these countries. Average poverty and hunger levels have been improving in this region since the 1990s and it has the lowest average poverty rate in Africa. The average dollar a day poverty rate across the countries in this part of Africa decreased from 58.9% in the 1990s to 49.1% in the 2000s and 44.7% in 2009 (Omilola *et al,* 2010).

Table 2: Annual growth rate for agricultural value added in East and Central Africa (Based on constant local currency; 1990-2009)

Country	1990s	Average 2000-04	Average 2004-09	2007	2008	2009
Burundi	-0.43	-1.63	-3.40	-	-	-
Comoros	2.50	4.64	1.10	3.00	4.50	4.50
Eritrea	7.14	-7.38	19.15	1.29		-
Ethiopia	2.80	3.45	10.72	9.45	7.50	6.00
Kenya	2.08	2.21	2.20	2.09	-4.98	3.00
Rwanda	3.27	5.21	5.22	0.70	15.00	9.60
Sudan	4.77	2.04	2.59	3.12	4.00	4.28
Uganda	3.70	1.14	1.98	-0.33	9.13	-1.76

Source: Own computation based on World Bank Development Indicator Online (2010)

In Southern Africa, since CAADP was introduced in 2003, and up to 2009, Angola, Namibia and Mozambique have exceeded, on average, the target of six percent annual growth in agriculture (Table 3). Agriculture in Angola has the best performance in the region with an average 12.6% annual increase in agricultural value added from 2004 to 2009. Namibia's agricultural sector has also performed well having achieved an 8.9% average annual growth rate, followed by Mozambique's with a growth rate of 7.7% over the same period. However, most of the countries are far below the target rate (Figure 1). Some of these countries recorded inconsistent growth rates from 2007 to 2009, with the exception of Lesotho, Madagascar, Mauritius and Namibia. Zimbabwe has seen an average annual decline of 6.5% in valued added by agriculture from 2004 to 2009. This could be easily attributed to the recent land and political crises in the country. Despite these specific cases, it is encouraging that the growth rate is positive for most countries, and has increased from 2004 to 2009 which means that most countries have improved performance post the CAADP target.

Again, what does this trend mean for the Southern Africa region? Chilonda, Olubode-Awosola and Minde (2008) report that agriculture is an important sector in the region as it contributes over 15% to overall GDP. The region's economic growth rate was estimated at one per cent in 2009. Again, poverty and hunger have declined since the 1990s yet the region still has the highest rate of poverty compared to the Western, East and Central Africa regions. Agricultural GDP is relatively low in Botswana, followed by South Africa and Mauritius, but high in Tanzania, followed by the Congo, Democratic Republic (DR), Malawi, Madagascar and Mozambique. Given the significant contribution of agriculture to the economies of most SADC countries, the trend of its absolute contribution is very important for food security and job creation in terms of poverty alleviation.

Table 3: Annual growth rate for agricultural value added in Southern Africa (based on constant local currency; 1990-2009)

Country	1990s	Average 2000-04	Average 2004-09	2007	2008	2009
Angola	-1.28	13.12	12.61	21.00	1.77	12.00
Botswana	0.08	-1.96	3.48	8.91	0.35	26.06
Congo, DR	2.14	-2.66	2.50	3.00	3.01	3.00
Lesotho	1.45	-3.16	0.53	-8.56	-0.58	6.33
Madagascar	1.89	1.64	2.65	2.20	2.78	3.19
Malawi	9.72	-0.09	4.31	5.94	5.17	8.49
Mauritius	-0.69	6.84	1.81	-5.22	5.70	7.20
Mozambique	4.60	3.86	7.68	7.72	9.54	6.72
Namibia	4.80	3.37	8.87	-6.66	-1.31	55.36
South Africa	0.77	2.16	1.57	3.54	10.87	-3.20
Swaziland	0.47	0.35	0.96	2.68	2.40	0.40
Tanzania	3.13	4.72	4.91	0.00	0.00	0.00
Zambia	5.13	1.31	1.02	0.43	-0.10	-0.07
Zimbabwe	4.92	-5.46	-6.45	-	-	-

Source: Own computation based on World Bank Development Indicator Online (2010)

In this study, we have only assessed the recent trends and progress towards achieving the accelerated agricultural growth target as set in CAADP. We therefore cannot attribute any causes to the trends as presented above. However, when we look into the literature on the role of agriculture in poverty reduction, the challenges to agricultural growth in the continent, with the rural-urban migration and urbanisation trends, are obvious. This leads to general policy guidelines that justify leveraging urban agriculture in most of these countries as discussed in the following section.

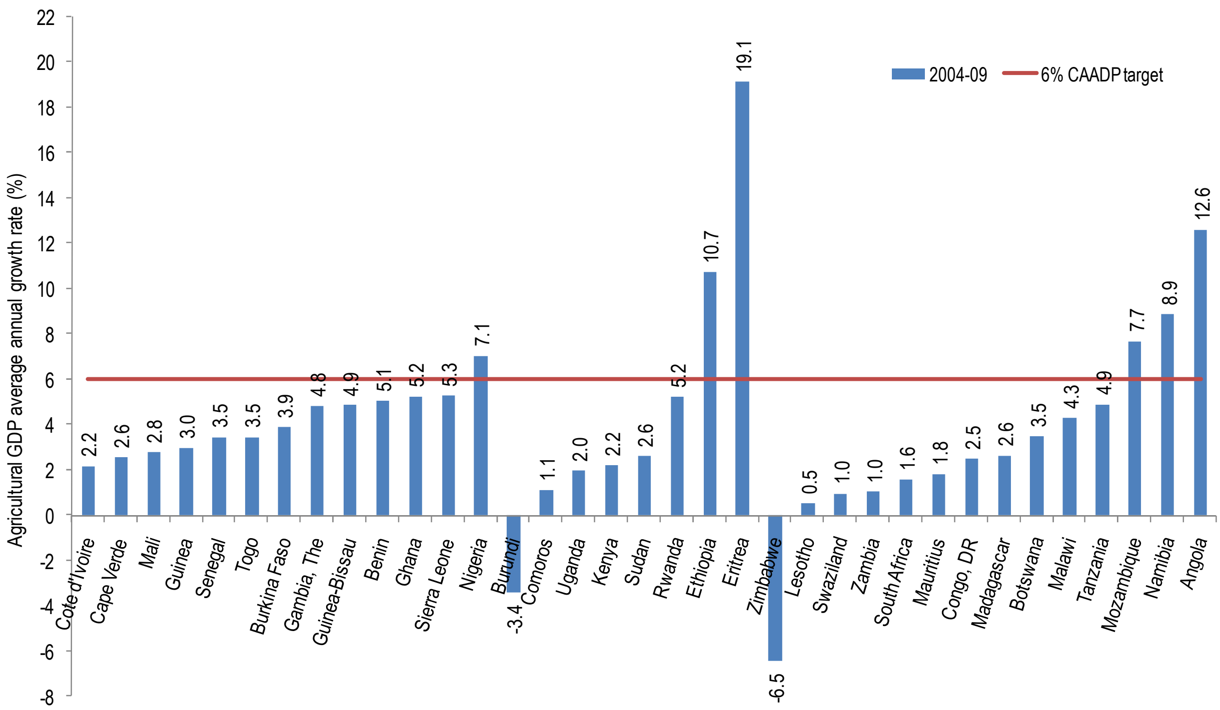

Figure 1: Progress towards achieving the 6 percent agricultural GDP growth in Africa

Source: Own computation based on World Bank Development Indicator Online (2010)

AGRICULTURE'S ROLE IN REDUCING POVERTY IN AFRICA: A CASE FOR URBAN AGRICULTURE

A text book answer to the question of which development strategy is appropriate for poverty reduction in Africa is agriculture. Yet, the major limitation to agricultural growth in Africa is low productivity, which is usually blamed on poor seeds/breeds, and a lack of fertilizer and machinery, has not been significantly solved. These problems are prominent and persist where there is poor transportation and agricultural marketing infrastructure. These are among many issues to be addressed. Several agriculture-specific investments are required to improve productivity and agricultural growth. Shenggen and Rosegrant (2008) report that an indicative scenario of a $5.75 billion agricultural investment has the potential to raise agricultural production to the point of achieving significant progress towards the MDG1 in nine countries in Sub-Saharan Africa. The countries, given their poverty reduction rates and the role of agriculture in their economies, then need to find their position within this investment-growth paradigm to apportion their agricultural spending (Shenggen, 2008). However, there is evidence of divergent perspectives regarding investment options for economic growth and the place of agriculture in poverty reduction.

Is agriculture an option as a poverty reduction and development tool?

The role of agriculture in economic growth in less developed countries is widely acknowledged. The World Bank (2007) in its World Development Report 2008, reiterates that agriculture continues to be a leading sector for economic growth, poverty reduction and food security in agriculture-based economies, which includes most of the Sub-Saharan African countries. In these economies, agriculture is a major source of livelihood for rural people through income and employment. Therefore, agriculture can play a leading role in overall economic growth in agriculture-based economies, given that in many of these countries food remains imperfectly tradable because of high transaction costs, and staple foods, such as roots and tubers, and local cereals, are only lightly traded.

While there is consensus on the role of agriculture in economic development in the less developed countries, there is no consensus on whether agriculture is the most appropriate way to fight poverty in developing countries. One school of thought argues that since rural poverty represents the major share of total poverty in most developing countries, and agricultural production and agriculture-related activities are the major sources of income for the rural poor, and because food expenditure consumes the largest proportion of their meagre incomes, agricultural growth is the most effective way to reduce poverty (Bresciani and Valdes, 2007). Through its multiple consumption and production linkages, and externalities with the rest of the economy, agriculture in low income economies has been considered an engine for growth for the rural and overall economy. Since the importance of agricultural growth in poverty alleviation has increasingly been regarded as transcending its share of total GDP, the policy biases against agriculture in developing countries have come under severe scrutiny. Proponents of this school argue that agricultural growth is not only effective for poverty reduction *per se* but has a stronger effect on poverty reduction than other sectors of the economy such as manufacturing and services (Schimmelpfennig and Norton, 2003).

The Word Bank (2008) highlights that agricultural growth has special powers in reducing poverty across all country types, and noted that evidence from estimates between countries suggests that GDP growth originating from agriculture is at least twice as effective in reducing poverty as GDP growth originating from other sectors of the economy. In a study in India, Datt and Ravallion (1998) showed that rural growth, spurred on by agricultural growth, was effective in reducing poverty. Their study also showed that the contribution of agricultural growth to poverty reduction was not limited to rural areas, but also reduced urban poverty. In addition, agricultural growth can contribute to reducing income inequality in both urban and rural areas. However, some scholars argue that in countries where income distribution is highly skewed, the poor benefit less from agricultural growth, hence the need for targeted agricultural initiatives in such circumstances (Schimmelpfennig and Norton, 2003).

The second school of thought also recognizes the contribution of agriculture to poverty reduction but attaches more importance to non-agricultural activities (for example, manufacturing and services). A proponent of this school argue that while agricultural growth is good for the poor, and contributes positively to overall growth in absolute terms, it is growth in the non-agricultural sectors that matters the most in poverty alleviation (Bravo-Ortega & Lederman, 2005). However, Christiaensen, Demery and Kuhl (2006) and Bravo-Ortega and Lederman (2005) showed that for developing countries, agricultural growth has a relatively higher impact on poverty than its observed share in the economy due to the indirect effects of agricultural growth on non-agricultural growth, which also stimulates poverty reduction. Bresciani and Valdes (2007) indicated that agricultural growth contributes to poverty reduction in three channels, namely, the labour market channel, through employment and wage effects; the direct income effect coupled with growth multiplier effects; and reducing food prices. Results of several studies, conducted in a number of different countries, indicate that the role of agricultural growth in reducing poverty can be dramatic and much more effective than other sectors. Agricultural growth has a strong positive impact on poverty, often significantly greater than that of other economic sectors (DfID, 2005).

What can be gleaned from the different perspectives above is that the role of agriculture will differ slightly across African countries as most countries are agri-based. There seems to be long-term evidence of agriculture's relative importance and the contributions it can make in different situations and economic stages. Given this slight difference across the continent, it may be difficult to rigidly define what agriculture's role or performance is a 'one-size fits all' policy. However, for the purposes of policy and strategy development, especially for the agriculture-led economic growth and development which underpin CAADP, what is expected from an agricultural sector given the economy's development stage? With regard to food security, literature shows that growing the agricultural sector is the primary channel for achieving household food security. Increased agricultural production increases food availability and incomes, thereby reducing food insecurity. Literature also concludes that unless agriculture reaches some degree of commercialization, the impact of agricultural growth on food insecurity and poverty alleviation is limited.

To maximize agriculture's contribution to such an economy improvements are needed in infrastructure, such as roads in order to get farm produce to market, clean water supply, electricity and other social amenities for the rural populace. This may lessen rural-urban migration and sustain agricultural production. However, taking cognizance of the dynamic world in which we live with a number of countervailing forces, argue. Agriculture respond rapidly to capture markets, technological, environmental and other opportunities, and perhaps to challenges (such as regional integration) in a sustainable manner, as the emphasis shifts from food security to reducing rural poverty. Again, agriculture at any stage should respond by exploiting opportunities that present themselves in the dynamic environment.

Is urban agriculture a viable response to the issue of poverty alleviation in Africa?

Burger *et al* (2009) pose the question as to whether urban agriculture has the potential, as suggested by the MDG, to lift people out of poverty in Africa, while urban agriculture is becoming more and more popular as an alternative food system, not only in developing world, but also globally. Urban agriculture looks like one such development tool and opportunity as rural-urban migration and urbanisation increases in developing countries (Mawois, Aubry and Le Bail, 2010) and rural-urban integration lags behind in most countries. The agricultural growth model in most African countries, over more than a generation, is intensification. This has not been sustainable in the long term. One of the reasons is that production systems have not intensified in line with unstable events and increases in population in urban areas.

For instance, in late 2007 and early 2008, food prices revealed a particular pattern. Most of the African countries were hard hit by the food crisis because of wide-spread poverty, showing there are still imperfect and partially isolated markets. Transportation and agricultural marketing infrastructure in the African countries are not yet fully developed, making it difficult to transport food from the rural areas to urban markets. The recent launching of a conference of the Greater Liverpool Food Alliance (GLFA), on promoting urban and peri-urban agriculture to make Liverpool a food secured city in North-West England, demonstrates that urban agriculture is being seen as a tool of resilience for crisis-hit Western economies (Osborn, 2010). Although international food prices have come down, uncertainty remains concerning agricultural markets, specifically the accessibility and diversity of food supplies. Urban agricultural can be a means to shorten the distribution chain by growing food close to the consumers. This will put more money in the hands of producers while consumers pay less for fresher and healthier food. The study by Mawois, Aubry and Le Bail (2010) show how, from an agronomic view, urban farming can meet increasing demand for fresh food in cities on the Northwest coast of Madagascar.

Another case for leveraging urban agriculture is that there is an indication that more than half of the world's population live in cities, the majority of whom are minimum wage earners in developing countries (King'ori, 2004). This necessitates permitting and encouraging urban agriculture as it appears to be one of the coping strategies for supporting people's livelihoods, and integrating the agricultural sector and the rural economy with the increasingly populous urban economy.

There is potential to exploit the increasing rural-urban migration and urbanisation challenge by using urban agriculture as an important lever for increasing accessibility and diversity of food supplies in the countries while the agricultural sector and the rural economy become integrated with the increasingly populous urban economy. Developing urban agriculture aligns well with one of the ECOWAS's six priority fields of action for implementing ECOWAP and NePAD's CAADP - developing agricultural supply chains and promoting markets by developing the different supply chains (food crops, peri-urban agriculture, export crops, short-cycle livestock rearing, agro-forestry food products, artisanal fishing and fish farming). In summary, for many years to come, the growth strategy for most agriculture-based economies has to be anchored on making agriculture productive. Meanwhile, while the rural economy will keep receiving investment attention, and there is the prospect of leveraging urban agriculture to fast track progress towards reducing poverty.

Burger et al (2009)'s doubt about the prospect of using urban agriculture to alleviate poverty can be seen as not only founded on the limitations confronting urban agriculture as a development tool in Africa, but also on their empirical evidence in South Africa where the households involved in urban agriculture look poorer than those which are not, and only about 7.5% of those involved in urban agriculture use urban farming as their main source of income. However, they further observe that people still get engaged in urban agriculture, either as a means of coping with poverty, or simply as a culture. This led the researchers to question the appropriate policy responses and practices to help people out of poverty. Researchers have a role to play in answering this question, as discussed in the following paragraphs.

CONCLUSIONS

In Africa, the degree to which agriculture grows by providing profitable jobs, supplying raw materials to the growing industrial sector, feeding the increasing urban population (lessening expenditure on food imports) and contributing to growing regional and world agricultural trade (exports), is expected to be reflected in the value added in agriculture. However, the growth in agricultural GDP is not consistent across the continent. Few countries have reached the CAADP target. Although we cannot attribute any causes to this trend, considering the literature on the role of agriculture in poverty reduction, and the obvious challenges to agricultural growth in the continent, we are inclined to make a case for leveraging urban agriculture in these countries.

Leveraging urban agriculture is important as one of the opportunities that presents itself in the dynamic environment that poses challenges to the agricultural sector. In addition, it has the potential to increase profit margins for producers, reduce costs for consumers, serve as a tool of resilience for poor and vulnerable households, and be an energy saving strategy for economies as a whole. Developing urban agriculture aligns well with one of the ECOWAS's six priority fields of action for implementing ECOWAP and NePAD's CAADP i.e., developing agricultural supply chains and promoting markets by developing the different supply chains (food crops, peri-urban agriculture, export crops, short-cycle livestock rearing, agro-forestry food products, artisanal fishing and fish farming) among others things. In general, for many years to come, the growth strategy for most agriculture-based economies has to be anchored on making agriculture productive. Hence, in order to avoid perpetuating the intensification agricultural growth model, which has not worked in most of these countries, there is a need for concerted efforts from different stakeholders to make urban agriculture productive and sustainable as one of the poverty alleviation strategies.

Specifically, researchers could contribute to more understanding of how its value can be realised, especially to reduce poverty in Africa. Specific research approaches will include integrated assessments of strategies and policies for land use, urban planning and development, food security and environmental management. This will help to inform how urban agriculture links with rest of the economy for policy decisions and development.

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ENVIRONMENTAL HAZARDS, PUBLIC HEALTH AND FOOD SAFETY

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Abstract

With urbanization close to 50% of each country's population, the basic needs for good accommodation, adequate water and food supplies have increased tremendously. The problems of overcrowding and over-utilization of scarce resources account for increase in preventable diseases such as cholera, malaria, typhoid, tuberculosis. Efforts at urban agriculture (UA) such as poultry and livestock farming, food crop and vegetable farming are limited by environmental hazards from poor or non-management of resources and resulting wastes. With global environmental management focus on recycling and other waste reduction efforts, dry fermentation of municipal solid wastes and farmyard manure into organic fertilizer and biogas which was found suitable for management of organic wastes will enhance UA. Anaerobic digestion of piggery wastes for a minimum of 75 days was found to destroy all the parasitic worms and eggs in the substrates and make such processed manure safe for urban agriculture.

INTRODUCTION

Water is crucial to living. Access to water and sanitation is both a right and a requirement for reducing poverty and a driver of growth (O'Connell, 2003). If the food needs of the global population are to be met, there must be adequate access to water for irrigation by farmers not only for urban agriculture (UA) but for the rural areas where the bulk of the food is produced. Most of the environmental and public health hazards, including those traceable to consumption of unwholesome foods and beverages, are traceable to inadequate and poor quality of water consumed or used by both human beings and animals and to lack of adequate sanitation facilities (Adewumi, 2010).

As at 2002 the Life expectancy of a new born baby in Nigeria was 52 years with Under-5 Mortality Rate (U5MR) of 183 per ‰ births, adult literacy rate of 64 % and 56 % primary school enrolment putting us at 15th worse position alongside Mauritania in West Africa and Rwanda in East Africa (UNICEF, 2003). Libya's U5MR is a healthier 19 deaths per ‰ births with a Life Expectancy of 73 years backed by a total adult literacy of 80 %, net primary school enrolment of 96 % during the same evaluation period.

Our agriculture whether rural or urban is still very much rudimentary relying on manual drudgery for most of the works instead of mechanized farming. We cannot feed ourselves and have had to import virtually everything. It does not matter whether one lives in the urban or rural area in Libya, access to good quality, adequate water supply and sanitation services are much better than Nigerian's access to water supply and sanitation. Investment on education and welfare programmes by the Libyan government has transformed Libya into an enviable level where U5MR fell from 270 in 1960 to 19 in 2002.

UNICEF (2003) suggested that U5MR be used as an index of level of development of nations since majority of the causes of childhood deaths are related to diseases and effects of poor quality and quantity of water and lack of sanitation facilities. The closer the U5M rank is to zero the closer a nation is to extinction or animal/primitive existence.

All member States of the United Nations, to which Nigeria and African countries are party, in September 2000 made a passionate commitment to address the crippling poverty and multiplying misery that grip many areas of the globe. At that meeting the Governments set a date of 2015 by which they would meet the eight Millennium Development Goals (MDGs): (1) **Eradicate extreme poverty and hunger**; (2) Achieve universal primary education; (3) Promote gender equality and empower women; (4) **Reduce child mortality**; (5) **Improve maternal health**; (6) **Combat HIV/AIDS, malaria and other diseases**; (7) **Ensure environmental sustainability through good access to Water and Sanitation**; and (8) Develop a global partnership for development (Jong-Wook and Bellamy (2004; Shordt *et al*, 2004).

The statutory meaning of *Development* is defined in Section 91 of the Nigerian Urban and Regional Planning Decree No 88 of 1992 amended by decree No 18 of 1999 as "the carrying out of any building, engineering, mining or other operations in, on, over or under any land". Development also means "the making of any environmentally significant change in the use of any land or demolition of building, including the felling of trees and the placing of freestanding erections used for display of advertisement on the land and the expression" O'Connell (2003) also present development as "a process of social transformation".

Majority of environmental hazards from urban and rural pollution from Municipal Solid Wastes (MSW) in cities, domestic and agricultural wastes in rural areas and problems of public health and food safety are traceable to the five emboldened MDGs (1, 4, 5, 6 and 7) above (Adewumi, 2010). With proper education and investment on health, the countries in the West African sub-region may, in the next and remaining half-decade of the target, partially improve on these goals that have hardly been touched in the last 10 years.

ENVIRONMENTAL SANITATION LEVEL

Given the statistics in the flyer for this Conference that the global urban population will reach 6.4 billion in the next 40 years or so with 60% residing in cities by 2030, the concern of this Conference on the attendant increase in food insecurity and malnutrition in one hand and crippling poverty and pollution, especially of the African environment, is well placed and timely. The worse off countries with malnutrition are in Africa, especially in countries where there has been prolonged conflict or ethnic or religious wars or where poorly planned developments such as in construction of roads and buildings have resulted in deforestation and exposure of farmable lands to harsh weather conditions resulting in soil erosion that reduces yield of farm produce.

Today most schools in Nigeria lack adequate provision of toilet facilities with 67% in urban, 74% in the semi-urban and 96% in the rural area having access to pit latrines, with others using the bush system or nearby streams (Fellows and Onibokun, 2003). Fellows and Onibokun (2003) further found that apart from poorly maintained and some overflowing pit latrines in Nigeria's six geopolitical zones, the accessibility norm of 1 toilet to 150 pupils/students was far exceeded in the ratio of 1:300 to1: 2000. Ahianba *et al* (2008) provided statistics that 54.6% (75.9 million) of Nigerians use pit latrines, 13.71% (19.1 million) use water closet, 0.58% (806,200 people) use bucket latrine system while the remaining 31.16% (43.3 million) Nigerians use other unsanitary methods.

Before the banning of the use of bucket latrines, night soil men collect these from premises to a central treatment place where the *Windrow* or *Indore* System is used to mix the faecal wastes with garbage and farm wastes and process to manure or organic fertilizer for planting vegetables and other crops. The *Indore* Process of organic fertilizer production was developed in a town after which the process is named in India, and the Windrow Process is a variation of it in which anaerobic process is used in converting faecal wastes and vegetable wastes, especially from farms into manure over a period ranging from 40 to 60 days.

This organic farming input method common in the early 1950s to shortly after Independence and still practiced in Kano State, was more informed by limited access to mineral fertilizer, which introduction later on accounted for more environmental degradation of soils and pollution of both surface and ground water sources. Although there is risk of health hazard to the collectors and processors through lack of personal hygiene, the composting system ensures that groundwater is not polluted from leaching and seepage from pit latrines. For integrated management of solid and farm wastes and faecal wastes, aerobic composting has been found to be less hazardous with richer manure product than the anaerobic methods and at shorter time duration of production (Adewumi *et al*, 2005a, b).

WATER SUPPLY

Access to water and sanitation underpins good health and consequent ability to attend school or to make a living. Presently a child dies every 15 seconds of a water-related disease while 40 billion working hours are lost to water-hauling in Africa alone (O'Connell, 2003). Today most urban cities with pipe-borne water supply do not have supplies regularly and water closets, which are supposed to be an improvement on pit latrines and the proscribed bucket latrines, have virtually become air-closets since only air oozes out of faucets when turned on without achieving the desired function of flushing. When the water eventually flows, brackish turbid water flows from the faucets.

Such coloured and turbid flow is a sign of post-treatment contamination from seepage from the surrounding soil into possibly corroded and leaky metal pipes and is thus hazardous. It may also be a result of reaction of chlorine used in water treatment with metal pipes used in conveying the treated water. By the 2006 Nigerian Census, 67 million people (48 % of the population) depend on surface water for domestic needs, 79 million (57 %) use hand dug wells, 27.8 million (20 %) harvest rain, 19.5 million (14%) have access to pipe borne water and another 14 % have access to borehole water sources (FGN, 2010; Longe *et al*, 2010). Despite this scarcity, about 177 km^3/yr of surface water is discharged into the Atlantic Ocean via the Niger Delta out of which the River Niger receives 36 km^3/yr from Niger Republic and 25 km^3/yr from Cameroon via the River Benue (FAO, 2003). The balance of 116 km^3/yr is from the tributaries of the River Niger within Nigeria. Watershed development for possible rainwater harvesting and reservoir augmentation would improve water availability for UA.

FOOD HYGIENE

Apart from the hazards of polluted waters there were reported cases of food poisoning and deaths in Ile-Ife from claimed preservatives used in processing the yam. The habit of sun-drying raw cassava and other food items such as pepper and tomatoes, on kerb side along major highways expose such processed foods to contamination with metallic wastes such as arsenic, aluminium, cadmium, iron, etc, apart from other forms of contaminations from animals and even the processor's footwear that may have stepped on faecal excrements. Apart from the dangers of unhygienic raw food processing, there are common cuisines such as *kilishi, donkwa* and *kulikuli,* melons, salads, cabbage, etc each of which can be eaten as snacks or with *main meals*. Such food items may also harbour pathogenic, disease –causing microorganisms from water used in washing them. The spread of typhoid or cholera and other Gastro-Intestinal Tract (GIT) infections are easily transmitted to susceptible hosts or consumers from such contaminated meals.

FLOODING AND EPIDEMICS

The recent flooding in several non-coastal parts of Nigeria has been erroneously attributed to global-warming and seen as an act of God instead of design failures and related human errors in watershed and water resources management. The flooding of major cities far-removed from the nation's coastline cannot be attributed to melting ice caps.

Cholera and other diseases of sanitation and personal hygiene are gradually becoming endemic in Nigeria, especially in some Northern States of Nigeria. First the lack of sanitation facilities by 55 % of the 70 % predominant rural dwellers in Nigeria particularly account for open defecation on farmlands and around such village settings; at times defecation is made directly into surface water bodies (Longe *et al*, 2010).

Another challenge to engineers is the plight of those in riverine areas, where though surrounded by water and people live on or above water, they have no drinkable water due to pollution from oil prospecting and flaring of gas, and other anthropogenic activities. Due to high water table and rising water level during rainy season, toilets are built on stilt and defecation done directly into water. In arid north and during prolonged rainfall leading to heavy surface runoffs, excrements deposited unsanitary on land in bushes around premises or on farms get washed along into river courses which use of its water lead to infections and outbreak of such communicable diseases as cholera that is presently ravaging some states.

ENVIRONMENTAL HAZARDS

Apart from the problems in the preceding sections, other sources of environmental and public health hazards include oil spillages from drilling and burst pipes, accumulated municipal and medical wastes that Fadipe (2006) found were mostly unsanitary disposed along with municipal wastes in open dumps. The burning of the municipal and medical wastes releases toxins into the atmosphere. Rainfall on these wastes washes both toxic materials and pathogenic micro organisms into water bodies and part of these may leach into underground water sources.

Solution to most of these problems are in the hands of engineers, especially civil engineers, agricultural engineers, etc who are responsible for developing infrastructures and structures and systems through the design and construction of buildings for human and livestock uses, roads, dams and water reservoirs, irrigation systems and infrastructure/facilities for water supply and sanitation.

ERADICATION OF EXTREME POVERTY AND HUNGER

Poverty eradication is premised on enlightenment. There is a general realisation that majority of graduates are unskilled and unemployable but mostly trainable. Entrepreneurial skill development is key tool for poverty eradication. Several individuals have found wealth in the collection and/or scavenging of Municipal Solid Wastes (MSW) and related scraps. The hazards related to this business include Acute Respiratory Infections (ARI), tetanus and food borne diseases and poisoning from exposure to toxic and infectious substances (Adewumi, 2010). The hazard could be reduced through training and organized waste collection and processing scheme.

A World Bank study on conversion of MSW and farmyard manure (FYM) in eleven cities in Southwest Nigeria into organic fertilizer showed that about 60% of MSW is garbage that could be recycled into organic fertilizer. The study found that combining 70% MSW with 30% of FYM such as poultry droppings and piggery wastes and digesting these produce good quality organic fertilizer after just three weeks; the over 30% of the remaining fraction can be recycled after sorting into types (Adewumi *et al*, 2005a, b). Production of biogas from the wastes was also studied in that project. Further work on this showed that dry fermentation method could yield higher volume of biogas and produce rich organic fertilizer as well (Adewumi *et al*, 2010).

This Technology has been used in Munich, Germany to process MSW into biogas and organic fertilizer; the gas is used in generating electricity. The stabilized organic fertilizer could be bagged and sold for UA even within buildings in land-scarce cities or taken to rural areas where the majority of the farms are located. This could be a major solution to urban MSW management as Lagos State is doing presently.

Three different businesses of *collecting*, *processing* and *recycling* can create employment and generate revenue from wastes management (Adewumi, 2009; Adewumi *et al*, 2010). A hand-pushed cart, apart from reducing pollution and dependence on fossil-fuel driven collection vehicles, is believed to provide avenue for employment for youths who must be given education for their own safety. He posited that Local Governments in Nigeria could increase their revenue bases through planned waste management programmes using Environmental Health Officers (EHOs) who are professionals trained to manage the environment and reduce environmental pollution.

Apart from these, engineers could develop facilities including solar dryers, etc for food processing in a hygienic manner. All stages in food production, transportation, processing, and packaging are also possible sources of revenue generation and entrepreneurial development. Healthy ventures like further processing of oil palm producing wastes such as palm kernel shells into activated carbon has the prospect of empowering women and youths usually involved in the farms (Adewumi, 2009). Rather than sell raw shells, the adsorbent could be produced using cottage industry level developed and described in Adewumi (2006a, b) and Adewumi (2009).

REDUCTION OF CHILD MORTALITY AND IMPROVEMENT OF MATERNAL HEALTH

The recent case of lead poisoning in Zamfara State that has killed more than 200 people is attributable to poverty, ignorance and exploitation and shows the strong association between child mortality and maternal health. Exposure to dusts from crude ores of lead that forms part of the wastes in gold-mining causes nervous disease when ingested or inhaled beyond a maximum contaminant level of 0.01mg/l (WHO, 1993).

Since women are easily exploited as sources of cheap labour in such ventures, and are also responsible for preparing foods for the family and breast-feeding of infants, it becomes easier for the hazard to spread to families in a community. Principle of hygiene especially hand-washing with soap that may reduce risk level becomes impracticable in a water-scarce community. Apart from access to education, especially health education, access to good nutrition and water supply, improved environment are keys to reducing the U5MR in Nigeria and other West African and other developing countries. One way of doing this is to reduce the time spent in fetching or accessing water and also improving the financial base of women in particular through safe, non-hazardous ventures. If necessary, there is the need for legislation to prevent nursing mothers from bringing their children into hazardous, industrial and even farm areas.

COMBATING HIV/AIDS, MALARIA AND OTHER DISEASES

The spread of HIV/AIDs is not due to sexual transmission alone. Carelessness in handling sharp objects infected with the virus is one other method of transmission. The disposal of hospital wastes requires health education of waste management staff of each hospital and also of scavengers who, due to poverty are exposed to several hazards of openly dumped, untreated Hospital wastes and even of MSW. Destroying breathing places of mosquitoes through proper drainage of premises and public places and infrastructure such as side drains on roads and feeder roads in residential areas, proper disposal of wastewater are steps that will improve the healthiness of our communities. Training and recruiting more EHOs who can enforce observance of sanitation laws will be more effective than purchasing more mosquito nets for distribution.

A major health threat and source of early deaths are road accidents resulting from pavement failures such as potholes, eroded pavements, lack of side drains on highways, etc. The unrelenting cases of cholera across several states of Nigeria are traceable to lack of good sanitation facilities and contaminated food and water sources. Three major reasons for persistence of these preventable diseases are mass poverty, lack of potable water, and poor environmental hygiene.

ENSURING ENVIRONMENTAL SUSTAINABILITY THROUGH GOOD ACCESS TO WATER AND SANITATION

The parlance *Prevention is better [and cheaper] than cure* is often taken in Nigeria to mean little or no budgetary allocation to public health apart from education that receives less than 10% of total budget instead of not less than 26 % advocated by UNESCO for any nation that takes growth seriously. Corruption also affects the quality of infrastructural projects that is meant for the public. Longe *et al* (2010) showed that despite robust laws and regulations majority of industries and even the public contravene regulatory laws with impunity. This results in unabated discharge of industrial and desludged septic tanks into water bodies in most cities, especially Lagos. Collapsed road pavements increase risk of deaths through accidents.

Chlorinated water pumped into our premises is a potential source of cancer of the kidney from trihalomethanes (THM); the need for tertiary treatment of water for drinking and cooking is essential to healthy living. We have developed a carbon adsorbent from activation of palm kernel shells at laboratory scale research that removed 93 % of the THM in tap water apart from removal of heavy metals and other organic impurities (Adewumi and Ogedengbe, 2005).

Sustainable lifestyles, sustainable agricultural practice, sustainable buildings are the present global focus of a drowning world. There is still hope if developed countries that account for more than 80 % of pollution that causes global warming, will release the fund used in protecting animals in wildlife and other efforts into assisting human beings in developing countries. We also in developing countries must stop wastages on unproductive ventures such as housewarming, and '*turning the back of the dead'* ceremonies and use such funds to support research efforts for a sustainable environment.

CONCLUSION

Engineers have a big role to play not only in UA but in all facets of our development. The possibilities of using recycling technology to convert most of the wastes in our environment into useful materials for domestic and farm use have been presented. If we are ever going to have any socio-political and economic right and empowerment, we must all seek to make our environment safe. Engineers and scientists need to justify our individual callings and develop innovative solutions to peculiar national problems and thereby create a sustainable living environment and employment. We can do it as a collective, we can do it as individual researchers through cross-fertilization of ideas as will be shared in this conference.

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ANALYSIS OF CLIMATIC DATA OF IBADAN METROPOLIS: IMPLICATIONS FOR GREEN CITY

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Abstract

A time series analysis of the climatic data of Ibadan metropolis collected over a period of 30 years on a monthly basis was carried out. The trend, seasonality and randomness in the data were diagnosed.

It was observed that climatic variables have been on the increase. Especially maximum temperature in December 1979 was 30^0C while the value in December 2009 stood at 33.5^0C. Conversely, negative trend was observed in the annual precipitation. Annual precipitation in 1979 was 1553.5mm while the value in 2009 stood at 1504.1mm. Deforestation due to road construction, residential buildings construction and urban migration has been on the increase. The implications of the results were discussed. It is recommended that consistent attention should be given to tree planting around the buildings, along the roads and as woodlots.

INTRODUCTION

The analysis of trends in the climatic time series in general and specifically for drought indices has become a subject of considerable interest (Capodici *et al.*, 2008). This is due to the fact that the presence of trends could be a signal of upcoming climate change. In the same vein, knowledge of evolution of precipitation may become a supporting tool in the definition of possible future scenarios in the management and planning of water resources within a territory.

On international scene, a number of researches about rainfall variation at different time scales had been carried out (e.g. Osborn *et al.*, 2000, Brunetti *et al.*, 2001). According to Houghton *et al.* (1996), daily time series analyses showed positive trends of daily rainfall intensities and an increase of extreme events during the last decades. In most of the areas characterized by rainfall intensity, an increased been detected (Groisman *et al.*, 1999). In Nigeria, meteorological data have shown that rainfall pattern has changed in the past decades. Oladipo (1995) reported that the decline in rainfall in Nigeria started at the beginning of the 1960s when a decade of relatively wet years ended.One important feature observed in Ibadan metropolis is the almost complete absence of primary forests. This may be partly due to human activities. Uncontrolled logging, agricultural activities, urbanization and mining activities contributed to loss of vegetation. The change in vegetation will have great consequences. It will lead to loss of biodiversity. Regeneration rate of tree will also decline because most seed bearing trees have been harvested. The main objective of this study is to assess the presence of significance in rainfall and temperature time series within Ibadan metropolis and to study the possible correlation.

METHODOLOGY

Ibadan is located approximately on longitude $3^o54'$ of Greenwich meridian and Latitude $7^o26'$ North of the equator at a distance of about 145 km NorthEast of Lagos. It has a total land area of 13,000 ha and is 750m above sea level (Oguntoyinbo 1994). Ibadan falls within South-West geopolitical zone of the country.

Two major Rivers drain Ibadan namely, The Ogunpa and Ona Rivers. The former drains the eastern part while the latter drains the western parts. Ibadan consists mainly of the basement complex rocks of metamorphic types of pre-Cambrian age, but with a few intrusions of granites and porphyries of Jurassic age. The rock in Ibadan can be grouped into major and minor rock types. The major rock types are quartzites complex comprising banded gneisses, gneisses and migmatites. The soils of Ibadan were formed from rocks of the pre-Cambrian basement complex formation. They were formed under moist semi-deciduous forest cover. The mean annual rainfall ranges between 1257 and 1373 mm (Oguntoyinbo 1994).

The data sets used in this study was obtained from the meteorological station of Forestry Research Institute of Nigeria (FRIN). The data cover a period of 30 years (i.e. 1979 – 2009). The data comprise of monthly rainfall (mm), number of rain days, minimum and maximum temperature (^{o}C).

The data were analyzed using time series analysis, descriptive statistics, correlation and regression analysis. The exponential smoothing and ARIMA (Autoregressive moving average) methodology were used. The general model introduced by Box and Jenkins (1976) includes autoregressive as well as moving average parameters, and explicitly includes differencing in the formulation of the model. Specifically, the three types of parameters in the model are: the autoregressive parameter (p), the number of differencing passes (d) and moving average parameters (q). Pearson product moment correlation procedure was used to investigate the nature of association between rainfall and temperature variables. The mathematical function for correlation coefficient computation is given as:

$$r_{XY} = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n}\right].\left[\sum Y^2 - \frac{(\sum Y)^2}{n}\right]}} \text{..................................} eqn.1$$

Where,

r = Correlation coefficient

X and Y are any named pair of variables (say, temperature and rainfall)

Linear regression of rainfall on temperature on one side, and number of rain days per month on temperature on the other side were carried out. It should be noted that temperature refers to the maximum temperature. The mathematical form of the models estimated by these statements is given as:

$Y = b_0 + b_1X$ …………………………… *eqn.2*

Where,

Y = Dependent variable (i.e. rainfall or number of rain days/month)

X= Independent variable (i.e. maximum temperature)

RESULTS AND DISCUSSIONS

Descriptive charts of the rainfall and temperature values

Figs.1 – 5 show monthly rainfall data, annual rainfall data, maximum and minimum temperature values and number of rainy days per month. Monthly rainfall appears to relatively reduce (fig. 1), the same trend was observed for the plot of annual rainfall values. This confirms the finding of Cannarozzo (1985). Also Aronica *et al.* (2002) found a reduction in annual rainfall. This could be associated with a marked loss of vegetation in the metropolis. The monthly maximum temperature values show a relatively small rise.

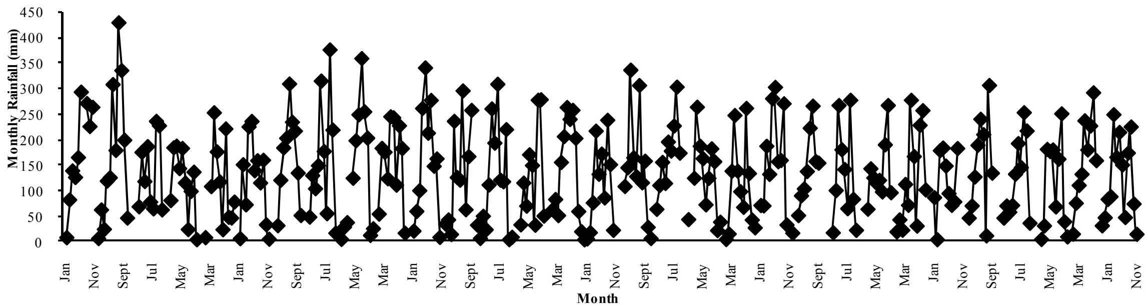

Fig. 1: Monthly rainfall data in Ibadan metropolis across a period of 31 months

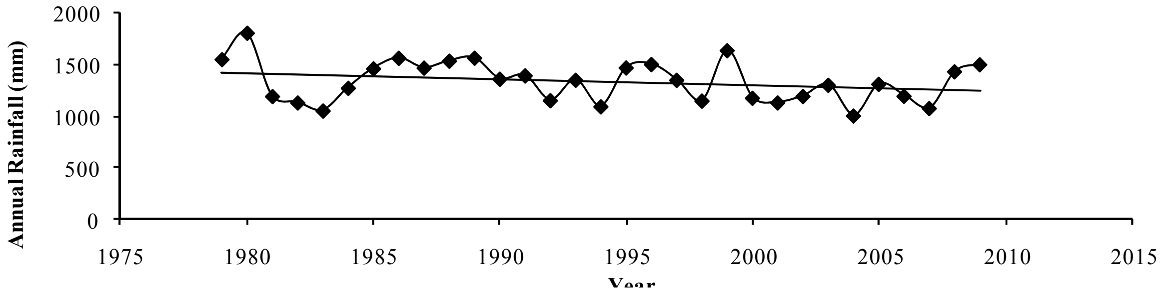

Fig. 2: Annual rainfall values across the years

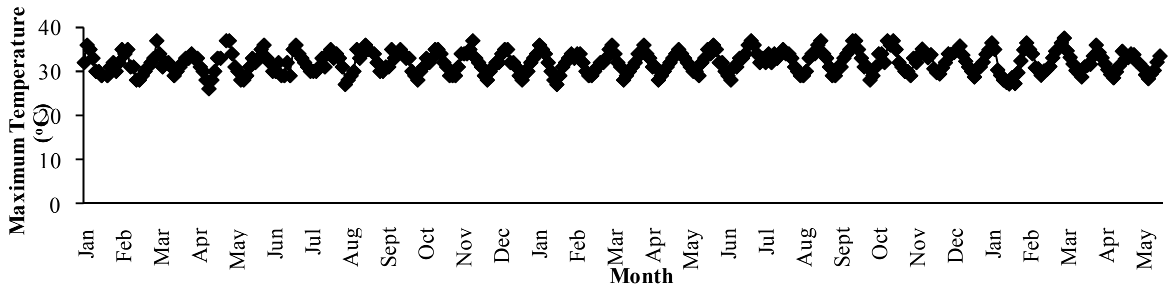

Fig. 3: Maximum temperature across the months

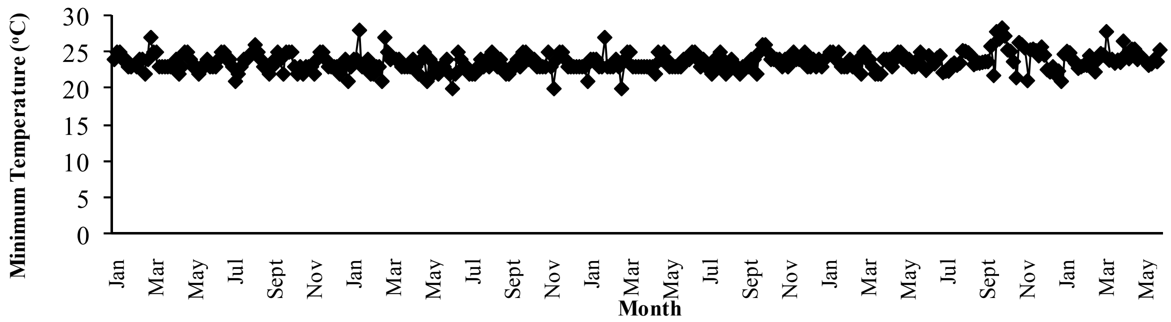

Fig. 4: Minimum temperature across the months

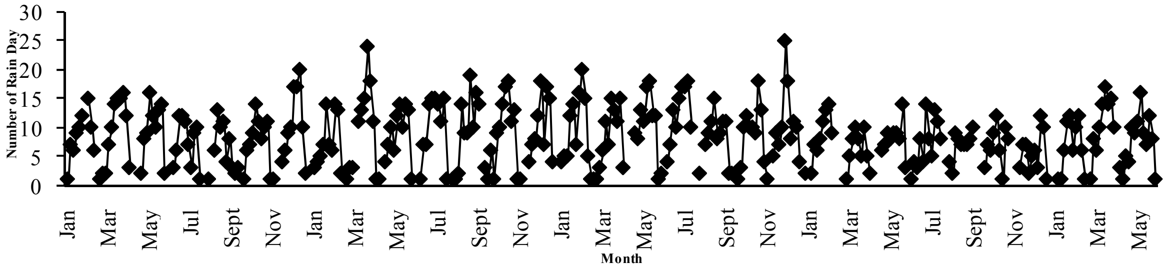

Fig. 5: Number of rain days across the months

Results of trend analysis on rainfall and temperature

The results of trend analysis are presented in Figs. 6 – 9. The trend gave good forecast.

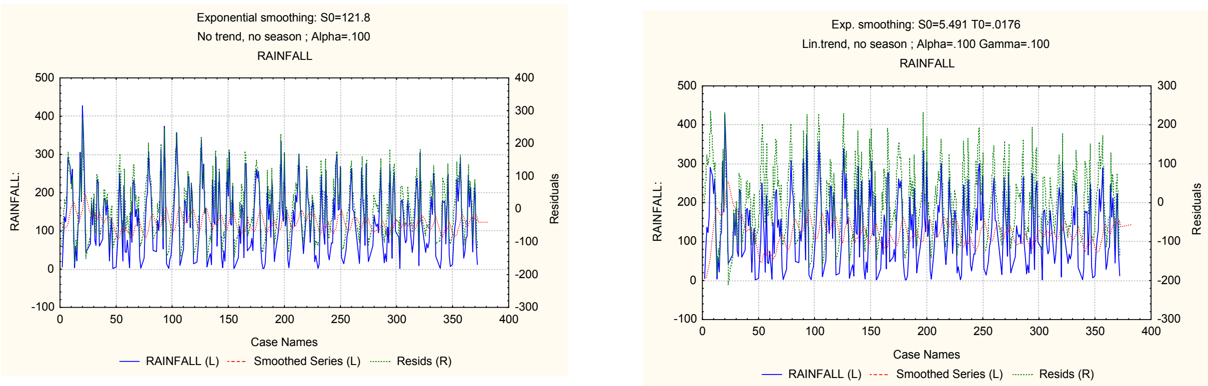

Fig. 6: Exponential smoothing of rainfall data under no linear and linear trends.

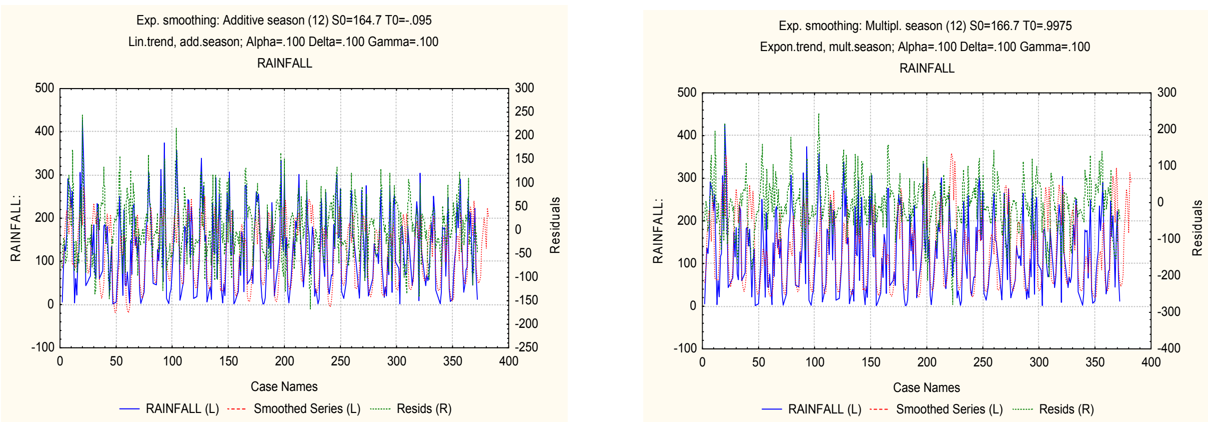

Fig.7: Exponential smoothing of rainfall data under exponential trend, additive and multiplicative seasons

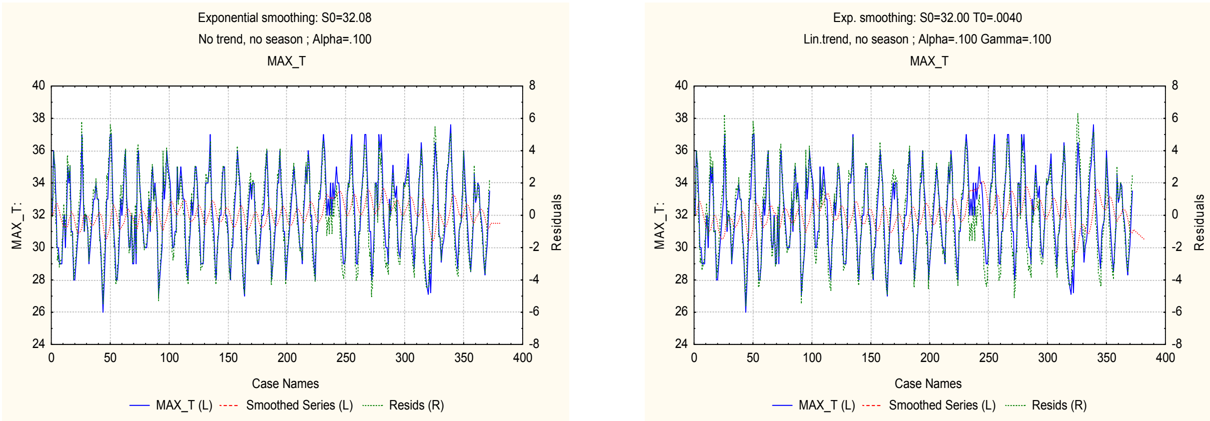

Fig.8: Exponential smoothing of maximum temperature values under no trend and linear trend

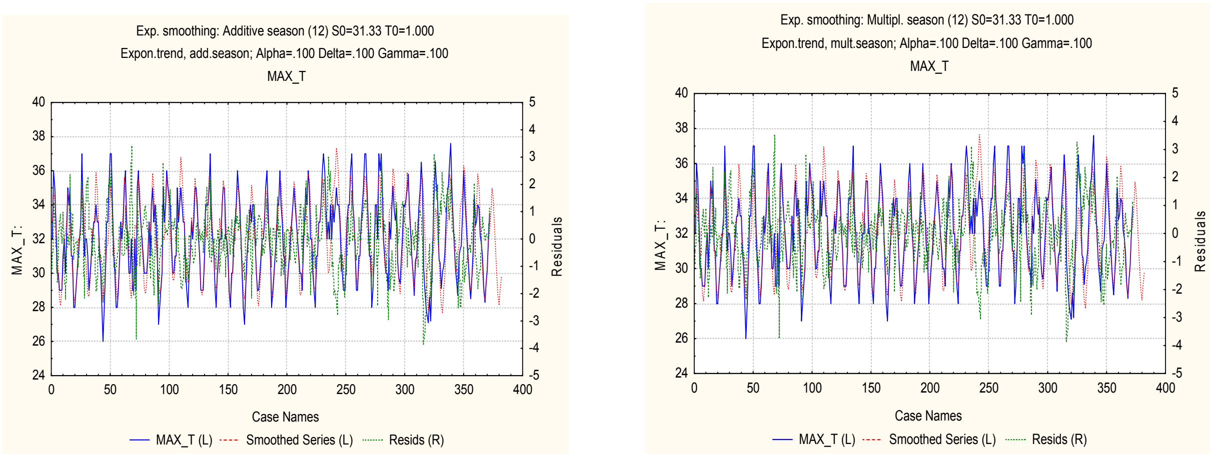

Fig.9: Exponential smoothing for maximum temperature under exponential trend, additive and multiplicative seasons

Results of correlation and regression analysis

The results of the correlation analysis are presented in Table 1 below:

Table 1: Results of Correlation Analysis

	Rainfall (mm)	NRD	Max. Temp.	Min. Temp.
Rainfall (mm)	1.00			
NRD	0.82*	1.00		
Max. Temp	- 0.50*	- 0.56*	1.00	
Min. Temp	- 0.27*	- 0.34*	0.52*	1.00

The result of the correlation analysis revealed a negative association between rainfall and temperature. Increase in temperature tends to be associated with decrease in rainfall.

The simple linear regression equation shows that monthly temperature is related to rainfall. The fitted equations are presented below:

$$\ln Rainfall = 11.9462 - 0.2354 Max.Temp \ldots\ldots\ldots\ldots\ldots eqn.3$$

$$R^2 = 0.23, \quad SEE = 1.035$$

$$NRD = 46.41 - 1.20 Max.Temp \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots eqn.4$$

$$R^2 = 0.31, \quad SEE = 4.192$$

Results of ARIMA

The results of ARIMA for rainfall and temperature data are presented in Tables 2, 3 and 4 below:

Table 2: Summary statistics of ARIMA model for rainfall data

Rainfall; Model: (1, 0, 1) (1, 0, 0) Transformation: ln(x)

Seasonal lag: 12, MSE = 1.1145

	Parameter	Asymptotic standard error	Asymptotic t (368)	P
P (1)	0.9734	0.0133	73.0121	0.000
Q (1)	0.3508	0.0672	5.2189	0.000
Ps (1)	0.3673	0.0545	6.7351	0.000

Table 3: Summary statistics of ARIMA model for maximum temperature data

Maximum temperature; Model: (1, 0, 1) (1, 0,1) Transformation: x^2

Seasonal lag: 12, MSE = 9499

	Parameter	Asymptotic standard error	Asymptotic t (368)	P
P (1)	0.9529	0.0179	53.094	0.000
Ps (1)	0.9919	0.0157	63.1354	0.000
Qs (1)	0.7915	0.0474	16.7081	0.000

Table 4: Summary statistics of ARIMA model for minimum temperature data

Minimum temperature; Model: (1, 0, 1) (1, 0, 0) Transformation: ln(x)

Seasonal lag: 12, MSE = 4108.7

	Parameter	Asymptotic standard error	Asymptotic t (368)	P
P (1)	0.9871	0.0095	104.3821	0.000
Q (1)	0.4619	0.0520	8.8742	0.000
Ps (1)	0.9886	0.0233	42.3790	0.000
Qs (1)	0.8575	0.0483	17.7588	0.000

The results of the ARIMA models indicate that the models fitted well to the data.

CONCLUSION

The aim of this research was to investigate the various patterns in the time series data of climatic variables of Ibadan metropolis, such as rainfall, number of rainy day, minimum and maximum temperature; to assess the association between temperature and rainfall variables; and to draw lessons for greening the city. The analysis of climatic trends showed a statistically significant negative trend in annual precipitation and statistically significant positive trend in mean annual temperature. It is apparent that downward trend in annual precipitation might not be unconnected with massive deforestation in the metropolis.

Further research/analysis has to be conducted in order to evaluate correlation between vegetation dynamics and climatic variables across several types of natural vegetation in the metropolis. It is however, recommended that sustained effort towards tree planting be initiated in Ibadan metropolis.

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FARMERS PERCEPTION OF CLIMATE CHANGE AND THEIR EFFECTS ON ARABLECROP PRODUCTION IN OYO STATE

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Abstract

The current study investigates the perception of urban-based farmers on climate change and their effects on arable crop production in Oyo North, a typical derived Savannah zone of Nigeria. A multistage sampling procedure was employed to purposively select three Local Government areas in the zone where agriculture is mostly practised namely Oriire, Ogbomoso South and Surulere. Each area represents an agricultural Extension block of the Oyo State Agricultural Development Programme (OYSADEP). Four cells were randomly selected from each of the blocks representing half of the cells in each block. Three towns where urban/peri-urban agriculture was predominant were selected from the 12 selected cells to make a total of 36 towns and five respondents were further selected from each of the towns from the list of arable crops farmers obtained from OYSADEP. Information collected includes those on respondents' socio-economic profile, levels of awareness on climate change, perception of and coping mechanisms adopted. A total of 210 respondents were interviewed for the study using structured questionnaire schedule. After cleaning, responses from 180 respondents were found useful. Frequency counts, Percentages and Logit model were used to analyse the data. Results show that majority (78%) of farmers were males, married (82%) and of middle age (67%) with the modal farming experience of about 16 years. Majority of the farmers strongly agreed that human activities (45%) and uncontrolled agricultural practices (53%) contributed to climate change. In conclusion, climate change should be addressed at the grassroots level and the farmers educated to recognise warning signals to climate change and plan ahead for coping strategies.

INTRODUCTION

Weather, which is the atmospheric condition of a place at a particular point in time, is the key variable in agricultural production (Anver, 2000). It includes precipitation, relative humidity, wind, pressure and temperature (Lal, 2004). An agricultural system is basically a man made ecosystem which depends on weather and climate to function just like the natural ecosystem. Climate determines whether or not rain fed agriculture will be feasible and the type of crops that can be successfully cultivated in a given area. Consequently, all crops have their climatic limits for physiological developments. Arable crops however require moisture, heat, light, as well as nutrient for their growth and development. (Jamieson and Cloughley, 2001)

Several factors directly connect climate change and agricultural productivity. Such factors include average temperature increase, change in rainfall amounts and patterns, rising atmospheric concentrations of carbon dioxide and so on. Increased rainfall could lead to nutrient leaching, loss of topsoil and water logging, all of which will seriously affect agricultural production and when this is accompanied by higher temperatures, there may be high incidence of pests and diseases (Githeko et al., 2000, Anderson et al., 2004, Orindi and Murray, 2005). McCarthy et al., (2001) noted that the impacts of climate change will not be uniform across the globe and considerable differences are expected among different regions. It is however an irony of fate that the most vulnerable group are the poorest countries which incidentally have contributed least to the global GHG emissions (Orindi and Murray, 2005). Nigeria is particularly vulnerable to impact of climate changes due to its geographical location, lack of social resources and limited adaptive capacity. The shortage of adaptive capacity is due to lack or inadequacies of scientific, technical, financial and institutional capacity to evaluate the impacts of climate change in the country (Oladepo, 1995).

Various studies that have been carried out on the short and long term effects of climate change have not adequately addressed issues relating to the perception of farmers towards adaptation strategies. Over time, a number of affected households and communities have developed coping strategies in response to extreme climate conditions but these can only assist them in the short term but their long run effect on increased and more severe shocks may not be feasible (Morris, et al., 2002). Howbeit, there is a need to strengthen such coping strategies to enable farmers live with the current climate variability as well as help them to adapt to long term climate change (Adger, 1996). This can only be made possible if one first understands the local farmer's knowledge of climate change, vulnerabilities and their perception on adaptation, capacities and risks (DFID, 2004).This study therefore seeks to understand the nature of the problem through perception of and adaptation to the climate change scenarios by the urban-based arable crop farmers in a typical agrarian zone of Oyo state.

The specific objectives of this study therefore are to: identify the socio economic status of urban -based arable crop farmers, investigate the arable farmers' perception on climate change, estimate the perceived effect of climate change on arable crop yield, and; determine the adaptation strategies of climate change.

METHODOLOGY

The study was carried out in three urban settlement areas of Ogbomoso, the most urbanised major city in Oyo north of Oyo State2 comprising five Local Government Areas namely Ogbomoso North, Ogbomoso South, Oriire, Surulere and Ogo-Oluwa. The areas are within latitude 4^o E and longitude of 8^0 N; and lies within the tropical rainforest zone with its characteristic wet and dry seasons. The average rainfall in the wet season of May-October is 1000mm, while the dry season runs from November to April with an average rainfall of 250mm.The temperature ranges from 70^oF to 90^oF throughout the season. A multistage sampling procedure was employed to purposively select three Local Government areas in the zone where agriculture is mostly practised namely Oriire, Ogbomoso South and Surulere. Each area represents an agricultural Extension block of the Oyo State Agricultural Development Programme (OYSADEP). Four cells were randomly selected from each of the blocks representing half of the cells in each block. Three towns where urban/peri-urban agriculture was predominant were selected from 12 selected cells to make a total of 36 towns and five respondents were further selected from each of the towns from the list of arable crops farmers obtained from OYSADEP. Information collected includes those on respondents' socio-economic profile, levels of awareness on climate change, perception of and coping mechanisms adopted. A total of 210 respondents were interviewed for the study using structured questionnaire schedule. After cleaning, responses from 180 respondents were found useful. Descriptive statistics was used to explain the socio-economic characteristics and Logit Regression model as used by Apata, et al., (2009) was adopted to analyse the determinants of perception and adaptation level of climate change by the arable crop farmers.

The basic Logit Regression is of the form: $Pi\ (Di = 1) = \dfrac{1}{1+ e^{Ii}}$ .... (1)

Where Ii is a linear combination of the explanatory variable of interest in this study ($X_{i,\ i=1,2,\ldots\ldots,23}$) Therefore,

$$Ii = ß_0 + ß_1 X_1 + ß_2 + X_2 +, \ldots, + ß_{19} X_{19} \quad (2)$$

However,

$$Pi\,(Di = 0) = 1 - Pi\,(Di = 1) \quad \ldots\ldots (3)$$

$$1 - Pi\,(Di = 1) = \frac{e\text{-}z}{1 + e^{-z}} \quad \ldots\ldots (4)$$

Dividing equation (1) by (3), the probability expressions can be transformed to determine the log-odds in favour of being poor or not. This manipulation results into:

$$\frac{Pi\,(Di = 1)}{[1 - Pi\,(Di = 1]} = \frac{1\ldots}{e^{-Ii}} \quad \ldots\ldots (5)$$

But $\frac{1}{e^{-Ii}} = e^{-Ii}$

$$\text{Therefore; } \frac{Pi\,(Di = 1)}{[1 - Pi\,(Di = 1]} = e^{-Ii} \quad \ldots\ldots (6)$$

$$\text{In; } \frac{[Pi\,(Di = 1)]}{[1 - Pi\,(Di = 1)]} = {}^{-Ii} \quad \ldots\ldots (7)$$

In the context of equation (7), the left hand side is the odd ratio of the probability of being poor in the level of perception and adaptation to climate change.

The estimating logarithmic equation is

$$Ii = ß_0 + ß_1 In_1 X_1 + ß_2 In_2 X_2 +, \ldots + ß_{19} In_{19} X_{19} \quad \ldots\ldots (8)$$

The dependent variable Di is a dichotomous variable, which is one when a respondent perceived any of the climate change variations and adapt to the changes and zero otherwise. The choice of the explanatory variables in the model was based on reviews of Rodriquez and Smiths (1994), Mendel and Nordhaus (1994), Ghazouani and Goaied (2001) and Apata, et al., (2009).

The explanatory variables used in the Logit Models and hypothesized as determinants of respondents poor in the level of perception and adaptation to climate change (that is specialized in only (mono) cropping) are: 1 for mono and 0 otherwise. Increased temperature (X_1), fall temperature (X_2), altered climate range (X_3), changed timing of rains (X_4), frequency of droughts (X_5), noticed climate change (X_6), cereal/legume intercropping (X_7), mulching (X_8), practiced zero tillage (X_9), making ridges across farms (X_{10}), farm size (X_{11}), own heavy machines (X_{12}), household size (X_{13}), farming experience (X_{14}), education (X_{15}), age of farmers (X_{16}) access to extension facilities (ACEXT) (X_{17}) Dummy, if access 1, otherwise 0, access to credit facilities (ACCRE) (X_{18}) and Sex (X_{19}

RESULT AND DISCUSSION

The distribution of respondents based on their socio-economic status is shown in table 1. There were 78% male respondents while the female respondents were 22%. This is because farming was considered primarily a man's job in Ogbomoso area. This observation is not uncommon in this part of the country in that women were mostly involved in house-hold chores, taking care of children and processing of agricultural farm products. Most of the respondents were married men and women who practice farming. This could be observed from the table as a total of 155 respondents (about 86%) of the total sample size were adult male and female. Only 25 of the 180 respondents were never married. The age distribution of the respondents shows that majority of them (67%) falls within 30 to 50 years of age. Only few (8%) of them however are still young and in their first 30 years of life, while those above this age are166 in number. This shows that a good number of the respondents were matured, married, responsible men and women who will hopefully be reliable enough to readily give the needed accurate response to questionnaire. A reasonable percentage of the respondents were either illiterate with no formal educational background (34%) or with only primary education background completed or not completed (47%).However, a few of them (4%) were educated men and women with secondary school certificate or tertiary institution certificates. Majority of the respondents had many years of experience in farming. About 47% had within 11 to 20 years of farming experience while 21% had more than 21 years of farming experience. Although majority of the respondents were non-literate in formal education, their long years of farming experience in arable crops could be advantageous to the farmers in that with experience they would have noticed the difference between the 'normal' climate under which they had been operating and the recent developments which would have made them aware of the change and this could help in the assessment studies on perception and adaptation of climate change.

Table 1: Distribution of respondents by socio-economic profile

Sex	**Number of Respondents**	**Percentage (%)**
Male	140	78
Female	40	22
Total	180	100
Marital Status	**Number of Respondents**	**Percentage (%)**
Single	25	13.9
Married	147	82
Divorced	08	4
Total	180	100
Age (Years)	**Number of Respondents**	**Percentage (%)**
Below 30	14	8
30 – 50	120	67
50 and above	46	25
Total	180	100
Educational background	**Number of Respondents**	**Percentage (%)**
No formal education	61	34
Primary school education	85	47
Secondary education	27	15
Tertiary School education	7	4
Total	180	100

Source: Field Survey, 2010

The response of the respondents as to the sizes of their owned farmland very close to the town shows that 21% of them have a size of within 0.1 to 0.3 hectares (ha); 5% have between 0.4 and 0.6 ha; 74% have a farmland size varying above 0.7 ha. This shows that the respondents were by no means small scale farmers since majority of them claimed that only a small portion (10% -20%) of their arable crop farms are within a trekking distance to their residence in town. This however tells much on the nature of acquisition of the lands where majority of the farmers operated on self owned and/or inherited lands in which case, land may not necessarily be a constraint to farm expansion.

As regards the percentage of land dedicated to arable crop farming, 40% of the farmers readily dedicated all their farmland for the arable crops; 37% of the respondents dedicated more than half of their total farmland to arable crops while the remaining 23% dedicated a little less than half of their farmland to arable crops. This finding shows the preponderance of arable crop farmers in the study area in that all the respondents' practice arable crop farming with or without other crops but vary in the size of land dedicated to it. It was also observed that a large percentage of the respondents dedicated almost all their farmland to arable farming. This is not un-expected in that the derived savannah nature of the vegetation prevalent in the area supports arable crops as their main cash crops.

A probe was made into the perception of respondents through focus discussion group by oral interview conducted on whether or not human activities contribute to climatic change. Findings revealed that about 27% of the respondents disagreed on the claim that human activity had any effect .They viewed the issues of climate change with spiritual perspectives and therefore had the religious belief on it as a natural occurrence and that, human beings should not be blamed for whatever occurs in nature. However, a greater percentage of respondents did agree in strong terms that human activity is responsible for climate change.

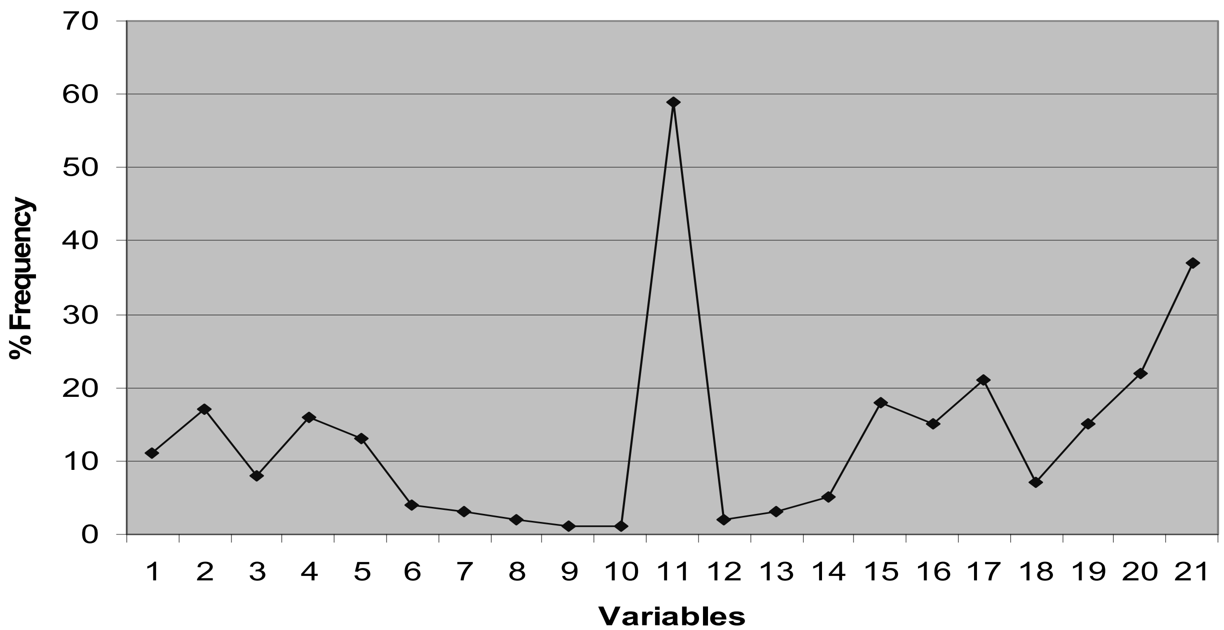
Findings also show the strong perception of respondents that among the human activities contributing to climate change, an uncontrolled agricultural practice takes the lead. A large percentage of the respondents "strongly agreed" with the statement (53%) and a further 42% agreed. The respondents that did not share the same opinion are relatively few (5%) and they are among the few less experienced farmers in the study area.

A total of 67 of the 180 respondents strongly perceived that climate change is responsible for low crop yield and a further 61 agreed while only 16 strongly disagreed.

Farmers were asked to comment freely on their current experience on the farm vis-à-vis the climate change and what they perceived to be the best and permanent solution to the identified problems. The summary of their response is presented in figure 1.

N.B: ***Some respondents gave multiple answers to this aspect of the questionnaire.***

Fig. 1: Perception of Long-term adaptionMaximum temperature across the months



KEY TO VARIABLES

1= Planting different crops; 2 =Planting different varieties; 3= Practicing crop diversification 4= Different planting dates; 5= Shorten length of growing period; 6 =Move to different site 7= Change amount of land ; 8 =Changes from crops to livestock; 9= Changes from livestock to crops; 10=Adjust livestock management practices; 11=**Moving from Farming to non-farming** ;12= Moving from Non-farming to farming; 13 = Increase irrigation; 14 = Change use of chemicals, fertilizers and pesticides; 15= Increase water conservation; 16= Soil conservation; 17 = Shading and shelter; 18 = Use insurance; 19 = Prayer; 20 = Other adaptations; 21 = No adaptation

The consensus of opinion is that the ultimate is to move away from farming to non-farming occupation. This, according to them, is in view of the progressive reduction in their farm yield coupled with low remuneration derivable from the sale of farm proceeds and their limited capability to foresee an alternative solution to the attendant problems occasioned by the climate change scenario. Many of them still capitalized on the drudgery in farming as compared with an almost risk-free "easy access" to economic incentives in urban areas as the basis for their response. The practice of money inducements by politicians to able-bodied men and women in recent times does not in any way help the worsening situation as many of the potential farmers are now engaged as party agents, errand boys and the like and enjoyed remunerations better than those derivable from farming.

Quitting farming to non-farm jobs formed the most common perceived adaptation practice suggested by the respondents (59%) as indicated in Figure 1.The implication of this is that farmers are gradually moving away from farming to non-farm activities, leaving rural areas in order to settle in urban areas in their quest to look for non existing jobs thereby compounding the existing social problems and worsening the food security situation of the country.

The actual adaptation measures and practices followed by farmers, grouped into ten categories. The main adaptation strategic measures followed Food and Agriculture Organization (FAO) classification as adopted by Dixon et al., (2001).

Multiple cropping mixed with livestock rearing under dry land conditions is the dominant system of adaptation practiced by the farmers (25.75%). Cereal/legume intercropping is the second most common strategy (21.28%), and multiple cropping without livestock under dry land (13.51%) comes third. Morris, et al., (2002) have recommended diversification and ensuring flexibility of assets as important in providing for greater livelihood flexibility.

The result of the estimated marginal effects and t-levels as calculated from the Logit Regression model is presented in table 2. The result shows that most of the explanatory variables considered are statistically significant at 10% level. The study uses specialized (mono) cropping as the base category for no adaptation and evaluates the other choices as alternatives to this option. The results show that altered climate change, noticed climate change frequency of droughts, age and sex all had no significant effect on adaptation, while increased temperature, intercropping of cereal/legume, mulching, zero tillage making ridges, farm size, farming experience, educational status access to extension and credit facilities are factors influencing adaptation positively. However, fall in temperature, change timing of rains, own heavy machines and household size are also significant factors but influence adaptation negatively. This result suggests that the larger the occurrence of these variables, the poorer the adaptation.

Table 2: Results of the Logit Regression Model

Explanatory Variables	Estimated Coefficient	Calculated t-value
Increased Temperature	.071E-02	3.414***
Fall in Temperature	-.411E-01	-3.8592**
Altered Climate Range	.5112	1.7252
Changed timing of rains	-.171E-01	-3.5563***
Frequency of Droughts	-.7651	-.2492
Noticed Climate Change	.5272	1.4342
Cereal/legume Intercropping	.5773	2.7373**
Mulching (1/0)	.212E-05	2.0602*
Zero Tillage (1/0)	833E-06	2.788***
Making Ridges across Farms (1/0)	.617	2.3767**
Farm size in Hectares	.727E-07	2.5164*
Owned heavy machines (1/0)	-.814E-01	- 3.9041***
Household size	-.134E+11	-4.0854***
Farming experience	.5166E-04	2.5249*
Educational status	.1152	4.0851***
Age of Farmers	.2464	.3619
Access to extension facilities (1/0)	.3517	2.6071**
Access to credit facilities (ACCRE) (1/0).	.2516	1.8651*
Sex (1/0)	-.5210	-.9464

*** = Significant at $p<0.01$, ** = Significant at $p<0.005$, * Significant at $p<0.001$
Log-likelihood function: -198.86, Significance level: (P<00001) Constant = 0.62
Number of observations is 180.

Source: Computer Printout of Logit Regression Analysis

In summary, the results revealed that fall in temperature influences the probability of switching away from mono-cropping more than changes in increased temperature. Similarly, the magnitudes of the marginal coefficients suggest that low outputs warning is a strong factor influencing the probability of switching to other systems that are better adapted to changes in temperature. Better access to extension and credit services seems to have a strong positive influence on adaptation.

In addition, access to other farm assets such as heavy machinery is found to promote the tendency to embark on large-scale farming. These results suggest that capital, land and labor serve as important factors for coping with adaptation. The choice of the suitable adaptation measure depends on factor endowments (i.e. family size, land area and capital resources). The more experienced farmers are, the more they are likely to adapt. Sex of the farmer did not seem to be of significance in influencing adaptation, as the marginal effect of the coefficient was statistically insignificant and signs are not suggestive of any discernible pattern. These results suggest that it is the experience on the farm rather than gender that matters for consideration on issues of adaptation to climate change.

CONCLUSION

It is evidenced from this study that arable food crop farmers are experiencing extreme climate events and being aware, they have started devising some means to survive. Farming experience and access to education were found to promote adaptation. Local people need to understand the possible impacts of climate change and how they could be affected so that they could get themselves prepared against the attendant disaster. This implies that education to improve awareness of potential benefits of adaptation is an important policy measure. Some of the coping strategies currently in place can only assist them in the short term and cannot deal with increased and more severe shocks. However, these survival strategies can serve to provide important lessons for how they can better prepare and adapt to climate change in the long-term.

Due to low outputs from farms, resulting from low rainfall and increased temperature, farmers appear to be abandoning mono-cropping for mixed cropping and mixed crop-livestock systems. The shift of emphasis from farming to non farm work is unfortunately one of the other forms of farmer's perceived long-term adaptation strategies.

This study also affirms that some arable crop farmers still believe in spiritual angle for the occurrence of global warming, but their experience indicated frequent inconsistencies in climate variables, though people's responses to the issue is low. Thus, there is the need to design strategies that could help the farmers/rural communities' respond effectively to global warming. This is in line with the recognition that the process of formulating policies related to natural resource management and rural development should be consultative, participatory and non-sectoral. Other stakeholders in agricultural sustainability must be worked with; such as the Agricultural Economists, Agro climatologists, Meteorologists, Agricultural Extensionists and Rural Sociologists for early warning alerts and interpretations in the language useful to farmers/rural communities. This will create an opportunity for natural resource management and rural development to be addressed in a more integrated way at the local level.

RECOMMENDATION

The role of government in educating the public on climate change and in providing other information that could enhance livelihood strategies is sine qua non.

There is an urgent need for meteorological reports and alerts to be made accessible (when necessary) to farmers in understandable forms. A combination of print, electronic and other forms of media should be used to maximize dissemination and accessibility to the end users.

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RAINFALL PATTERN AND ADAPTIVE STRATEGIES: A CASE STUDY OF TWO CITIES IN NORTH- WEST OF NIGERIA

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Abstract

Climate change is a global problem with its adverse impact as drought desertification resulting from inconsistent rainfall coastal flood and erosion due to a rise in sea level. This paper presents rainfall pattern of North- west Nigeria (Sokoto and Kebbi). Rainfall data were collected for over 90 years (1915-2007). These data were grouped into five and statistically treated (mean, standard deviations and maximum). Unit hydrograph of the rainfalls were computed and analyzed statistically. The statistical parameters were analyzed by using analysis of variance and adaptive strategies of the people were studied.

The study revealed that rainfall in these cities changed with the period (1915 – 2007). Climate change has significant effect on the mean rainfall along the group (F = 78.65 and 79.11 for Sokoto and Kebbi respectively), on yearly rainfall (F= 36.82 and 36.49) and on the maximum rainfall (F= 2.58 and 2.57).

It was concluded that there is a significant change in the rainfall pattern in the area, utilization of ponds (surface water) and ground water sources in the raining and dry season respectively are the adaptive strategies toward drought, with boating and concrete walkway as means of transportation in the flood zone.

INTRODUCTION

In Nigeria, agriculture is the dominant sector of the economy after crude oil. It contributes 41.73 percent to the Gross Domestic Product (GDP) in 2006 (National Bureau of Statistics, 2007) and generating employment for well over 70 percent of the labour force. It is also the available means of livelihood for the largely illiterate population residing in rural areas. The cumulative effect of the problems that had befallen the agricultural sector, especially in the 1980s and 1990s makes poverty to be highly concentrated among farming households. By implication, therefore, whatever affects the agricultural sector is bound to affect the lives of millions of people. However, recent fluctuations in weather variables, with its cumulative impact on climatic factors are part of the problems affecting agricultural production in Nigeria. In addition to these are several other climate-induced problems in the form of drought, flooding, desertification and soil degradation (Oyekale et al., 2009*)*. Nigeria's high vulnerability to climate change stems first from its geographical location (in the tropics and with a long coastline) and secondly, from being a developing country with little capacity to adapt to climate change due to low levels of awareness, human and financial resources; institutional and technological capability.

Changes in climate will interact with other forms of stress associated with agricultural production and affect crop yields and productivity in different ways, depending on the types of agricultural practices and systems in place (Watson et al., 1997). The main direct effects will be through changes in temperature, precipitation, length of growing season, and timing of extreme or critical threshold events relative to crop development. Analyzing the impact of climate change on Nigerian farm households, which are worst affected by poverty, is desirable for some reasons. The overall aim of this study is to evaluate and characterize rainfall from the extreme of North-west of Nigeria and adaptive strategies of the people.

Northern-Nigeria is located in semi- arid area (Figure 1). Rainfall in this region is low and unpredictable. Also, water consumption and supply in the region and the country is below water poverty line of 1000 m^3 per annum (Oke, 2010; Jarrah et al., 2010). It is widely known that Nigeria is facing increasing water difficulties and will continue to do so, in coming years unless solutions are provided. Population growth of the country is expected to continue at 3.0 % per annum while agricultural intensification programme of the government is expected to add to the national water burden. Over abstraction of groundwater in the northern region has resulted in significant falls in groundwater table in the region specifically in Iullemeden area. The situation is exacerbated by possible changes in the seasonal pattern of rainfall in Iullemeden region (Iullemeden is one of the major aquifer systems in the world Table 1a and b).

MATERIALS AND METHOD

Rainfall data from 1915 to 2007 were collected for two selected cities (Kebbi and Sokoto) in North- West of Nigeria from institutions, local government headquarters, state and Federal government archives (Ministry of Water Resources; NIMET Abuja; etc). These data were grouped into five main groups and analysed statistically by using analysis of variance (ANOVA) to establish effects of change on the rainfall data. Unit hydrographs were developed from the statistical parameters (mean and maximum) and adaptive strategies of the people were studied.

RESULT AND DISCUSSION

A change in this collective pattern of expression or the permanent departure of climatic patterns from mean values of observed climate indices is known as climate change (Obioh, 2002). Figures 2 (a to d) represent rainfall data (mean and maximum) for the selected states (Sokoto and Kebbi) respectively. From the figure it can be seen that rainy season of these cities starts in the month of May or June atimes (that is rainfall $\geq$ 1.0 mm/ day) and ends in the month September. This indicates that dry season in the cities starts from October every year and ends in April or May atime (longer dry season than rainy season). Also, from the figure the pattern of the rainfall is the same for all the groups, but difference in rainfall were observed as the year moves from 1915 toward 2007. Tables 2 and 3 show statistical values of the rainfall data of the study areas, while statistical analysis using analysis of variance (ANOVA) revealed that there is a significant difference between mean yearly rainfall and among the group at 90 % confidence level. For Sokoto the F- values were 78.65 and 36.82 for yearly mean and maximum rainfall respectively, while the F-values for mean and maximum rainfall along the group were 2.58 and 8.00 respectively. Also, for Kebbi the F- values are 79.11 and 36.49 for yearly mean and maximum rainfalls respectively, while the F-values for mean and maximum rainfall along the group were 2.57 and 2.65 respectively. These results indicate that there is a significant change in the rainfall pattern and climate change has influence on rainfall.

Figure 3 represents the unit hydrograph of mean and maximum rainfall of the study area and figure 4 indicates the effective rainfall (mean and maximum) for the study areas. From the figures and the statistical analysis, it was revealed that there is no significant difference between the unit hydrograph (F = 0.00) along the groups and yearly. This result indicates that rainfall intensity and runoff yearly had the same unit shape and pattern.

Previous studies on climate change

Oyekale (2009) stated that the entirety of the human systems (water resources, agriculture, forestry, fisheries, human settlements, energy systems, industry and human health) will be affected by climate change. These changes can be due to: decreased water availability in many arid regions, affecting agriculture and hydro-power generation; widespread increase in the risk of flooding for many human settlements from both increased heavy precipitation events. Also it will affect people living in river valleys and sea-level rise. It can affect people in low lying coastal areas; altitudinal and pole ward shifts in climatic patterns, growing seasons and ranges of plant and animal species. It will affect in general reductions in potential crop yield in most tropical and sub-tropical regions; and loss of biodiversity and extinction of some vulnerable species, among others. Oyekale (2009) study revealed that there is need for pragmatic approach in devising adaptation strategies against adverse climatic changes. The northern part of Nigeria should be given special attention due to the expected negative impact of climatic variability on their returns to agriculture and welfare. For example, the location of Sokoto and Kebbi puts both squarely between latitude 12^{o} N and 14^{o}N in the Sudan Sahel vegetation zone. This is a sensitive zone where intensive agriculture including animal breeding takes place. The result is frequent drought and desertification at a rate of 0.6km per annum.

Figure 1: Map of Nigeria showing 36 states and Federal Capital Territory

Table 1a: Some major aquifers containing predominantly non-renewable groundwater resources

COUNTRY	AQUIFER SYSTEM	EXTENSION (km^2)	EXPLOITABLE RESERVES (Mm^3)	CURRENT EXTRACTION (Mm^3/a)	RECENT REFERENCES
Egypt, Libya, Sudan, Chad	Nubian Sandstone	2,200,000	14,460,000	2,170,000	UNESCO-IHP (2006) Bakhbakhi, (this volume), OSS (2003
Algeria, Libya, Tunisia	North Western Sahara	1,000,000	1,280,000	2,560	Pallas and Salem (1999), OSS (2003)
Algeria, Libya, Niger	Murzuk Basin	450,000	60 to 80,000	1,750	Salem (1992), OSS (2003)
Mauritania, Senegal, Gambia	Maastrichtian	200,000	480 to 580,000	265	Khouri (1990), OSS (2003)
Mali, Niger, Nigeria	Iullemeden Multilayer Continental	500,000	250,000 to 2,000,000	225	Dodo (1992), OSS (2003)
Niger, Nigeria, Chad, Sudan, Cameroon, Libya	Chad Basin	600,000	170 to 350,000	250	Terap (1992), OSS (2003)
Botswana	Central Kalahari Karroo Sandstone	80,000	86,000	2,890	Carlsson (1993)
Saudi Arabia, Bahrain, Qatar, UAE	Various	225,000 to 250,000	500,000 to 2,185,000	13,790	Abderraman (this volume)
Jordan (only)*	Qa Disi Aquifer	3,000	6,250	170	Garber and Salameh (19
Australia	Great Artesian Basin	1,700,000	170,000	600	Habermehl (this volume)

Note:
* Extends into Saudi Arabia, where it is included in the entry above

(Source: FMWR, 2010)

Table 1b Trans-boundary Aquifers in Africa

Aquifer	Countries
Nubian Sandstone Aquifer System (NSAS)	**Chad, Egypt , Libya, Sudan**
Iullemeden Continental Sedimentary Aquifer	**Mali, Niger, Nigeria (Algeria, Benin)**
Northern Sahara Aquifer System (NSAS) [Grand Erg Oriental]	**Algeria, Libya, Tunisia**
Coastal Marine Sedimentary basins	Angola, DRC, Mozambique, Namibia, S. Africa, Tanzania
Coastal Marine Sedimentary basins	Kenya, Tanzania
Basement complex aquifers	Tanzania, with Burundi, Rwanda, DRC
Volcanic aquifer systems (Kilimanjaro)	Kenya, Tanzania
Alluvial deposits in deltas (Kagera, Ruvuma	Tanzania with Uganda resp Mozambique
Congo Intra-cratonic - Continental basin	DRC, Angola
Northern. Kalahari /Karoo basin	Angola, Botswana, Namibia, Zambia
South-Eastern Kalahari /Karoo basin	Namibia, Botswana, S. Africa
Karoo Sedimentary Aquifer	Lesotho, S. Africa
Nata Karoo sub-basin	Botswana, Namibia, Zimbabwe
Tuli Karoo sub-basin	Botswana, South Africa, Zimbabwe
Karoo Sandstone aquifer	Mozambique, Tanzania
Ramotswa Dolomite basin,	Botswana, South Africa
Shire Valley Alluvial aquifer	Malawi, Mozambique
Suture zones, Medium Zambezi	Botswana, Mozambique, S. Africa, Zimbabwe
Limpopo Basin	Mozambique, Swaziland
Rhyolite-Breccia aquifer (Mhlumeni Border)	Mozambique, Swaziland
Merti Aquifer	Kenya, Somalia
Volcanic Aquifers EA Mount Elgon, and Mfumbira resp.	Uganda with Kenya and Rwanda, DRC
Regolith, Rift Aquifers	Uganda with Sudan and with Kenya and Tanzania
"Shallow Quartenary Aquifers"	Burkina-Fasso, Ivory Coast, Mali, Sénégal
Coastal multi-Aquifer System (continental, quaternary, limestone)	Ghana, Ivory Coast
Coastal Sedimentary Aquifer System (Dahomeyan Basin)	Benin, Nigeria, Togo,
Senegal- Mauritania	Gambia, Guinee-Bissau, Mauritania, Senegal
Toudéni	Algeria, Mali, Mauritania
Tin-Séririne basin in the Tassili Oua N'Ahaggar (*bassin du Tafassasset*)	Algeria, Niger
Djado- Bilma Basin	Niger, Libia, Chad
l'Aïr (discontinued) cristalline basement aquifer	Algeria, Mali, Niger
Liptako-Gourma, (discontinued) cristalline basement aquifer	Bourkina Fasso, Niger
Chad Aquifer Basin	Central African Republic, Chad, Cameroon, Niger, Nigeria
Errachidia	Algeria, Morrocco
Tindouf	Algeria, Morocco (Sahara),
Morzuk Djado	Algeria, Libya, Niger
Upper Nile (Nubian)	Ethiopia, Sudan
Ogaden - Juba	Ethiopia, Kenya Somalia,
Awash Valley Sedimentary Aquifer	Djibouti, Ethiopia

Source: FMWR, 2010

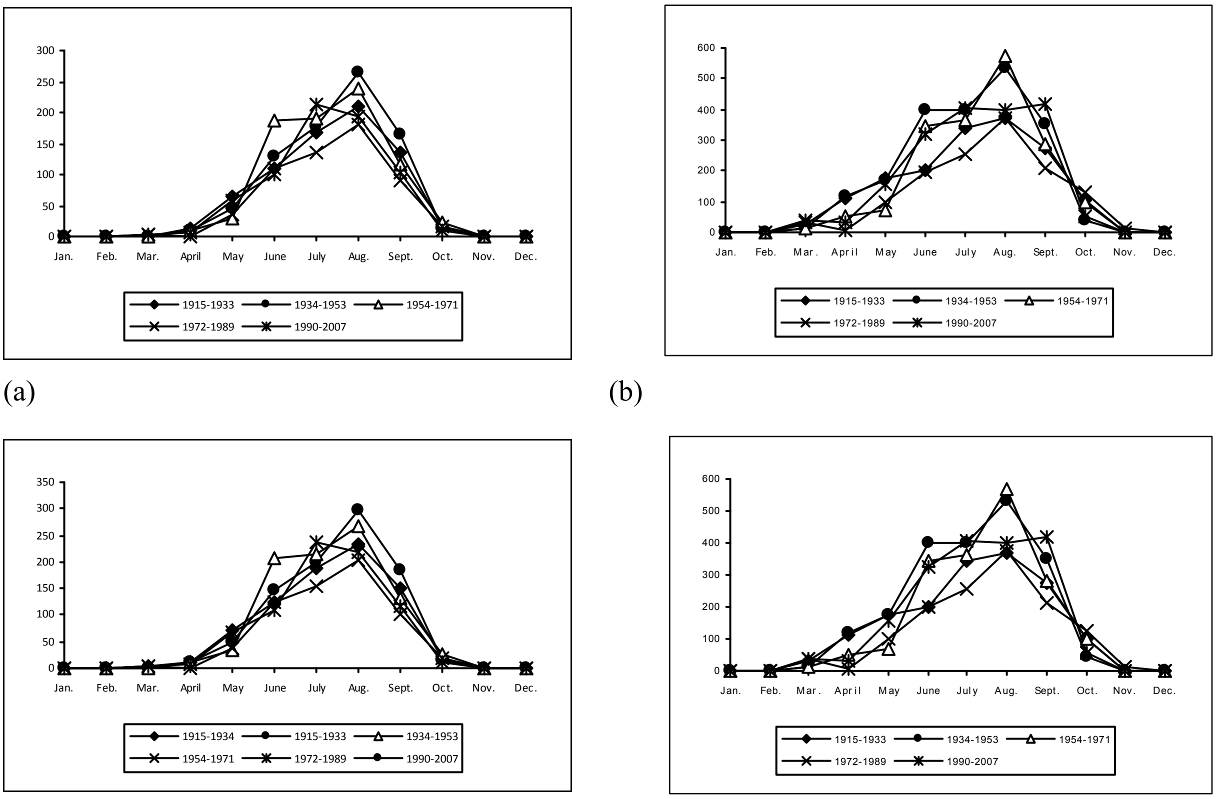


Figure 2 Rainfall data from the study area

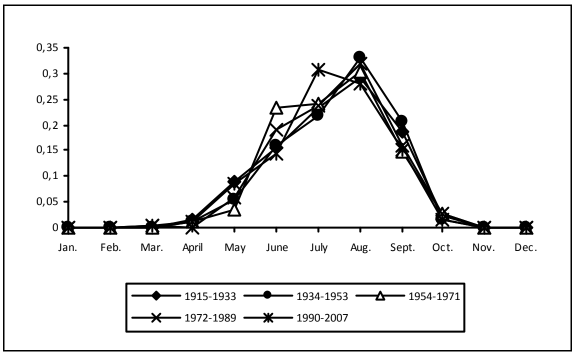
(a) Monthly mean for Sokoto (b) Monthly maximum for Sokoto
(c) Monthly mean for Kebbi (d) Monthly maximum for Kebbi

Table 2 Statistical parameters of rainfall data for Sokoto

Groups	Statistical Parameters	January	February	March	April	May	June	July	August	September	October	November	December
Group A (1915-1933)	Mean (mm)	0	0	1	12	64	110	167	209	134	16	0	0
	Maximum(mm)	0	0	26	99	154	182	305	331	245	91	0	0
	SD	0	0	6	24	41	48	70	85	69	24	0	0
Group B (1934-1953)	Mean (mm)	0	0	1	11	45	130	176	266	166	14	0	0
	Maximum(mm)	0	0	9	105	154	355	355	475	312	37	0	0
	SD	0	0	2	26	40	80	59	102	73	13	0	0
Group C (1954-1971)	Mean (mm)	0	0	1	10	29	186	191	240	117	22	0	0
	Maximum(mm)	3	3	9	45	63	306	326	510	254	89	0	0
	SD	1	1	2	13	16	67	74	92	63	29	0	0
Group D (1972-1989)	Mean (mm)	0	0	3	1	34	110	137	182	91	15	0	0
	Maximum(mm)	0	0	31	7	89	176	229	335	188	114	9	0
	SD	0	0	8	2	30	42	41	67	39	28	2	0
Group E (1990-2007)	Mean (mm)	0	0	3	7	59	99	213	194	104	10	0	0
	Maximum(mm)	0	3	33	31	141	288	362	356	375	49	0	0
	SD	0	1	8	10	42	74	80	76	88	14	0	0

Table 3 Statistical parameters of rainfall data for Kebbi

Groups	Statistical Parameters	January	February	March	April	May	June	July	August	September	October	November	December
Group A (1915-1933)	Mean (mm)	0	0	2	13	72	123	187	234	150	18	0	0
	Maximum(mm)	0	0	29	111	173	203	341	371	275	102	0	0
	SD	0	0	7	27	46	54	78	95	77	27	0	0
Group B (1934-1953)	Mean (mm)	0	0	1	13	50	145	198	298	186	15	0	0
	Maximum(mm)	0	0	10	118	172	398	398	532	350	41	0	0
	SD	0	0	2	29	45	89	66	114	82	15	0	0
Group C (1954-1971)	Mean (mm)	0	0	1	11	33	208	214	268	131	25	0	0
	Maximum(mm)	3	3	10	50	70	343	365	571	284	99	0	0
	SD	1	1	3	15	18	75	83	103	70	32	0	0
Group D (1972-1989)	Mean (mm)	0	0	3	1	38	123	154	204	102	17	1	0
	Maximum(mm)	0	0	35	8	100	197	257	375	211	128	10	0
	SD	0	0	9	3	33	47	46	75	44	31	2	0
Group E (1990-2007)	Mean (mm)	0	0	3	8	66	111	238	218	117	11	0	0
	Maximum(mm)	0	3	37	34	158	322	405	398	420	54	0	0
	SD	0	1	9	11	47	83	90	85	98	16	0	0



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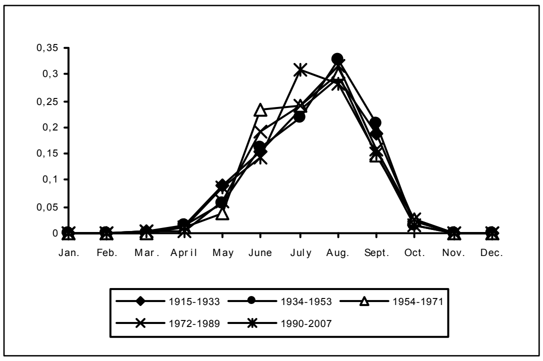

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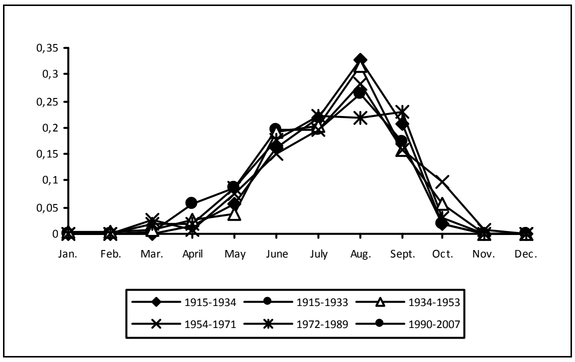

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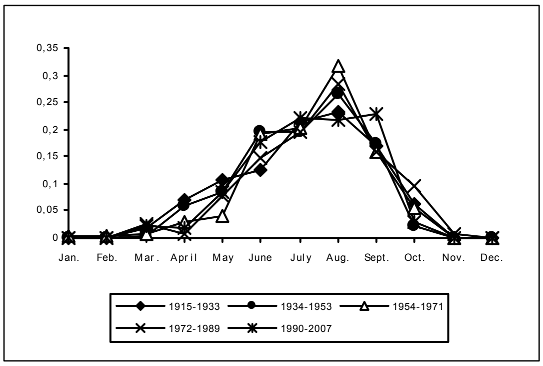

(d)

Figure 3 Unit hydrograph of the Rainfall data from the study area

(a) Monthly mean for Sokoto (b) Monthly maximum for Sokoto
(c) Monthly mean for Kebbi (d) Monthly maximum for Kebbi

Mayowa and Omojola (2005) observed a decrease in rainfall over a 60 year period in most of the Northern part of Nigeria in agreement with the present observation on rainfall pattern and intensity. Mayowa and Omojola (2005) presented effects of climate change on rainfall and land cover in Nigeria. From their studies some regions have rainfall increase while some regions have decrease in rainfall resulting in floods and drought respectively. These changes led to changes in land cover such as undisturbed forest, sand dunes, flood plain.

Adaptive Strategies: Traditional sources of water supply to the population in the project area are the rivers, lakes, pools, wells, seepages and springs. The surface water (rivers) is in use during the rainy season. In the dry season when most rivers cease to flow, water is obtained from shallow pits dugs in the river alluvium or stagnant ponds. Seasonal ponds, locally called "tabkuna" occupy clayey depressions. They are quite common in the sedimentary rocks less on the basement complex. They make a seasonal inhabitation of the area possible, where a crop is grown during the rainy season and Fulani graze their cattle. With the drying up of these ponds the population migrates to places with permanent water. All these traditional means of water supply are the source of much disease since the people and their stock wade into the water. Beside pollution by filth, water borne diseases such as amoebic dysentery, guinea worm and bilharzias are common frequent. Better resources are spring and wells. Springs are very common during the rains, but most of them cease to flow in the dry season.

CONCLUSIONS

Based on the study it can be concluded that:

- there is a significant change in the rainfall pattern in the area,
- utilization of ponds (surface water) and ground water sources in the raining and dry season respectively are the adaptive strategies toward drought,
- utilization of boating and concrete walkway as means transport in the flood zone.

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DETERMINANTS OF FARM INCOME IN THE PERI-URBAN AGRICULTURE OF ILE-IFE, OSUN STATE, NIGERIA

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Abstract

This paper analysed peri-urban agriculture in Ile-Ile, Osun State, Nigeria. Data were collected from 100 randomly selected farmers on their socio-economic characteristics and income distribution. Data were analysed using descriptive and inferential statistics. Results showed that old age farmers, both male and female were engaged in peri-urban farming. The majority of household had size between 6 to 10 members with long experience in peri-urban farming. The major crops cultivated included maize, cassava, vegetables, yam and cocoa with cassava as the source of highest farm income followed by cocoa. Farmlands were acquired mostly by inheritance. The points of sale of farm output comprised farm gate, market, and cooperative, while age and formal education were the main determinants of peri-urban farm income.

INTRODUCTION

Agriculture plays a pivotal role in the economy of Nigeria as it provides food and raw materials for the citizen and the industry. Agriculture is both for commercial and subsistence purposes. The commercial farming is intensive and industrial in nature involving large farmland cultivation or large number of livestock rearing using huge amount of inputs, with the ultimate aim of maximizing profit, while the subsistence farming which is practiced on a small area uses less inputs with the objective of producing enough food mostly for family consumption.

Peri-urban agriculture is referred to as the practice of agriculture in peri-urban areas by peri-urban residents. The most striking feature of peri-urban agriculture which distinguishes it from rural agriculture is that, it is integrated into the urban economic and ecological system (RUAF Foundation, 2010). Such linkages include the use of urban residents as labourers, use of urban resources (like organic waste as compost, and urban waste water for irrigation), having direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of urban food chain system, competing for land with other urban activities, being influenced by urban policies and plans (RUAF Foundation, 2010). Peri-urban agriculture also involves provision of food product from different types of crops and animals products. In this type of agriculture, production and marketing tend to be more closely interrelated in terms of time and space than rural agriculture. This is due to large geographic proximity and quicker resource flow between the peri-urban and urban centres. Although in most developing countries an important part of peri-urban agricultural is for self consumption, with surpluses being sold. The importance of the market oriented peri-urban agriculture, both in volume and economic value, should not also be underestimated. Products are sold at farm gates, in local shops, on local (farmers) markets, or to intermediaries. Mainly fresh products are sold but part of it is processed for home use, cooked and sold on the streets, or processed and packaged for sale (RUAF Foundation, 2010).

In the literature different authors analysed the characteristics of peri-urban agriculture. Stevenson et al. (1996) insists on the need to distinguish between agriculture "in the peri-urban zone" and "peri-urban agriculture". To build a useful and viable peri-urban agriculture edifice requires much materials and engineering than assembled so far (Mougeot, 1999). Few authors actually distinguished between intra and peri urban locations. For those using intra-urban agriculture, criteria considered are: population size, density threshold, official city limits, municipal boundaries, agricultural use of land zoned for other use (Mbiba, 1994), agriculture within the legal and regulatory purview of urban authorities (Aldington, 1997). In comparing rural and urban agriculture, Moustier (1998) defined urban agriculture as that which is carried out within or on the outskirts of a city where a non agricultural use of land resources is a real option, while rural agriculture is found in areas where this option is not an issue. In the CIRAD Agricongo study of market vegetable farming in Brazzaville, for instance, gardens within the city limits are labelled "intra urban" whereas those off limit (within certain travel-time band) are called "peri-urban" (Moustier, 1999). Mougeot (1999) also observed that although peri-urban agriculture has been growing in absolute terms in most cities, its contribution to urban food supplies relative to rural agriculture and import varies, depending on product and season. Peri-urban agriculture critically flattens price/variety seasonality by lessening dependence on off-season imports, or making up for reduced supplies from rural agriculture during the dry season. Moustier (1998) reported that volumes marketed and transportation costs are larger in rural agriculture, while marginal sale profits and bargaining power of producers against traders are higher in peri-urban agriculture. Mougeot (1999) observed that fewer levels of trade and a higher percentage of producers are involved in the trade of peri-urban agriculture than in rural agriculture and imports. Data available from different sources indicate that peri-urban agriculture makes an important contribution to employment and income generation. In early 1990s, agriculture provided the highest self-employment earnings in small scale enterprises in Nairobi and the third highest earnings in all of urban Kenya (House et al. 1993). Freeman (1991) estimated the value of Nairobi farmers' 1987 annual income (two seasons) off-plot crop production alone to be USD 4 million. The peri-urban agriculture effect on the rest of the urban economy has not been quantified (Mougeot, 1999). Peri-urban agriculture requires inputs and human resources for fencing, crop management, storage, transportation and processing. Income from peri-urban agriculture is used to buy processed food, appliances, clothes, and service and can be invested into other smaller businesses. In spite of the viability and vibrancy which the economy of peri-urban agriculture may appear to enjoy as a result of nearness to the urban centres, there is need to evaluate the determinants of income in peri-urban farming and identify the elements of increasing productivity and ensuring income sustainability.

METHODOLOGY

The study was carried out in four (4) peri-urban areas (Ajebandele, Agric, Iyan -Foworogi and Ayepe-Olode) of Ile –Ife which is located in the southwest of Nigeria. The state has a population of 2,203,070 people and made up of 33 local governments areas among which are Ife Central and Ife East LGAs where the study was carried out. The two climatic seasons in the area are the rainy season and the dry season. The rainy season starts in March to end in October, while the dry season starts in November and ends in February. Annual rainfall is 1,570 mm and the temperature ranges from 25^0C to 27.5^0C. Primary data were obtained through structured questionnaire administered to farmers in the area. A total of 100 farmers were sampled. The information obtained included: economic status of respondents, number of years in farming, sources of farm-land, target consumers, effects of urbanisation on types of crops grown, land availability, information on inputs used and outputs, including information on age, sex, marital status of the respondents. Methods of data analysis included descriptive statistics, simple regression and cross-tabulation analysis using Chi^2. Descriptive techniques were used to analyse the socio-economic characteristics of farmers using frequencies and percentages. The determinants of farm income were assessed using a regression analysis. The following functional forms were estimated for best fit:

Linear function: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_6 X_6 + U$

Semi-linear : $Y = \delta_0 + \delta_1 LnX_1 + \delta_2 LnX_2 + \ldots + \delta_6 LnX_6 + \mu$

Double Log function: $LnY = \alpha_0 + \alpha_1 LnX_1 + \ldots + \alpha_6 LnX_6 + \varepsilon$

Where, Y = Farm income (₦); X_i = vector of selected socio-economic variables with i= 1..6

β_0 = Constant ; $\beta_1 ... \beta_6$ = regression coefficients and U= Stochastic term (error term)

RESULTS AND DISCUSSION

Socio-economic characteristics

Table 1 shows the distribution of the respondents' socio-economic characteristics. The proportion of farmers within the age range of 47-56 was the highest, followed by 57-66 years with 34% and 25% respectively, while the proportion within the bracket 27-36 and 37-46 were 12% and 10% respectively. This means a relatively aged farming population when considering the national life expectancy at birth of 49 years (UN report, 2010-2015). This adversely affected productivity in the area. The sex distribution showed a higher proportion of male (66%) relatively to female (34%) as expected. In term of education 28% of farmers had no formal education, while another 28% got formal education to the level of OND, 35% had secondary education and 10% stopped their education at primary level while 09% were university graduates. This result shows that a higher proportion of the respondents had some level of formal education which may ease adoption of agricultural innovations and improve productivity. Sixty – five percent (65%) of the respondents had household size of 6 to 10 members, 20% had 1-5 members, and 10% had 11 to 15 members. The relatively high proportion of large household sizes is likely to positively influence productivity and farm income as it implies reduction in the cost of hired labour for farming. The farming experience showed that 26% of respondents have experience in peri-urban agriculture of less than 25 years, 44% between 26-40 years and 30% above 40 years. The relatively high level of experience in farming may influence productivity and farm income positively as less trials and errors would be involved. The source of farmland showed the following results: lease (36%), inheritance (35%), purchase (15%), family land (8%) and rent (6%). The total number of respondents on inheritance, purchase and family lands amount to 58%. This suggests that more respondents will feel secure in making long term investment on their farmland. The types of crops cultivated were maize (89%), cassava (76%), vegetable (52%), yam (44%), cocoa (20%), etc. Maize, cassava, and vegetable were therefore the most demanded crops in the area. The results also showed that 43% of the respondents earned between ₦51,000 and ₦100,000 annual income, 28% had less than 50,000 and 13% earned between ₦100,000 and ₦ 150,000 while 16% earned over ₦150,000. The relatively low level of income realized could be as a result of the scale of peri-urban agriculture practiced. The points of sale of farm produce included farm gate (37%), market (26%), market and farm gate (26%), cooperative (11%). The low sales through cooperative despite the advantages may be traced to low membership of farmer's association and this is likely to negatively affect farm income. Effectively, only 30% of peri-urban farmers were member of association against 70% who did not. This implies less opportunity for increasing farmers' market power. The sources of greatest farm income were cassava (55%), cocoa (21%), vegetable (15%) and maize (9%). The highest proportion to cassava sees cassava as substitute for cocoa in terms of cash provision when contrasting with the past.

Table1: Socio-economic characteristics of respondents

Age (years)	Frequency	Percentage
17 – 26	13	13
27 – 36	12	12
37 – 46	10	10
47 – 56	34	34
57 – above	31	31
Sex	**Frequency**	**Percentage**
Male	66	66
Female	34	34
Total	100	100
Level of Education	**Frequency**	**Percentage**
None	28	28
Primary	10	10
Secondary	25	25
Secondary and OND	28	28
Bachelor	09	09
Total	100	100
Household size	**Frequency**	**Percentage**
1 -5	20	20
6 -10	65	65
11 – above	15	15
Total	100	100
Farming experience	**Frequency**	**Percentage**
00 – 25	26	26
26 – 40	44	44
Above 40	30	30
Total	100	100
Source of farmland	**Frequency**	**Percentage**
Purchase	15	15
Lease	36	36
Rent	06	06
Inheritance	35	35
Family	08	08
Total	100	100
Crops cultivated	**Frequency**	**Percentage**
Cassava	76	76
Cocoa	20	20
Maize	89	89
Vegetable	52	52
Yam	44	44
Cocoyam	09	09
Pepper	08	08
Others	14	14
Total	100	100
Annual farm income	**Frequency**	**Percentage**
Below 50,000	28	28
51,000 – 100,000	43	43
101,000 – 150,000	13	13

150,000 - above	16	16
Total	100	100
Point of sale of farm produce	**Frequency**	**Percentage**
Market	26	26
Farm gate	**37**	**37**
Cooperative	11	11
Market/Farm gate	26	26
Total	100	100
Source of highest farm income	**Frequency**	**Percentage**
Cassava	55	55
Cocoa	21	21
Maize	09	09
Vegetable	15	15
Total	100	100
Membership of Association	**Frequency**	**Percentage**
Yes	30	30
No	70	70

Source: Survey Data

Determinants of farm income: The lead equation out of the three functional forms regressed was selected based on the best fit. In Table 2, the result of the linear regression analysis shows a significant regression with F-value of 3.65 significant at 1%. The coefficient of multiple determination R^2 of 0.13, indicates that the selected socio-economic variables explained only 13.8 % of total income variability. Of all the variables only the coefficients of age and the level of education were significant at 5% and 1% respectively. This result implies that age and years of formal education were the main determinants of income among peri-urban farmers.

Table 2: Determinants of farm income

Independent variables	Coefficients	t- value
Constant	0.729	0.348
Age	0.022**	2.33
Sex	-0.369	-0.903
Level of formal education	0.004***	2.97
Family size	-0.794	-0.262
Farming experience	-0.752	-0.317
Farm size	-0.126	-1.542
Adj. R^2 = 0.13; F = 3.65***		

***; **: coefficient significant at 1 and 5 percent level respectively.

CONCLUSION AND RECOMMENDATION

Peri-urban agriculture in the area is characterised by an aged farming population, educated, and a relatively high family labour availability. Access to farmland was mostly by inheritance which is an opportunity for investment on farmland. Highest sources of cash in farming were cassava followed by cocoa and vegetable. The determinants of farm income were age and the level of education. The sustainability of peri-urban agriculture in the study area is threatened by the poor economic status of respondents. Furthermore the study reveals that urban demand is a major determinant of the types of food crops cultivated. It is recommended that the economic status of farmers be enhanced through provision of subsidies and loans to experienced and educated farmers, while farmers be sensitized on the need to join farming groups so as to improve they market access and reduce their cost of production. Land reform policy which seeks to secure peri-urban farmlands should also be promoted.

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EFFECTIVE SOLID WASTE MANAGEMENT AMONG PERI-URBAN HOUSEHOLDS IN EGBEDA AND OLUYOLE LOCAL GOVERNMENT AREAS OF OYO STATE, NIGERIA

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Abstract

The study analyzed the determinants of effective solid waste management among peri-urban households in Oyo state. Multistage sampling technique was used in selecting 80 households in Egbeda and Oluyole LGA of Oyo state. Data were collected using structured questionnaires and analysed using both descriptive statistics and quantitative method (logit regression). The results revealed that the level of education and amount paid for waste collection were positively related to the probability of household awareness of solid waste management/collection service in the area while age and monthly income were negatively related to the probability of household awareness of solid waste management/collection service in the area. Household size was positively related to the probability of household using an effective waste collection services while age, amount paid and level of education were negatively related to the probability of household using an effective waste collection services. The study therefore recommends that the populace should be properly educated on the importance of effective solid waste management by the government through media and public enlightenment, also the amount charged by the service providers should be reviewed downward through subsidization by the government.

INTRODUCTION

Solid waste is referred to as the material that no longer has any value to the person who is responsible for it and it is not intended to be discharged through a pipe (Ajani, 2008). Solid waste generation in Nigeria is increasing at an alarming rate with no corresponding efficient and modern technology for the management of the generated waste (Onibokun and Kumuyi, 1996). It is often characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal of solid waste. Also the changing economic trends and rapid urbanization complicate solid waste management (SWM) in developing countries.

Consequently, solid waste is not only increasing in quantity but also changing in composition from less organic to more paper, packing waste, plastics, glass, metal wastes among other waste and this is a fact leading to the low collection rates (Bartone 1993). The quantity and rate of solid waste generation in the various states of Nigeria depends on the population, level of industrialization, socio-economic status of the citizens and the kinds of commercial activities being predominant. Nigeria, having a population of 120 millions (Sridhar and Adeoye, 2003), generated 0.58Kg solid waste per person per day, and in some Nigerian cities such as: Abeokuta in Ogun state (0.60Kg/person/day), Ado-Ekiti in Ekiti state (0.71Kg/person/day), Akure in Ondo state (0.54Kg/person /day), Ile-Ife in Osun state (0.46Kg/person/day) and Ibadan in Oyo state (0.71Kg/person/day) (Adewumi *et al.*, 2005). About 55,200Kg per day of solid wastes was estimated to be generated in the traditional city of Oyo in Oyo state (Abel and Afolabi, 2007).

Peri-urban area solid waste collection is often more complex compared to urban area and is often characterized with deficient collection, uncontrolled dumping and stock piling. This often times results into water pollution, air pollution, air and water borne diseases, yet no drastic efforts are directed at necessary improvements. Challenges such as risks to health and life, physical hazards which relate to the occupation of unsuitable sites, lack of access to basic water and sanitation and poor housing conditions are some of the environmental problems faced by the peri-urban households.

Past studies (Ajani, 2008, Adewumi *et al.*, 2005 and Onibokun and Kumuyi, 2004) have undertaken to study solid waste generation pattern in Ibadan metropolis and it seems the awareness about solid waste generation in the peri-urban areas are obscured. This paper attempts to expand the scope of knowledge of solid waste management in the peri-urban areas of Oyo state by analyzing the information, to create such awareness that those who are in the field of environmental management may put all hands on deck to rescue the peri-urban areas of Oyo state from the menace of solid waste generation. This study therefore focuses on evaluating the level of household awareness of solid waste management/collection service and factors that determine the employment of effective waste service providers in the study area.

MATERIALS AND METHODS

Study Area

This study was carried out in Egbeda and Oluyole Local Government areas of Oyo state, which are part of the peri-urban LGAs in Ibadan area. Ibadan peri-urban areas of Oyo state were selected being the largest urban centre with high number of peri-urban areas in the state. Egbeda LGA covers a landmass of 185.508 square kilometer and estimated population of 319,388 people. Egbeda LGA is suburb to Ibadan Metropolis and host notable industries such as the Nigerian Breweries Plc, Bode Foams and the Atlantic Carpets, Ajoda New Town are also located in the Local Government Area. Oluyole LGA covers a land area of 635.384 square kilometers and estimated population of 229,951 people. Oluyole Local Government is a home for small, medium and large scale industries. The two LGA were selected because of their phenomenal population explosion which is a mixture of rural and urban dwellers and sporadic physical development.

Sampling Technique

A multi-stage sampling technique was used in selecting the respondents. The first stage is purposive selection of the peri-urban Local Government Areas (LGAs) in Ibadan area (being the largest urban centre with high number of peri-urban areas in the state). The second stage involved the random selection of two LGAs from the Ibadan peri-urban which is Egbeda and Oluyole LGAs. The third stage is random selection of two wards from each LGAs (four wards) while the fourth stage is the random selection of four areas in the wards selected. The final stage involved the selection of households from the areas based on probability proportionate to size of the areas. The information obtained was coded and analyzed through the use of descriptive statistics: frequency count, percentage and quantitative techniques: logit regression analysis. Logit model was used to determine the factors that affect household awareness of solid waste management/collection service in the area and household probability of using an effective waste collection services.

Logit model

The model is expressed as: $P = \frac{1}{1+e^{-zi}}$ 1

$where \;\; Z_i = \beta_1 + \beta_2 X_1$

Pi is a probability that:, *Xi* is a set of independent variables, β_1 is the constant term

Logit model was used in the study to:

1. Determine the factors that influence the household awareness of Solid Waste Management/Collection Service in their Location/Area: The logit model for the

household aware of SWM/collection is expressed as: $Y_i = \beta_i + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 + \beta_8 + \beta_9 + v_i$, where Y = household response to awareness of SWM/collection question which is either 1 if Yes or 0 if No, βi = constant βi = partial slope coefficient of X_1 = Age (years), X_2 = Marital Status, X_3 = Education (Number of years spent in school), X_4 =Household size, X_5= Occupation, X_6 = Monthly income (Naira), X_7 = House ownership, X_8 = Type of house, X_9 = Amount paid for the service (Naira), v_i = error term

2. Determine the probability of household using an effective waste collection services: Logit model was also used to determine the probability that a household will employ the service of the waste collection services. The logit model is expressed as: $Y_i = \beta_i + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 + \beta_8 + \beta_9 + \beta_{10} + v_i$, where Y = household response to employment of SWM/collection services providers which is either 1 if Yes or 0 if No, βi = constant βi = partial slope coefficient of X_1 = Amount paid for the service (Naira), X_2 = Age (years), X_3 = Marital Status, X_4 = Household position, X_5 = Education (Number of years spent in school), X_6= Household size, X_7 = Occupation, X_8 = Monthly income (Naira), X_9 = House ownership, X_{10} = frequency of waste collection and disposal, v_i = error term

RESULTS AND DISCUSSION

Socio-economics Characteristics

Table 1 presents the basic descriptive statistics on household socio-economics characteristics. An average household in the study area has about six members, average age of 40 years, the respondents spent a minimum of 14 years in school which shows that majority of the respondents have up to tertiary education and an average monthly income of ₦ 35,368.75.

Table 1: Basic Descriptive Statistics on Household Characteristics

Socioeconomic Characteristics	Number	Minimum	Maximum	Mean	Standard Deviation
Household size	80	1	13.00	5.46	1.76
Age (Year)	80	16	80	40.23	10.75
Years of Schooling (years)	80	6	16	14.61	2.27
Average monthly income (Naira)	80	7000.00	150000.00	35,368.75	25,282.3

Source: Field Survey, 2010

Solid waste disposal, waste management awareness and problems encountered

Table 2 shows that 52.5% of the respondents are not aware of solid waste collection services in the study area, about 40% used either a private or public skip while 60% disposed their waste through other means such as open space dumping, burning, road side dumping etc. The table also shows the overall percentage of methods of self disposal by the households, 40% disposed their solid waste through open space burning, 20% dumps in an empty open space. Households who did not use either a private or public skip gave the strongest reason (28.75%) of far residence location, irregular collection (21.25%), far public skip location (20%), and non provision of the service in the area (13.75%).

Table 2: Solid waste management/collection services awareness and methods of disposal

Awareness	**Frequency**	**Percentages**
Aware of the solid waste management service	38	47.5
Not aware of the solid waste management service	42	52.5
Means of Solid Waste Disposal		
Local government authority	6	7.5
Private waste management service	21	26.25
Individual/self	53	66.25
Means of Solid waste disposal		
Local government authority	6	7.5
Private waste management service	21	26.25
Individual/self	53	66.25
Methods		
Open space dumping	16	20
Open space burning	32	40
Road side dumping	12	15
Open gutter dumping	1	1.25
Drum burning	9	11.25
Community incinerator	2	2.5
Flowing stream/river	7	8.75
Open space and gutter dumping	1	1.25
Reasons		
High charges	7	8.75
Far residence location	23	28.75
Far public skip location	16	20
Irregular collection	17	21.25
Service not provided for in my area	11	13.75
High charges and irregular collection	3	3.75
Far residence and irregular collection	3	3.75
Total	80	100

Source: Field Survey, 2010

Problems encountered due to indiscriminate waste disposal

Table 3 presents the problems encountered by the households due to indiscriminate waste disposal options. The major problem encountered by the households due to indiscriminate waste disposal is air pollution (47.5%), unpleasant dump sight (22.5%) and decomposed garbage, other problems includes blocked drainage and flooding (5%), unpleasant smell and air pollution (3.75%).

Table 3: Problems encountered due to indiscriminate waste disposal

Problems	Frequency	Percentages
Air pollution	38	47.5
Blocked Drainage	4	5
Flooding	4	5
Unpleasant dump sight	18	22.5
Disease outbreak	1	1.25
Unpleasant smell	3	3.75
Air pollution and unpleasant dump sight	3	3.75
Decomposed garbage	9	11.25
Total	80	100.00

Source: Field Survey, 2010

Factors influencing the household awareness of Solid Waste Management/Collection Service in their Location/Area

The result of the logit model used to determine the factors that affect the household awareness of solid waste management/collection service in their location/area is given in Table 4. The result reveals that age, education, monthly income and amount paid for waste collection were statistically significant at 10% and 5% respectively. The logit regression shows the following results: (1) The age of the respondents is negatively related to the level of household awareness of solid waste management/collection service in their location/area probability that the employ the waste collection services providers. The result indicates that an increase in age will decrease the level of households' awareness of solid waste management/collection service in their location/area. (2) The number of years spent in school is positively related to the level of household awareness of solid waste management/collection service, the result showed that as the number of years spent in school increases the level of household awareness of solid waste management/collection service will also increase. (3) The monthly income of the household is negatively related to the level of household awareness of solid waste management/collection service in their location/area, this indicates that an increase in income will decrease the level of households' awareness of solid waste management/collection service in their location/area.(4) Amount paid for the waste collection service is negatively related to the level of household awareness on solid waste collection in their area, the result indicates that an increase in amount paid will reduce the level household awareness on solid waste disposal in their area.

Table 4: Result of logit regression: Factors influencing the household awareness of Solid Waste Management/Collection Service in their Location/Area

Variables	Coefficients	T-value	P(Z/Z)
Age	-0.0597877	-1.91	0.056**
Marital status	-0.2618015	-0.52	0.603
Educational level	0.2479727	1.67	0.095*
Household size	-0.0252987	-0.17	0.868
Occupation	-0.778415	-0.24	0.810
Monthly Income	-0.0000214	-1.72	0.085*
House ownership	-0.0911429	-0.37	0.708
Type of house	0.060921	0.12	0.901
Amount paid	-0.0019671	2.80	0.005*

Number of Observations = 80, Prob > Chi sq = 0.0000, Pseudo R sq = 0.5254

LR Chi sq (9) =24.95

Log likelihood = -42.874914

** 5%, * 10%

Factors affecting households' use of an effective SWC

Logit model was also used to determine the probability of household in the area employing a waste collection service provider. The result of the logit model is given in Table 5. The result showed that amount paid for waste collection, age, education and household size were statistically significant at 10% and 5% respectively. Other variables such as marital status, household position, occupation, income, house ownership and frequency of waste collection and disposal do not statistically influence the probability that the households' will employ the waste collection services providers. The logit regression shows the following results: (1) The amount paid for the service is negatively related to the probability that the households will employ the waste collection services providers and is statistically significant at 1% significance level, this implies that the probability of households' employing the waste collection services providers by the households decreases with an increase in amount paid. (2) The age of the respondents is negatively related to the probability that the households will employ the waste collection services providers. The result indicates that an increase in age will decrease the probability of households' employing the waste collection services providers. (3) The number of years spent in school is negatively related to the probability of households' employing the waste collection services providers, the result showed that as the number of years spent in school increases the probability of households' employing the waste collection services providers will decrease. (4) The household size of the respondents is positively related to the probability that the household will employ the waste collection services providers and this indicates that an increase in the household size by 1 will increase the probability of households' employing the waste collection services providers.

Table 5: Result of logit regression: Factors affecting households' use of an effective SWC

Variables	Coefficients	T-value	P(Z/Z)
Amount paid	-0.0011063	-1.88	0.060*
Age	-0.0636509	-2.10	0.036**
Marital status	0.7660356	1.46	0.143
Household position	-0.3518028	-1.16	0.245
Educational level	-0.2219752	1.66	0.098*
Household size	0.2707624	1.70	0.088*
Occupation	0.1015713	0.35	0.730
Monthly Income	0.0000129	1.07	0.284
House ownership	-0.1582861	-0.70	0.483
Frequency of waste collection/disposal	-0.0625034	0.23	0.816
Number of Observations = 80, Prob >Chi sq = 0.000, Pseudo R sq = 0.5737			
LR Chi sq (10) =16.40105			
Log likelihood = -46.9130			

* 10%, ** 5%

CONCLUSION

There is low level of awareness of waste management/collection services in peri-urban area of Oyo state. About 40 percent of the households used either the local government waste authority skip or the private waste management service while other used other indiscriminate solid waste disposal methods like: open dumping, open burning, Road side dumping, dumping in drainages.etc. This shows that the percentage that used the indiscriminate waste disposal options is higher in the study area. Amount paid for waste collection services, educational status, household size and age were factors influencing household use of an effective SWC management in peri-urban of Oyo state. The study therefore recommends the following:

- Government through the Ministry of Environment and Water resources, and Ministry of Health should educate the populace on the importance of effective solid waste management, impact of good solid waste management on health and cultivate the habit of using proper disposal methods. This could be achieved through advertisement and public enlightenment programmes.
- Also, amount charged by the waste collection service providers should be reduced to make the service affordable.
- Local Government Waste Authority in the peri - urban areas should also intensify their efforts in ensuring adequate solid waste collection services and proper management.

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PERI-URBAN FARMING HOUSEHOLDS LIVELIHOOD IN LAGOS STATE, NIGERIA

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Abstract

This paper examined the consequences of urban and peri-urban farming on the socio-economic life of farm households in Lagos state, Nigeria. Specifically, the paper examined the socio-economic characteristics of the households, assesses their income and expenditure profile, examines their livelihoods choices, challenges and coping strategies, and analyses the socio-economic factors influencing their income generating potentials. Using multi-stage sampling procedure, primary data were collected from 180 farm households during the 2008/2009 production season with survey questionnaire, and complemented with focus group discussion. Data were analysed using descriptive statistics, budgetary and regression analyses. Results showed that urban agriculture is a highly dynamic and important sector with features that include irrigated year-round production, coupled with the comparative advantages of production close to the markets, and the availability of productive resources such as urban wastes, wastewater, and vacant public land. It is also a source of employment for hired labourers and workers in related micro-enterprises such as processing of agricultural produce and street vending of food. In addition, both men and women were found to benefit economically and in terms of social status. This implies that policies and developmental progtrammes aimed at promoting urban agriculture will improve the livelihood of many people in the peri-urban centres.

INTRODUCTION

Peri-urban and urban agricultural systems have been classified into home-based production systems (Chauca, 1999); open space locations (Rosario, 1999); vegetable markets (Maxwell, 1999) or animal husbandry production (Chauca, 1999); time dedication such as part-time producers (urban night security men, artisans peri-urban absentee farmers) and full time and all year round producers (Rosario, 1999); as well as products destination or market orientation (Ogbu, 2007). However, over 70% of leafy vegetables coming to the markets in most cities have their origin in the open spaces and home gardens (Garnett, 2000).

According to Mougeot (2006), while 20% of the world's food is produced in urban and peri-urban areas, about 40% of the population in urban cities of Africa is involved in urban agriculture. Studies (Garnett, 2000) have however, shown that fresh vegetables and poultry products are the major items of production in most urban areas, with little of cereals, grain legumes and roots/tubers. They are important for food security and significant contributors to income security and nutritive diets of many households. For example, UA has been reported to provide between 20% and 30% of households' food supplies in Tanzania (Mougeot, 2006), about 55% in Uganda, and 90% of fresh vegetable consumption is from urban production in Ghana and Tanzania (Arce et al., 2006). In Nigeria, Ogbu and Essien (2007) reported that between 60 and 75% of fresh vegetable consumption in cities is from production within and around the cities and accounts for a large part of diversified diets required for improving dietary quality and the health of the people. It also constitutes an important component of urban dwellers' food expenditure. According to Max well et al. (1999), most families (including the poor) in cities purchase the food they consume and spend as much as 60-80% of their income on food. With the growing trend in urbanization, reduced purchasing power, high unemployment rate, high incidence of poverty and malnutrition, absence of reasonably priced and insufficient basic foodstuffs for the urban poor, could prove a major threat to local and national political stability. UA has therefore become an integral part of the urban system in recent times (NBS, 2006; WFP, 2008).

Despite the importance of UA to the socio-economic life and welfare of urban households, information on UA is limited and not well documented. In addition, policy makers and governments in Nigeria have not utilized the full potentials of UA for economic growth. This paper therefore evaluates the contribution of urban and peri-urban agriculture as a viable strategy to improving the socio-economic life of households in Lagos state, Nigeria. The paper examines the socio-economic characteristics of the households; assesses their livelihoods choices, challenges and coping strategies; examines their income and expenditure profile; and analyses the socio-economic factors influencing households' income generating potentials.

METHODOLOGY

The study was conducted in four Local Government Councils (Somolu, Surulere, Ikeja and Kosofe) of Lagos state, Nigeria. The state is located on longitude 2^0 42'E and 3^0 22'E of the Greenwich Meridian and latitudes 6^0 22'N and 6^0 42'N of the equator, with average daily maximum temperature of about 30^0C. Purposive sampling was used to select four communities in the study area, and between 30 and 45 farmers selected in each community to give a total of 180 farmers. Data were collected in 2009 using pretested questionnaire drawn to cover respondents' socio-economic variables such as age, literacy level, gender; income and expenditure profile; production challenges and coping strategies, and input-output relationships. Data were analysed using descriptive statistics, budgetary technique and regression analysis. Descriptive statistics involved the use of means and frequency counts to describe the variables used in the study, budgetary technique was used to analyse the income and expenditure profile of the respondents, while the determinants of respondents' income generating potentials were analysed using regression analysis.

RESULTS AND DISCUSSIONS

Vegetable production was the major crop on respondents' farms and it is dominated by fmale farmers with only 36% male involvement, as evidenced in Hovorka et al. (2009). Vegetables grown include onion, tomato, okra, pepper, amaranthus, carrot, melon, *corchorus olitorius* (ewedu), hibiscus *sabdariffa* (sobo), and *adansonia digitata* (baobab leaves). Production activities take place at the homestead as home gardening, or on land away from the residence (off-plot), on private land (owned, leased) or on public land (parks, conservation areas, along roads, streams and railways), or semi-public land (schoolyards, grounds of schools and hospitals).

The mean age of the respondents (38 years) shows that the farmers fall within the active age bracket of between 30 and 60 years (Kolawole, 2009) and therefore young and enterprising in carrying out their farming activities. With mean farming experience of 9 years, majority of the respondents are married and 72% can read and/or write to understand information passed to them on their farm activities. The average farm size was 0.6ha mostly acquired through lease and use of undeveloped government land; some acquired land through gift and purchase but none was by inheritance as usually observed in rural farming (Byerlee and Heisey, 1997). Most, (87%) of the respondents, are members of different associations, and vegetable farmers' association accounting for 70%. Though only 12% of the farmers had no source of credit for their farm activities, 95.4% of the remaining 88% obtained credit through self effort. This shows that associations only contribute minimally to credit provision to the respondents. Both hired and family labour were used in vegetable production, but with higher proportion of family labour while contact with extension service was high, implying easy accessibility to agronomic information that can enhance their production activities.

Income and expenditure profile of vegetable producers

The income and expenditure profiles of respondents are shown in Table 1. Households mainly engaged in agriculture, comprising crop production (vegetable production) and livestock rearing (mainly poultry keeping); and secondary occupation like tailoring, bricklaying, trading). Total income was about ₦25,150,000 with a mean of ₦139,250 arising from both primary and secondary sources of occupation. The highest primary income earning activity was crop production (particularly vegetable production), accounting for 48% and only a small proportion (6%) of the income was from livestock, mainly by keeping small ruminants and poultry.

Table 1: Income and expenditure profile of the farming households

Item	Average income earning (₦/annum)	Percent
Income Source		
Primary occupation:		
- Crop	12004095	47.73
- Livestock	1473790	5.86
Secondary occupation	7472065	29.71
Wife (ves)	17605	0.07
Male children	1129235	4.49
Female children	495455	1.97
Relative	103115	0.41
Remittance from other sources	2366615	9.41
Gift	88025	0.35
Total Income	25150000	100.0
Mean Income	139250	-
Expenditure	**Amount (₦)**	**% of Total**
Food	4971263	32.0
Housing (Rent)	53255	0.23
Clothing	2030646	7.69
Transport	1398529	5.04
Electricity	590439	2.55
Water	9262	0.04
Health care	1329066	4.74
Education	1993599	6.61
Extended familyRemittance	752520	3.25
House help	2315	0.01
Entertainment	900708	3.89
Gift/Donation	817352	3.53
Savings	4945793	21.36
Festival	1261918	0
Association/Social Clubs	715473	3.09
Ceremonies	1011850	4.37
Tobacco/Alcohol	261645	1.13
Others	108826	0.47
Total	23154460	100.00
Mean Expenditure per Household (₦)	128600	-

Source: Data analysis, 2010.

Income from secondary occupation ranked second (about 30%). On the contrary, total expenditure was ₦23,154,460 with a mean of ₦128,600 and food constituted the highest item of expenditure (32%), followed by savings (21%). Other items of expenditure are clothing, education, transport and health care in that order.

Livelihoods pattern and choices of respondents

The distribution of respondents livelihood choices showed that vegetable production ranked highest, while maize production, and rearing of small ruminant animals followed in that order (Table 2). However, limited access to land, tenure insecurity due to uncertainty in land use, and high production costs were major challenges faced by respondents in their production activities. This corroborates Kenneth et al. (2009) that space is at a premium in cities and their suburb, and is expensive and difficult to secure. Mougeot (2006) indicated that most farmers cultivate along roadsides due to limited space which is also a risky practice since it exposes food to car pollution. Other limitations to livelihood choices are: limited access to productive resources, inadequate credit, pilfering on distant farms, prohibitive urban regulations, and harassment by state and local government tax officials. This suggests that since vegetable production is part of whatever activity households engaged in, any developmental programme aimed at improving the livelihood of the people should target addressing the identified production constraints.

Table 2: Household livelihood choices and bottlenecks

Item	Frequency*	Percent (%)
Livelihood choices:		
Crops farming (maize)	72	40.0
Vegetable growing	180	100.0
Small ruminant/poultry	46	25.6
Commercial livestock.	22	12.2
Bottlenecks:		
Limited access to land	162	90.0
Lack of security of tenure	153	85.0
Limited access to productive resources/ inputs	119	66.1
High production costs	126	70.0
Theft of crops grown on distant farms	79	43.9
Lack of credit	94	52.2
Harassment by local/state government tax authorities	52	28.9

*Multiple responses taken
Source: Data analysis, 2010

Households coping strategies to production constraints

Generally, respondents diversified their means of livelihood as a risk management strategy. The coping strategies used to address production challenges are either anticipatory (ex-ante) and/or reactive (ex-post) (Table 3). Anticipatory approaches include agricultural diversification which involves the production of several different crops or livestock that will not fail at the same time, and asset accumulation which involves the rearing of small animals such as poultry and sheep to reduce risk. Reactive measures however, involve engagement in secondary activities such as petty trading, tailoring, and employment in Government and NGO programmes. Due to limited land, respondents tend to use undeveloped public land (such as parks, conservation areas, along roads, streams, and railways and school yards) for their production activities. This has led to rising concerns about the need for appropriate allocation of land and property rights through successful policy measures that can be incorporated in urban planning, to give tenure security to urban agriculture (Maxwell, 1999). Personal savings and borrowing from friends and relatives are used to address the problem of inadequate credit, while the quantity of inputs required for production activities are reduced because of their prohibitive costs.

Table 3: Household major coping strategies to livelihood challenges

Item	Frequency*	Percent
Diversify farm activities	72	32
Non-farm work	44	19
Sales of small animals	31	14
Reduce household expenditure	26	11
Sales of other assets	21	9
Harvesting rainwater	18	8
Access to different water resource	15	7

*Multiple responses taken
Source: Data analysis, 2010

Determinants of household income

Multiple linear regression estimates showed that the model is of good fit; with a significant F-value and a coefficient of determination (R^2) indicating that 86% of the variation in the dependent variable (income) is explained by the independent variables in the model. The factors influencing households' income generating potentials are shown in Table 4. Age and education, significantly and positively influenced the income generating potentials of respondents ($p<0.01$), while gender, farm size, membership of associations had positive influences at ($p<0.05$). As respondents' age increase by a year, their income earnings increase by about ₦347, implying that most of the respondents fall within the active age bracket (Kolawole, 2009), as indicated by the mean age of 38 years. Respondents are therefore considered young, enterprising and capable of adopting new innovations in their production activities, particularly when taken along with the significance of the education variable which shows that for every additional year of education acquired, respondents' income increases by ₦165, as evidenced in Bamire et al. (2010). Increasing the number of female respondents by one unit increases household income by ₦290, suggesting that peri-urban agriculture is much more rewarding to women farmers.

Table 4: Estimates of factors influencing respondent's income generating potentials

Variable	Regression coefficients
Constant	-466.5*
Age (years)	346.9*
Gender (Female 1, male 0)	290.3**
Education (years)	165.0*
Family size (#)	117.7
Farm size (ha)	242.4**
Membership of association (Yes 1, No 0)	182.1**
Extension contact (yes 1, No 0)	20.2
R^2	0.86
F-value	25.9*

*, ** Significant at (p<0.01) and (p<0.05) respectively
Source: Data analysis, 2010.

Though, every additional unit of farmland increases income by ₦118, the non-availability of large land areas for agriculture in urban/ peri-urban cities calls for the use of intensive management practices on available land. Membership in associations also enhances their income potentials; every additional membership increases respondents' income earning capacity by ₦182. This supports the findings of Moustier and Danso (2006) on the importance of urban/peri-urban agriculture (UA/PUA) in local economic development. However, extension had a positive but non-significant influence on the income of the respondents, suggesting that the extension advice in peri-urban centres is not geared towards their main production activities, as evidenced in the findings of Moustier and Danso (2006). Thus, government policies and development agency programmes aimed at promoting the welfare and standard of living of peri-urban households should take these factors into consideration in their decision-making processes.

SUMMARY AND CONCLUSION

Young and enterprising women constitute an important part of peri-urban farming as they combine this with other tasks in the household, taking advantage of undeveloped public land (such as parks, conservation areas, and along roads, streams, and railways, as well as school yards) for their production activities. However, limited access to land, tenure insecurity, and high production costs are major challenges faced by households in their production activities and livelihood choices. Households use either anticipatory (ex-ante) and/or reactive (ex-post) coping strategies to address production challenges through agricultural diversification, asset accumulation and engagement in secondary activities. Age, education, gender, farm size and membership of associations significantly influenced the income generating potentials of the households, implying that urban development initiatives should consider these factors in formulating decisions that would enhance the livelihood of the people.

In conclusion, UA/PUA should be incorporated into the city system to scale-up production by addressing the production constraints, creating awareness and enlightening the people of its importance. An office for Director of urban/peri-urban Food and Agriculture should be created to promote this initiative, while providing an explicit policy for UA/PUA in Nigeria.

Finally, there is need to conduct a comprehensive study covering all urban/peri-urban agricultural systems in Nigeria to gather data for planning and research.

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PERI-URBAN FARMING IN IBADAN METROPOLIS

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Abstract

This study addresses the dynamics of agriculture in the peri-urban areas of Ibadan with a view to establishing the profitability of the enterprise and articulating necessary policy measures to guide the process. Multistage sampling technique was used to obtain information from 150 respondents in the city of Ibadan. Descriptive and inferential statistics were used to analyze the data. The results revealed that the mean age of peri-urban farmers was 51.1 years and 81% of them were men. The gross margin realized by farmers was ₦257,638.50 with a net farm revenue of ₦240,678.50. The regression analysis revealed that distance of farms to the markets, farm expenditure and farm size were significant determinants of farm income. The study concluded that policy measures that will significantly access farmers to affordable and improved farm inputs (fertilizer, seedlings and implements); enhance access to larger farmlands as well as improve literacy and modern farming skills will enhance the profitability of peri-urban farming and ensure adequate food supply to cities.

INTRODUCTION

All over the world, the primacy of cities as economic, commercial, political, and industrial centres have made them foci of massive in migration of people seeking better living conditions from the country side. In the developed countries, economic development has led to the creation of enormous wealth and the resources needed to effectively manage cities. In such nations, efficient transportation, functional electricity that facilitates refrigeration, rich industrial population and efficient marketing system promote the shipment of food produce from the rural areas as well as from international sources to the city. In such international cities, food is not just available, they are cheap. In the developing countries however, there has been a visible mismatch between urbanization and availability of resources necessary to sustainably manage the cities resulting in infrastructural decay, unemployment, poverty, slums, and crime. By far however, food security is the most critical problem facing the growing cities. This result mainly from the fact that even with their structural problems, cities represent enclaves where the dysfunctional infrastructure are much better compared to the rural areas without these facilities.. This study aimed at evaluating policy, socio-economic and environmental factors determining the profitability of urban agriculture with a view to offering appropriate policy measures necessary to ensure the sustainability of the enterprise and food security at the city level.

METHODOLOGY

The study was conducted in the peri-urban areas of the city of Ibadan, the Oyo State capital. Ibadan the largest traditional city in Africa south of the Sahara has an estimated population of 2, 410,000 (UN-HABITAT, 2001) distributed in 11 local government areas (LGAs). The city enjoys two climatic seasons – the rainy season (March to October) and the dry season (November – February). While the mean annual rainfall is 1,262mm, temperatures range between 22.5^{o}C and 27.5^{o}C (Oguntoyinbo, 1994).

Multistage sampling technique was used to obtain required information for this study. First, the city of Ibadan was purposively selected because as a major city combining the features of traditional and modernization, it provides the critical setting for active agricultural activities in the peri-urban areas that services the non-agricultural population in the urban core. Six LGAs were then randomly selected from the eleven LGAs in Ibadan metropolis. These LGAs are Egbeda, Oluyole, Lagelu, Ona Ara, Ibadan North East and Akinyele. Finally, in each of these LGAs, 25 farming households were also randomly selected. In all, 150 respondents were selected for the study.

Data collected were analyzed using descriptive statistics, budgetary analysis and the multiple regression technique. Descriptive statistics, including frequency counts, means and percentages were used to describe the socio-economic characteristics of respondents in the study area. Budgetary analysis was employed to determine the profitability of peri-urban farming enterprises using the gross margin as stated in equation (1):

$$\pi_i = P_i Q_i - TCi \quad \text{...} \quad (1)$$

where,

π_i = gross margin per acre (₦/acre),

P_i = price per unit of output(₦),

Q_i = output of individual farm enterprise (Kg), and,

TCi = total costs of production (fixed cost {FC} plus variable cost {VC}) (₦)

Variable costs (VC) included in the analysis were expenditures on labour, seedlings, fertilizers, agrochemicals and transportation. Items that could be used for more than a production cycle were classified as fixed costs (FC). These included cutlasses, sprayers and farm-barns. Ratio measures were computed to assess the performance of the enterprise during the survey period.

A multiple regression model was used to determine the factors affecting income from peri-urban enterprises in the study area. The model was implicitly specified as:

$$Y_1 = f(X_1,X_2,X_3,X_4,X_5,X_6,X_7,\varepsilon_i) \quad \text{..} \quad (2)$$

where,

Y_1 = total farm income (₦)

X_1 = distance of farmlands to markets (km)

X_2 = age of farmers (years)

X_3 = education level of respondents (years)

X_4 = family size

X_5 = farming experience of respondents (years)

X_6 = farm expenditure (₦)

X_7 = farm size (acres)

ε_i = error term.

A priori expectations for the variables were for X_2, X_3, X_5, and X_7 to be positively correlated while X_1 and X_6 were to be negatively correlated with farm income. X_4 could be positively or negatively correlated depending on whether the family is a production or consumption unit respectively.

The double and semi-logarithm forms of the regression models were fitted to the model specified in (2) above. However, only the double logarithm model provided the best fit and in line with *a priori* expectations.

RESULTS AND DISCUSSIONS

The socioeconomic characteristics of the respondents are presented in Table 1. As shown, 89.3% of the respondents were male while 10.7% were female. This is expected as the city of Ibadan provides vast opportunity for commerce which is more appealing to women than farming. This is especially so because the predominantly ethnic Yoruba women in the city have a long tradition of engagement in local, national and international commerce along the West African commercial corridor (Mabogunje, 1972). Majority of the farmers (42.7%) were within the age bracket of 41 to 50 years and in fact 64.7% of the farmers aged between 21 and 50 years. While 21.3% aged between 51 and 60 years, the remaining 14% were above 60 years of age. The mean age for the respondents was 51.1 years. Although the farmers were clearly in their middle age and active, the opportunities for commerce, education and informal sector activities have attracted the very young away from the farm. Hence, policy efforts to enhance food production in the urban areas in the short to medium term should target the middle aged farmers. In the long term however, policy strategies which can also help in attracting younger persons to farming should be pursued.

Table 1 also shows that 78% of the respondents were married while only 16% were single. Two percent were separated while the remaining 4% were widowed. Thus while the need to earn income is a critical factor promoting peri-urban agriculture, the need for ensuring food security among household members is also another important factor driving peri-urban farming. In terms of family size, 68% of the farmers had between 3 and 4 members in their households, 18% had between 5 and 6 members while the remaining 14% had between 1 and 2. The mean family size was 3.6 and is substantially less than over 7 (Oluwasola, 2010; Oluwasola and Alimi, 2007) found in most rural agricultural communities in the southwestern section of Nigeria. The low family size has serious implications for labour availability since even the married women could be involved in commerce and as such will not be able to assist their husbands in the farm business. This calls for accessing farmers with labour saving devices at affordable prices to reduce the drudgery of farm work as well as reduce the cost of labour in total farm expenditure.

The respondents’ level of education was also low. Twenty six percent did not have any form of formal education; 12% did not complete primary education while 27.3% completed primary education. Another 24.7% attended but did not complete secondary schools while 8% completed secondary education. Only 2% of the farmer respondents had tertiary education. The very low level of education of the farmers has very important implications for the national goal of transforming the traditional farming system from a subsistent to a commercially oriented one as it could adversely affect their capacity to access critical technical, production and marketing information required to adequately service the dynamics of urban food demand. Over 80% of the farmers have being involved in peri-urban agriculture for over 10 years. On the average, the respondents have being farming for 19.5 years. This is enough to make the farmers experts in their chosen field.

A major factor determining small holder agriculture is the availability as well as access to land. In the study area, the total land area accessible to 80% of the respondents was between 1 and 2 hectares while the remaining 20% could access up to 4 hectares. The mean land per farmer was 2.3 hectares. In terms of cultivated landholdings however, 84% of the respondents cultivated between 1 and 2 hectares while the remaining 16% farm size ranged between 3 and 4 hectares. The average farm size in the study area was 1.8 hectares which is slightly less than the national average of 2.0 hectares (NINCID, 2006; Idachaba, 1989). As the city of Ibadan continues to expand to encroach its peri-urban areas, land will become intensively used. Intensive use of land in a peasant agricultural economy where land is not adequately conserved could lead to severe environmental problems. For most (80%) of the farmers, the farm lands they operated on belonged to the family; 2% were tenant farmers while 18% purchased their land. Thus as much as 82% could not excise their lands to raise funds or use them as collaterals. When farmers have no permanent tenure of their farm lands, they are always unwilling to invest on conservation whereas, their production efforts tend to mine land resources rather than conserve them (Oluwasola, 1999). Shortage of capital as well as the short term planning horizon of small holder farmers could also militate against land conservation. As observed by Kay (1987), soil conservation requires cash expenditures which can only yield returns in the long term. There is thus the need for a comprehensive urban policy that restricts access to prime agricultural lands. Environmental education and extension services in the area of farm input procurement and usage as well as conservation measures are also crucial to ensure the long term sustainability of farm lands and farming in the study area.

All the respondents planted arable crops including maize, cassava, yams and vegetables. In addition, 15.3% of them planted tree crops like citrus, mango, oil palm, cashew and kolanut. While the arable crops, mango and citrus met the food needs of Ibadan metropolis directly, cashew and oil palm were purchased by small enterprises that processed them for the market in Ibadan and beyond. Kolanut was processed and sold to marketers who ship them to the northern part of the country.

Table 1: Socio-Economic Characteristics of Respondents

S/N	Socio-Economic Characteristics	Frequency	Percentage	Cumulative percentage	Mean
1.	Gender of respondents				
	Male	134	89.3		
	Female	16	10.7		
2.	Age Distribution of Respondents				
	21 - 30 years	9	6.0	-	
	31 – 40 years	24	16.0	22.0	51.1
	41 – 50 years	64	42.7	64.7	
	51 – 60 years	32	21.3	86.0	
	> 60 years	21	14.0	100.0	
3.	Marital Status of Respondents:				
	Single	24	16.0	-	
	Married	117	78.0	94.0	
	Divorced/Separated	3	2.0	96.0	
	Widowed	6	4.0	100.0	
4.	Level of Education of Respondents				
	No formal education	39	26.0	-	
	Did not complete primary school	18	12.0	38.0	
	Completed primary school	41	27.3	65.3	
	Did not complete secondary	37	24.7	90.0	
	school	12	8.0	98.0	
	Completed secondary school	3	2.0	100.0	
	Completed tertiary education				
5.					
		21	14.0	-	
	Respondents Household Size	102	68.0	82.0	3.6
	1 – 2 members	27	18.0	100.0	
	3 – 4 members				
6.	5 - 6 members				
		30	20.0	-	
	Farming experience	60	40.0	60.0	
	≤ 10 years	36	24.0	84.0	
	11 – 20 years	9	6.0	90.0	19.5
	21 – 30 years	9	6.0	96.0	
	31 – 40 years	6	4.0	100.0	
	41 – 50 years				
	>50 years				

Source: Field survey, 2008.

Only 12 (8%) of the 150 farmers sampled used rotational bush fallowing as a means of conserving soil fertility. Of the twelve, 7 (58.3%) practiced a fallow length of one year while the remaining 5 (41.7%) used two years fallow intervals. The average fallow length was 1.4 years. Clearly, this short fallow interval is not enough for the soil to naturally replenish itself hence, over time, the land will become degraded. To solve the problem of soil fertility, 26% of the farmers used organic fertilizer while another 16% used leguminous plants to replenish soil fertility. However, 50% of the respondents used mainly inorganic fertilizer to replenish soil fertility with its attendant implications for soil and ground water loading.

Twenty percent of the respondents' farmlands were located between 1 and 2 km away from the nearest market in the city of Ibadan. Forty six percent were located between 3 and 4 km while the remaining 34% were located between 5 and 6 km away from the nearest market. The average distance of farm lands to the nearest market was 2.6km. This closeness to the market is one of the prime advantages of peri-urban agriculture. Not only are the farm products able to reach the market fresh, the cost of transportation to and from the farm is also low.

Cost and Returns to Peri-Urban Farming activities

As shown in Table 2, the average revenue of ₦368,190 (US$2,454.60) far exceeded the average cost of ₦127,638.50 (US$850.92). Given an average net revenue of ₦240,678.50 (US$1,604.52), the monthly income realized amounted to ₦20,056.54 (US$133.71) which is more than double the national minimum wage of ₦11,500 (US$76.67) or the newly approved ₦18,000 (US$120). The gross margin to enterprise was also ₦257,838.50. In terms of cost components, Table 2 reveals that labour is the single most important variable cost component as it constitutes 62.29% of total variable cost. Other important cost items include expenditure on fertilizer/agrochemicals, farm implements, cost of seedlings and land preparation. Transportation which constitutes 6.67% of total variable cost was the least expense item. This is to be expected given the fact that most of the farms were located within an average distance of 2.6km from the nearest market.

The financial ratios in Table 2 shows that in terms of expense-structure ratio, for every ₦100 spent on farm cultivation, ₦13 was spent on fixed inputs while ₦87 was spent on variable inputs. This suggests that the farmers can easily adjust to market conditions since expenditures on variable inputs constitute a very high proportion of total cost of production. However, it also implies that oscillations in the market price of variable inputs could highly impact the gross margin obtained. Policies that will lead to a reduction in the costs of these inputs particularly the cost of labour will reduce cost of production; enhance output as more farmlands could then be brought under cultivation and increase farm income. The rate of return on investment was 1.89 which suggests an increasing return to scale with every ₦100 invested returning ₦189. The Benefit-Cost ratio of 2.88 indicates that peri-urban agriculture is profitable in the study area as every ₦100 invested in the enterprise yields additional ₦188 over and above the amount invested.

Table 2: Analysis of Costs and Returns

Item Category	Amount (₦)	Percentage in Cost
Total income	368,190.00	
Land preparation	(7,500.00)	6.78
Cost of seedlings	(9,708.00)	8.78
Cost of farm inputs (fertilizer/agrochemicals)	(8,800.00)	7.96
Cost of farm implements	(8,308.50)	7.52
Cost of labour on weed control	(68,864.00)	62.29
Cost of transportation	(7,371.00)	6.67
Total variable costs	*(110,551.50)*	*100.00*
Gross margin	257,638.50	
Depreciation	(8,960.00)	52.83
Other fixed costs items	(8,000.00)	47.17
Total fixed costs	*(16,960.00)*	*100.00*
Total Cost	(127,511.50)	
Net revenue	240,678.50	
Expense-Structure Ratio	0.13	
Benefit-Cost Ratio (TR/TC)	2.88	
Rate of Return	1.89	

Source: Field Survey (2008)

Determinants of Peri-Urban Farm Income

$$\begin{aligned} LnY = \; & 2.81 + \underset{(0.475)}{4.655} \ln X_1 - \underset{(0.489)}{0.781} \ln X_2 + \underset{(0.236)}{0.247} \ln X_3 - \underset{(0.157)}{0.053} \ln X_4 \\ & + \underset{(0.178)}{0.302} \ln X_5^* - \underset{(0.598)}{0.171} \ln X_6^* + \underset{(0.354)}{0.695} \ln X_7^* \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3) \end{aligned}$$

$R^2 = 0.795$

Adj. $R^2 = 0.753$

$F = 25.956$

(figures in parentheses are the standard errors)

* significant at 5% level.

The model in equation 3 shows that with the exception of age of respondents (X_2), family size (X_4) and farm expenditure (X_6) which were negatively correlated with income from peri-urban farming, all other variables: distance of farms to market (X_1), education level of respondents (X_3), farming experience (X_5) and farm size (X_7) were positively correlated.

However, only three of the variables, farming experience (X_5), farm expenditure (X_6) and farm size (X_7) were statistically significant.

In accordance with a priori expectations, farming experience of respondents was positively correlated with farm income. The variable was also statistically significant. The coefficient of the variable indicates that percentage increase in the experience of farmers in farm business would lead to 30.2% increase in farm income in the study area. Farm expenditure though negatively correlated with farm income and in conformity with a priori expectations was also statistically significant. The coefficient of the variable indicates that a percentage decrease in farm expenditure would lead to 17.1% increase in farm income. Most importantly however, is the behavior of the farm size variable which was positively correlated in conformity with a priori expectations. It was also statistically significant. The coefficient of the variable indicates that a percentage increase in farm size would lead to 69.5% increase in farm income.The adjusted coefficient of determination of 0.753 indicates that about 75% of the variability in income from peri-urban farming in the study area is associated with the explanatory variables specified in the model.

CONCLUSION

Farming around cities with high industrial and commercial potentials like the city of Ibadan is highly profitable as shown in this study where the average monthly earnings far exceed the current as well as the proposed national minimum wage. This earning is after the farming households have satisfied the household needs for subsistence. Consequently, policy strategies should focus on how to employ the system to solve the problems of inadequate food supply to cities, employment generation and poverty reduction in Nigerian cities. Labour cost constitutes the largest cost component in peri-urban farming. Hence, policy efforts aimed at promoting labour saving devices should be stepped up. These should include the provision of timely inputs especially improved seeds, agrochemicals and organic fertilizers.

The major determinants of peri-urban agriculture were distance of farms to markets, farm expenditure and farm size. Closeness of the farms to the city implies lower transportation cost. The transportation costs could be further reduced if the roads linking the peri-urban region are in good shape. Hence, policy efforts particularly at the State and Local Government Council levels should aim at making the road arteries motorable to enhance the profitability of peri-urban farming. Farm size is very critical. In the study area, land is already scarce and in the face of rapid urban expansion, could become a major limiting factor to farming. Incidentally the major policy affecting land is the Land Use Act which confers only user rights on farm operators. There is thus the need for land reforms to give tenure to farm operators, excise fertile land and fishing grounds from non-agricultural development and make land a living capital (Mabogunje, 1995) which can be used as collateral.

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DIAGNOSTIC SURVEY OF THE FADAMA PRACTICE IN SOME SELECTED CITIES OF THE SOUTH WESTERN NIGERIA

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Abstract

Diagnostic survey was carried out in some major cities in the South Western Zone of Nigeria to explore the ways in which the river banks and valley bottoms existing in these cities were being utilized agriculturally. Four states including Oyo, Ogun, Osun and Ekiti were selected from the zone using Multistage sampling procedure while two towns (except Ogun) were randomly selected from each state. The major streams and rivers in each town were purposely identified to determine the suitability of the lands at their banks and valley bottoms for agricultural production using structured questionnaires and oral interviews. Data were collected on the status of the streams and rivers to know whether they are perennial or seasonal, usage of the surrounding lands (Fadama sites), soil moisture level during the period of November to January/February, type of crops grown and their growth performance, problems facing the project and their solutions, and benefits derivable from the practice. Findings have revealed that appreciable amount of candidate Fadama lands which hitherto have been constituted into waste lands abounds in most major cities in the South Western Zone of Nigeria. Less than 50% of these lands were utilized for agricultural production inspite of their satisfactory moisture level during the dry season that could still sustain good performance and yield of vegetable crops at this period of the year. Leafy vegetables including *Amaranthus Sp, Celosia argetea* and *Corchorus olitorus* were mostly grown where the lands were utilized. Tomato (*Lycopercon esculentus*) a fruit vegetable was not commonly cultivated while sugar cane was found throughout the year in few of the river banks. Weed management and fertilizer application (organic and inorganic) were found to be the most essential cultural operations practiced for the good growth performance and yield of vegetables. Nursery establishment for the raising of ornamentals for Landscape Horticulture was found to be practiced at a far lesser extent than vegetable production in these swamps and valley bottoms. Incessant devouring of crops by domestic animals including goats and sheeps, occasional pilfering of produce by inhabitants and unavailability/high price of fertilizers were the problems affecting the existing practice while the land tenure system in Nigeria with vested ownership in individuals (inspite of the land decree) was found to be the major constraints militating against further expansion of the project.

INTRODUCTION

Diagnostic survey is an Agricultural exploratory process where the farmers' production problems are identified and solutions proffered either on the spot or later. Abalu (1985) defined Diagnostic Survey as representing a simple and relatively quick method of identifying key constraints and problems that operate in a defined area and which are responsible for preventing the farmers in the area from increasing their agricultural production to required levels and improving their welfare in the process. O Realizing that Diagnostic Survey is an important tool to obtain information in Agricultural Research, several Diagnostic or Exploratory surveys have been conducted on farmers' agricultural activities and practices ranging from farming systems to farmers' circumstances/production problems (both arable and tree crop settings) and socio-economic problems of the farmers (Fisher et al; 1985; Olunuga et al; 1985; Omidiji et al; 1985; Oyeneye, 1985; Adeyemi 1995(a); 1995(b), 1997). Conducting Diagnostic Survey on Fadama practice in urban cities/towns in the South Western Nigeria was therefore to identify the problems faced by the farmers engaged in the project and to explore the ways by which the practice could be further improved to increase the income of the farmers.

"Fadama" is an Hausa word for irrigable lands that are flood plains and low lying areas underlined by shallow alluvial deposits found along Nigerian river banks or systems. Fadama sites favour considerably the production of fresh crops with high yields because of excellent growth or environmental factors and less incidence of diseases and pests that are prevalent during the dry season. Among the crops produced during the dry season, vegetables are the most highly demanded because of their richness in iron, vitamins and other minerals and which make them an important component of a balanced diet. About 250g of vegetables is recommended for consumption per capita per day (Bose et al; 1999).

The present level of Fadama practice in the urban cities and towns of the South Western Nigerian where less than 50% of the available land is cultivated and faced with other multifarious production problems needs a lot of improvement. Although, the Federal Government of Nigeria through the National Fadama Development Project had promoted simple and low-cost improved irrigation technology among the Fadama farmers as well as expanded the programmes within the country and also provided resources to the farmer to increase their income, these efforts to empower the farmers were limited to rural areas only, not to the urban dry season farmers. This study is therefore an attempt to identify the major rivers/streams and valley bottoms in some selected cities and towns of the South Western Nigeria to appraise the dry season farming (Fadama practice) along their banks (Fadama sites) and recommend ways of further improving and expanding the practice to increase urban farmers' income as well as reduce or completely eradicate the unsightly features formed by the uncultivated Fadama sites in the urban cities and towns of South Western Nigeria.

MATERIALS AND METHODS

Diagnostic Survey was carried out in some selected cities/towns of South Western Nigeria including Ibadan, Igboora (Oyo State); Ile-Ife, Ilesa (Osun State); Ado-Ekiti, Ikere (Ekiti State); and Abeokuta (Ogun State) during the dry season (November – February) in 2008 and 2009 to explore the major rivers/streams and valley bottoms existing in them to critically appraise the Fadama projects carried out along the river banks in these cities/towns. Multistage sampling procedure was employed to select the four states from which two towns (except Ogun) were randomly selected per state. All the rivers in each town/city were identified using purposive sampling procedure. Structured questionnaires were distributed to the farmers to elicit information on the status of the river/streams (to know whether they are perennial or seasonal), amount of land available for cultivation, amount of land already cultivated, swamp/marsh and soil moisture of the river banks (Fadama sites) during the dry season, type of agricultural production, types of crops/vegetables grown, performance of crops/vegetables, cost of production, benefits derivable from the practice, economics of practice for the determination of Benefit Cost Ration (BCR) and Comparative Advantage (CA), Constraints/problems encountered by farmers. Farmers were also visited on sites for oral interviews using "check/list to ask various questions to confirm the earlier answers to the questionnaires. Interviews were held per Fadama site. Farmers' population per site depending on the size of the Fadama site varied between 5 and 50 including women and men since each Fadama site was a conglomerate of small holdings with farm sizes varying between 0.1 and 0.4ha per capita. The questions were answered by the leader in each site assisted by one or two other enlightened farmers in answering the questions as well as enunciating the constraints facing them in the operation of their farms. Few of the farmers interviewed belonged to the Government organized Fadama farmers groups while the majority of the farmers were self sponsored and did not belong to the formalized Fadama farmers' groups.

Some of the important farm operations and activities performed by Fadama farmers were studied on the visits to their farms or Fadama sites. Land preparation was carried out by hand weeding through cutlassing or hoeing, uprooting of grass roots and rhizomes, filling and leveling of land, planting of seeds and pre-emergence application of herbicides where planting was done on flat but where bedding was done, planting of seeds and application of herbicides were delayed until after bedding. Bed width varied between 1.8 and 2.4m and by any convenient length. Irrigation was effected through local method of constructing small and narrow trenches (tunnels) for surface water to flow from one point to the other on the ground and use of watering cans to draw water from the streams for irrigation. Farmers in some cases used pumping machines to pump water from the rivers where it is perennial, and from deep wells where the water from the streams had dried off. Fertilizers were applied within a week after planting at 40-60kg/ha of NPK (15-15-15) or Nitrogenous fertilizer like CAN. Insect pest (leaf defoliator) was controlled with the application of insecticide "Best" (Cypermethrin). Indigenous technologies through the digging of big and deep perimetric trenches round the farms and leaving of thick bush to surround the farms to serve as boundaries were also used to control annual pests.

The performance of crops, mostly vegetables was also evaluated on the field using visual observations on scales of 1-10, where 1 = poor performance and 10 = excellent performance of the crops. Data obtained were analyzed using descriptive statistics.

RESULTS

A total of 59 rivers/streams and valley bottoms were surveyed in seven cities/towns under different Local Government Areas (LGA) in four states of the South Western Nigeria. Number of rivers varied between 2 and 15 per city with only three of the rivers without land for agricultural production (Table 1). Most rivers/streams were perennial with 76.27% of them with moderate swamps while 13.56% and 10.17% had high and low swamps respectively. The soil moisture was found to be satisfactory during the dry season except in two locations where the soil moisture content was low (Table 2). Table 3 shows that the existing available land per Fadama site and the amount of land cultivated from it. Mean available land per Fadama site varied between 1.78 in Ilesa and 3.5ha in Ikere while mean cultivated land ranged from 0.85 in Abeokuta – 1.90ha in Ikere with percent range of 43.06 – 53.50. However considering percentage of lands cultivated to crops separately, Ife and Ilesa with 55.30 and 56.49% out performed other cities and towns in the South West of Nigeria. Vegetables of assorted species were found grown in all the Fadama sites with very small portion of the site allotted to flower nursery production in only Labe and Odo-Ona Fadama sites in Ibadan while sugar cane and plantain were also found in very small proportion at Omiokun, Ile-Ife and Agunrodo in Ilesa. Few sites, Onipepeye (Ibadan), Alaparun, Odo-Esa and Abelonko (Igboora); O.A.U valley bottom (Ile-Ife) and Odo-Ira (Ilesa), however, were still found uncultivated during the two years of study inspite of their availability for cultivation. Total land used for agricultural production during the dry season was less than 50% of the total available land for cultivation.

Vegetables found on the Fadama sites include *Amaranthus cruentus*, *Celosia argetea*, *Corchorus olitorius*, Okra *Abelmoschus esculentus* (leafy and fruit) *Tefelria Sp.* and tomato (*Lycopersicum esculentum*). Amaranth and Celosia were cultivated in all Fadama sites while *Corchorus olitorius* was also grown in all Fadama sites except those of Ekiti State. Okra was grown in all Fadama sites in Igboora in Oyo state and Ado-Ekiti and Ikere in Ekiti State. It was grown as leafy vegetables in Igboora while it was grown as fruit vegetable in Ekiti State. Tomato and Tefelria were found sparsely grown in few of the Fadama sites. Generally, all the vegetables performed very well with growth performance mean scores of 82.5 – 96.7%.

Cost of producing one hectare of vegetables varied with the type of farm on which the vegetables were grown whether on-station / near on-station or downstream farms, and the type of sales to which the vegetables were subjected (whether wholesale or retailed). Consequently, the cost of producing one hectare of vegetables varied between ₦40,500 and

₦50,000 for wholesale and ₦82,000 and ₦112,750 for retailed vegetables. High returns of ₦615, 000 – ₦935, 000/ha from wholesale farms and

₦1, 296,000 – ₦2, 100,000 / ha from retailed farms were realized from the production of dry season vegetables. Consequently, Benefit/Cost Ratio (BCR) derivable from the project ranged from 15.70 – 18.63 while the Comparative Advantage of Fadama project over the rainy season production of vegetables was about 25.0 – 254.68 %.

Table 1: Name of Rives/Streams Surveyed and their locations in the South Western Nigeria

Name	***State***	***Town/City***	***L.G.A***[2]	***Land Situation***
Ogunpa	Oyo	Ibadan	Ibadan North West	LNA[3]
Eleyele	Oyo	Ibadan	Ibadan North West	LAA[4]
Gege	Oyo	Ibadan	Ibadan South West	LNA
Odo-Ona (MP)	Oyo	Ibadan	Ibadan South West	LAA
Labe	Oyo	Ibadan	Ibadan South West	LAA
Kudeti	Oyo	Ibadan	Ibadan South East	LAA
Orogun	Oyo	Ibadan	Ibadan North	LAA
U.I. Valley Bottom	Oyo	Ibadan	Ibadan North	LAA
Onipepeye	Oyo	Ibadan	Ibadan North East	LAA
Odo-Ona Elewe	Oyo	Ibadan	Oluyole	LAA
Odo-Ona Kekere	Oyo	Ibadan	Oluyole	LAA
Odo-Ona nla	Oyo	Ibadan	Oluyole	LAA
Jagun	Oyo	Ibadan	Ido	LAA
Ajagbe	Oyo	Ibadan	Ido	LAA
Odo-Alaro	Oyo	Ibadan	Ido	LAA
Alaparun	Oyo	Igboora	Ibarapa Central	LAA
Tenbelu	Oyo	Igboora	1Ibarapa Central	LAA
Odo-Esa	Oyo	Igboora	Ibarapa Central	LAA
Ayan	Oyo	Igboora	Ibarapa Central	LAA
Iyaagan	Oyo	Igboora	Ibarapa Central	LAA
Agboin	Oyo	Igboora	Ibarapa Central	LAA
Afekiti	Oyo	Igboora	Ibarapa Central	LAA
Ogun	Oyo	Igboora	Ibarapa Central	LAA
Abelonko	Oyo	Igboora	Ibarapa Central	LAA
Omisanjana	Ekiti	Ado-Ekiti	Ado-Ekiti	LAA
Odo-Eje	Ekiti	Ado-Ekiti	Ado-Ekiti	LAA
UNAD Valley Bottom	Ekiti	Ado-Ekiti	Ado-Ekiti	LAA
Ajilosun	Ekiti	Ado-Ekiti	Ado-Ekiti	LAA
Ureje (Ikere Road)	Ekiti	Ado-Ekiti	Ado-Ekiti	LAA
Ureje (Ijan Road)	Ekiti	Ado-Ekiti	Ado-Ekiti	LAA
Aya	Ekiti	Ikere	Ikere	LAA
Osun	Ekiti	Ikere	Ikere	LAA
Esinmirin	Osun	Ile-Ife	Ife Central	LAA
Mokuro	Osun	Ile-Ife	Ife Central	LAA
Dokun-dosa	Osun	Ile-Ife	Ife Central	LAA
Esinmirin 2 (Igboya)	Osun	Ile-Ife	Ife Central	LAA
Agbara	Osun	Ile-Ife	Ife Central	LAA
O.A.U Valley Bottom	Osun	Ile-Ife	Ife Central	LAA
Omi-Ebo	Osun	Ile-Ife	Ife Central	LAA
Omirin	Osun	Ile-Ife	Ife East	LAA
Kosere	Osun	Ile-Ife	Ife East	LAA

[2] LGA – Local Government Area

[3] LNA – Land not Available for Agricultural Production

[4] LAA – Land Available for Agricultural Production

Agaun	Osun	Ile-Ife	Ife East	LAA
Omiokun	Osun	Ile-Ife	Ife East	LAA
Itanagbon	Osun	Ile-Ife	Ife East	LAA
Odo-Iro	Osun	Ilesa	Ilesa West	LAA
Odo-Ira	Osun	Ilesa	Ilesa West	LAA
Kaya Father	Osun	Ilesa	Ilesa West	LAA
Adeti	Osun	Ilesa	Ilesa West	LNA
Agunrodo	Osun	Ilesa	Ilesa West	LAA
Orunoga	Osun	Ilesa	Ilesa West	LAA
Omi-Iru	Osun	Ilesa	Ilesa West	LAA
Erinyin	Osun	Ilesa	Ilesa West	LAA
Omi- Asoro	Osun	Ilesa	Ilesa East	LAA
Ogun (Ago-Oka)	Ogun	Abeokuta	Abeokuta North	LAA
Ogun (Adedotun)	Ogun	Abeokuta	Abeokuta North	LAA
Leme	Ogun	Abeokuta	Abeokuta North	LAA
Shijipon	Ogun	Abeokuta	Abeokuta South	LAA
Ajegunle	Ogun	Abeokuta	Abeokuta South	LAA
Olomoore	Ogun	Abeokuta	Abeokuta South	LAA

Table 2: Characteristics/Particulars of the Rivers and River banks (Fadama Sites)

City	*River*	*Particulars of Rivers and River Banks*		
		River Status	*Swamppiness of the River*	*Soil MC*[5]
Ibadan	Ogunpa	Perennial	Low	--
	Eleyele	Perennial	Low	S[6]
	Gege	Perennial	Low	--
	Odo-Ona (M.P)	Perennial	Low	S
	Odo – Alaro	Perennial	Moderate	S
	Labe	Perennial	Moderate	S
	Kudeti	Perennial	Low	S
	Orogun	Perennial	Moderate	S
	U.I. Valley Bottom	Perennial	Moderate	S
	Onipepeye	Perennial	Moderate	S
	Odo-Ona (Elewe)	Perennial	Moderate	S
	Odo-Ona (Kekere)	Perennial	Moderate	S
	Odo-Ona nla	Perennial	Moderate	S
	Jagun	Perennial	Moderate	S
	Agbaje	Perennial	High	S
Igboora	Alaparun	Perennial	Moderate	S
	Tenbelu	Perennial	High	S
	Odo-Esa	Perennial	Moderate	S
	Ayan	Perennial	Moderate	S
	Iyaagun	Perennial	Moderate	S
	Agboin	Perennial	Moderate	S
	Afekiti	Perennial	High	S
	Ogun	Seasonal	Low	L[7]
	Abelonko	Seasonal	Low	L
Ado-Ekiti	Omisanjana	Perennial	Moderate	S
	Odo-Eje	Perennial	Moderate	S
	UNAD Valley	Perennial	High	S

[5] Soil MC – Soil Moisture Content of Fadama site during dry season
[6] S – Satisfactory Soil Moisture Content of the River Banks (Fadama Site)
[7] L – Low Soil Moisture Content of the site during dry season.

	Bottom			
	Ajilosun	Perennial	Moderate	S
	Ureje (Ikere Road)	Perennial	Moderate	S
	Ureje (Ijan Road)	Perennial	Moderate	S
Ikere	Aya	Perennial	Moderate	S
	Osun	Perennial	Moderate	S
Ile-Ife	Esinmirin	Perennial	High	S
	Mokuro	Perennial	High	S
	Dokun-Dosa	Perennial	High	S
	Esinmirin 2 (Igboya)	Perennial	Moderate	S
	Agbara	Perennial	Moderate	S
	O.A.U Valley Bottom	Perennial	Moderate	S
	Omi-Ebo	Perennial	Moderate	S
	Omirin	Perennial	Partly High	S
	Kosere	Perennial	Moderate	S
	Agaun	Perennial	High	S
	Omiokun	Perennial	Moderate	S
	Itaagbon	Perennial	Moderate	S
Ilesa	Odo-Iro	Perennial	Moderate	S
	Odo-Ira	Perennial	Partly High	S
	Kaya Father	Perennial	Moderate	S
	Adeti	Perennial	Low	--
	Omi-Iru	Perennial	Moderate	S
	Erinyin	Perennial	Moderate	S
	Agunrodo	Seasonal	Moderate	S
	Orunoga	Perennial	Moderate	S
	Omi – Asoro	Perennial	Moderate	S
Abeokuta	Ogun (Ago-Oka)	Perennial	Moderate	S
	Ogun (Adedotun)	Perennial	Moderate	S
	Leme	Perennial	Moderate	S
	Shijipon	Perennial	Moderate	S
	Ajegunle	Perennial	Moderate	S
	Olomoore	Perennial	Moderate	S

Table 3: Hectarage of Land Cultivated from the existing available lands at the Fadama sites

Town / City	*River/Stream (Fadama Site)*	*Available Land (Ha.)*	*Amount (Ha.) Cultivated*	*Percentage (%)*	*Type of Agricultural Production*
Ibadan	Eleyele	2.0	1.00	50.00	Vegetables
	Odo-Ona (NP)	3.0	1.20	40.00	Vegetables
			0.20		Flower Nursery
	Labe	2.0	1.50	75.00	Vegetable + Nursery
	Kudeti	1.2	0.80	66.67	Vegetables
	Orogun	1.4	1.00	71.42	Vegetables
	U.I. Valley Bottom	2.5	2.50	100.00	Vegetables
	Onipepeye	1.2	0.00	0.00	----
	Odo-Ona Elewe Fadama	2.0	1.00	50.00	Vegetables
	Odo-Ona Kekere Farmers	3.0	1.50	50.00	Vegetables
	Odo-Ona nla (FF)	4.4	1.50	34.09	Vegetables
	Odo-Alaro	2.0	1.00	50.00	Vegetables
	Jagun	3.0	1.00	33.33	Vegetables
	Ajagbe	2.0	1.00	50.00	Vegetables
	Mean	**2.28**	**1.15**	**51.57**	

Igboora	Alaparun	2.00	0.00	0.00	----
	Tenbelu	2.00	1.00	50.00	Vegetables
	Odo-Esa	0.80	0.00	0.00	----
	Ayan	6.00	5.00	83.00	Vegetables
	Ayaagan	2.00	0.00	0.00	----
	Agboin	0.80	0.80	100.00	Vegetables
	Afekiti	1.00	0.20	20.00	Vegetables
	Ogun (OYSCA)	2.00	1.00	50.00	Vegetables
	Abelonko	2.00	0.00	0.00	----
	Mean	**2.06**	**0.89**	**33.67**	
Ado-Ekiti	Omisanjana (FF)	4.00	3.00	75.00	Vegetables
	Odo-Eje (FF)	2.50	1.00	40.00	Vegetables
	UNAD Valley Bottom	2.00	1.00	50.00	Vegetables
	Ajilosun	2.00	0.60	30.00	Vegetables
	Ureje (Ikere Road)	1.00	0.60	60.00	Vegetables
	Ureje (Ijan Road) (FF)	4.00	3.00	75.00	Vegetables
	Mean	**2.57**	**1.53**	**65.00**	
Ikere	Aya	2.00	1.00	50.00	Vegetables
	Osun	5.00	2.80	56.00	Vegetables
	Mean	**3.50**	**1.90**	**53.50**	
Ile-Ife	Esinmirin	3.4	1.6	47.05	Vegetables
	Mokuro	2.0	2.0	100.00	Vegetables
	Dokun-Dosa	2.0	2.0	100.00	Vegetables
	Esinmirin 2 (Igboya)	3.2	1.8	56.30	Vegetables
	Agbara (FF)	2.4	2,4	100.00	Vegetables
	O.A.U Valley Bottom	2.5	0.0	0.00	----
	Omi-Ebo (FF)	2.0	1.0	50.00	Vegetables
	Omirin (FF)	9.0	4.0	44.44	Vegetables
	Kosere	2.6	1.4	53.85	Vegetables
	Agaun	3.2	0.0	0.00	----
	Omiokun	2.8	2.0	71.80	Vegetables
	Itaagbon	2.0	0.8	663.64	Sugarcane
	Mean	**3.09**	**1.58**	**55.30**	
Ilesa	Odo-Iro (FF)	2.00	1.20	60.00	Vegetables
	Odo-Ira	1.60	0.00	0.00	----
	Kaya Father	1.50	0.80	53.33	Vegetables
	Omi-Iru	0.50	0.50	100.00	Vegetables
	Erinyin	3.00	1.50	50.00	Vegetables
	Agunrodo	1.40	0.40	28.00	Sugarcane, Plantain
	Orunoga (FF)	1.20	1.20	100.00	Vegetables
	Omi-Asoro (FF)	3.00	1.80	60.00	Vegetables
	Mean	**1.78**	**0.93**	**56.49**	
Abeokuta	Ogan Ago Oka	2.00	0.80	40.00	Vegetables
	Ogun (Adedotun)	2.40	1.00	41.67	Vegetables
	Lemo	1.60	0.50	31.25	Vegetables
	Shijipon (FF)	2.00	1.00	50.00	Vegetables
	Ajegunle (FF)	2.00	0.80	40.00	Vegetables
	Olomoore	1.80	1.00	35.55	Vegetables
	Mean	**1.96**	**0.85**	**43.06**	
	Overall Mean	**2.41**	**1.33**	**49.71**	

DISCUSSION

There were no available lands for agricultural production at Ogunpa, Gege in Ibadan and Adeti in Ilesa because their banks which could have been used as Fadama sites were occupied with buildings and other structures. At Adeti in Ilesa, people were almost building on the river.

There were high or much swamps in some of the rivers because adequate channellisation of the course of the rivers was not made to make the rivers/streams to flow smoothly and which in some cases resulted in excessive overflooding of the Fadama sites and which at times made the land uncultivable as occurred in the upper part of Omirin river in Ile-Ife. However, greater percentage of the rivers surveyed had moderate swamps because their courses were either naturally or physically channeled to make their water bodies flow smoothly without hindrance and as a result of which agricultural activities were highly carried out in the banks (Fadama site) of these rivers. The low soil moisture content at the locations surveyed (Ogun and Abelonko) was due to seasonality or non perrenniality and low swamp content of the rivers. The lower % of cultivated land to Fadama agriculture still shows that more lands are still available for the production of dry season vegetables and as such more frontiers of dry season agriculture should be opened in the South Western Nigeria. In addition to the excessive flooding of the Fadama sites, old age of the landlords and the tenure system accounted for non-cultivation of some Fadama sites in the South West of Nigeria. People's culture still played a conspicuous role in influencing the type of vegetables cultivated in the different cities/towns surveyed in the South Western Nigeria. Amaranth (white on green) and Celosia were grown in all Fadama sites while Okra was grown as leafy vegetables in Igboora because of the affinity of the Igboora people for the consumption of Okra leaves as vegetable. However, vegetable jute *Corchorus olitorius* was not grown in any of the Fadama sites in Ekiti State because Ekiti people do not have affinity for it.

Cost of production was high in dry season vegetable production because it requires intensive agriculture where high rates of inputs such as seeds, fertilizer, herbicides, and labour for soil filling/bed making, rouging, harvesting and transportation are required. The high cost of production was however off set or absorbed by the high returns made from the sales of high yielding farm produce (vegetables) realized from the project. This is in agreement with the findings of Bamire and Oke (2004) who found that higher total revenue was obtained under dry season conditions than those of rainy season and that dry season production proved to be more efficient than that of rainy season. Because of this higher returns from it, dry season farming has become an in-thing in many communities in West Africa and China especially upper East Region and Yendi municipality in Ghana and Chikraeng District in China are presently engaged on the practice of dry season farming in vegetables, maize, tomato and rice so as to ensure food security and put an end to the perennial food shortages in the areas (UNDD, 2010; SRPD, 2010; MOFA, 2010). The higher returns in terms of revenue that accrued from the production of dry season vegetables was responsible for the high Benefit Cost Ratio and Comparative Advantage (C/A) attained from the project. However, it was more profitable to sell vegetables at retailed prices because double to triple prices of the wholesale were realized under retailed price system in which the vegetables were sold per unit bunch while the vegetables were sold per unit area of land under wholesale procedure.

Identifying and proffering appropriate solutions to the various constraints and problems encountered by farmers on dry season vegetable production would tremendously assist the farmers to attain the optimum productivity of their crops and vegetables. Lack of fertilizer and untimely application of fertilizers be they NPK compound fertilizer or Nitrogenous fertilizer would result in poor growth performance of vegetables. Excessive possession of swamps at the banks of some of the streams/rivers and valley bottoms can prevent the water level in the Fadama sites to recede to a level where crops and vegetables could thrive well on them during dry season. Channellisation of the river course can completely solve the problem by making the river to flow smoothly without any serious flooding of the banks than the normal seepage of water through the soil particles. Where channellisation by government and government agencies were still not forth coming, simple indigenous technology of tunneling of the soil to divert water back to the stream is recommended to solve the problem.

Organization of farmers into cooperative societies would assist them to procure highly proceed highly priced agricultural inputs including fertilizers, herbicides and insecticides. Application for Agricultural loans at Local, State, Federal Government level and even at bank level may be very useful in solving farmers' financial problems. Formation of farmers into cooperative societies to improve their purchasing and bargaining powers as well as their credibility is also recommended as panacea to the farmers financial bottle neck. Lasting and improved protective measures such as construction of fencing with hard local materials such as bamboo and glyricidia trees or use of 5cm wire mesh are recommended as permanent solution to prevent the incursion of animals into Fadama sites in the urban cities. Where the soil water is low during the dry season to fully support the good growth of vegetables, purchasing of pumping machines, and sufficient hoses and sinking of efficient deep wells through membership of cooperative societies are good panacea to the problem of low soil moisture during dry season. Proper linkage of the farmers with the extension agents (Village Extension Assistants (VEAS)) of the Agricultural Projects (ADP^{s}) of the State Ministry of Agriculture in the South Western Nigeria and attendance of short duration courses and seminars organized by the Nigerian Institute of Horticultural Research (NIHORT) and other relevant Research Institutes in Nigeria would afford the farmers the opportunity of grasping the necessary technology required in the production of vegetable and other arable crops.

CONCLUSION

Embarking on dry season vegetable production in the South Western Nigeria can be a very gainful and advantageous Agricultural enterprise when effectively and efficiently managed and considering the Benefit Cost Ratio (BCR) of 15.70 – 18.63 and Comparative Advantage (C/A) of over 250% accruable from the practice. Farmers are therefore encouraged to adopt technologies on simple method of irrigation and other production components in vegetable production as well as get prepared or geared up to utilize the remaining uncultivated Fadama lands in the various towns and cities in the South West of Nigeria to further boost the economy of the country as well as improve the income of the practicing farmers and the landscape of our cities and towns.

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EFFECTS OF ORGANIC AND INORGANIC FERTILIZERS ON THE PRODUCTIVITY OF *AMARANTHUS CRUENTUS* IN ILE-IFE, OSUN STATE, NIGERIA

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Abstract

The aim of the study was to analyse the effects of organic and inorganic fertilizers on *Amaranthus cruentus* production with the view to choosing the most profitable *Amaranth* production method. Data were collected with the aid of well-structured questionnaires that were administered to 140 farmers. Descriptive statistics, budgetary and multiple regression analysis were the analytical methods employed to achieve the objectives. The results indicated that 60.7% of the *Amaranth* farmers were females and 37% of the respondents were organic manure users. 0.65 acre was the mean size of the plot where organic fertilizer was used and 0.5 acre was the mean plot size for inorganic fertilizers. The gross margin for organic fertilizer users and inorganic fertilizer users were N52,333.10 per acre and N59,717.28 per acre respectively while N51,033.10 per acre and N58,156.48 per acre were their respective net income. Multiple regression estimates indicated that farm size, years of experience, labour and seed were significant variables determining the profitability of the crop. The study showed that the use of both types of fertilizer was profitable especially with the inorganic fertilizer. However, to increase production, the study revealed that farm size and labour must be given a positive attention.

INTRODUCTION

Urban agriculture has since been recognized as an integral and permanent element of the urban socio-economic and ecological system as reported by Van Veenhuizen and Danso (2007). This is because, about 50 per cent of the world's population now live in cities; 77 per cent of Latin Americans live in cities, while in Asia and Africa the proportion is currently 39 per cent, climbing at a rate of 3 and 4 per cent per year respectively (UN Habitat, 2003), and the numbers of urban poor are rapidly increasing with an associated growing urban demand for perishable products, including vegetables, meat, milk, and eggs, coupled with the comparative advantages of production close to the markets, and the availability of productive resources, including urban organic wastes, wastewater, and vacant public land.

Broadly speaking, two classes of fertilizers exist. These are organic and inorganic fertilizers. Nigeria is an agricultural giant nation in Africa with a total land area of 93.7million square kilometres out of which cultivable land area is about 71.2million hectares. This land area accommodates several species of indigenous leaf vegetables (ILVs). The rich diversity of the ILVs of Nigeria has been documented by several researchers including Adebooye *et al* (2003).

Vegetables (leafy and fruits) are widely grown in most parts of Sub-Saharan Africa, especially in the urban areas, and they constitute the most affordable and sustainable source of micronutrients in diets. They contain between 30 % and 50 % of iron and vitamins in resource poor diets (Sabo and Dia, 2009). *Amaranthus cruentus* is recognised as an easy-to-grow, extremely productive and nutritious vegetable. With application of fertilizers in the tropics, it is probably the highest yielding leaf vegetable. It has high potential for the production of leaf protein concentrates. Its excellent nutritional value makes it an important vegetable for human nutrition, both in the rural and in the urban areas; for home consumption and as cheap green vegetable in the city market. The necessitating continuous and intensive production of this vegetable in this area on the same pieces of land is being threatened by the resulting low soil fertility; hence the use of fertilizer is compelled.

This study was undertaken to analyse the effects of organic and inorganic fertilizers on *Amaranthus cruentus* production and; determine costs and returns to the use of these fertilizers with a view of determining the more profitable between the two classes of fertilizer.

MATERIALS AND METHODS

This study was carried out in Ife Central Local Government Area, Osun State, Southwestern Nigeria. Ile-Ife is a fairly cosmopolitan town in the State, with the bulk of dwellers engaged in the service industry. Nonetheless, a good percentage of the dwellers also have either or both tree and arable crops farm plots at the neighbouring villages. Commercial production of vegetable is therefore localised in the major cities of the State including Ile-Ife. Market survey revealed that the most common leafy vegetable both in the raining and dry seasons is *Amarantus cruentus* with the dry season's production being complemented by irrigation systems.

DATA AND ANALYTICAL TECHNIQUES

One hundred and forty respondents were randomly selected. Data was collected with the use of structured questionnaire. The information collected includes farmers' socio-economic characteristics, inputs including the quantity of organic and inorganic fertilizer and output. A combination of home units and farm plots were used in collecting information from farmers to accommodate farmers' convenience.

Analytical methods employed were descriptive statistics, budgetary techniques and multiple regression analysis. Socio-economic characteristics of the respondents were analysed using percentages, range mean. Budgetary approach was undertaken to estimate costs and returns to each of the farmers.

The total cost component is expressed as: TC = TFC + TVC; TC = Total cost; TFC = Total fixed cost and TVC = Total variable cost. Gross margin was calculated as TR – VC; Where TR = Total revenue = Price X Quantity; VC = Variable cost, and Profit = TR – TC. In order to indicate the performance of the farm enterprise, efficiency ratios analysed included cost ratio, rate of returns and labour intensity. A multiple linear regression model which is an extension of the simple linear regression was employed to determine the relationship between the Amaranth output and the various independent variables and the technique of least squares was used to estimate the multiple regression equation. Rather than straight lines, the geometric interpretation of the model involved planes. The strength of the relationship between output and independent variables was therefore measured by R^2. The multiple linear regression is defined by:

$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + B_{10}X_{10} + B_{11}X_{11} + e_i$; Where Y is Amaranth output; X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10} and X_{11} represent age, marital status, educational status, years of experience, household size, farm size (ha), quantity of inorganic fertilizer (kg), quantity of organic manure (kg), pesticide, seed and labour respectively. According to Nwaru and Iheke (2010) farm size is expected to have a positive relationship with output. Fertilizer, according to Amujoyegbe *et al.* (2007), is expected to positively affect the performance of the crop.

RESULTS AND DISCUSSION

As shown in table 1, the mean age of the respondents was 45.5 years. Based on Ringe-Metzger (1993), this implies that majority of the producers were young adults and were physically active. The mean household size was 7.8 acre and 0.55 acre for farm size. All the respondents had various levels of either formal or informal education. 32.9% of the respondents had various levels of formal education while the remaining 67.1% had various levels of informal education relating to production of vegetables. The respondents' levels of education affected their sense of appreciation for the need of fertilizers.

Table 1: Mean Distribution by type of and Percentage Distribution of farmers by sex, marital status and educational status

Variable	Organic manure users	Inorganic fertilizer users	All samples
Mean age (yrs)	45.3	47.1	45.5
Mean of household size	8.4	7.7	7.8
Mean of farm size (acre)	0.65	0.5	0.55
Male	30.8%	40.8%	39.3%
Female	69.2%	59.2%	60.7%
Married	90%	12.5%	23.6%
Divorced	0%	4.2%	3.6%
Separated	0%	25%	21.4%
Single	10%	58.3%	51.4%
Formal education	35%	34.2%	32.9%
Informal education	65%	65.8%	67.1%

Field survey, 2009

The results indicated that 60.7% of the *Amaranth* farmers were females and 37% of the respondents were organic manure users. Most farms were smallholders; 0.65 acre was the mean size of the plot where organic fertilizer was used and 0.5 acre was the mean plot size for inorganic fertilizers.

Budgetary analysis revealed that the average total revenue for organic manure users was ₦85,232.1 while that of inorganic fertilizer users was ₦63,777.5. The cost to revenue ratio for both organic manure and inorganic fertilizer users were 0.20 and 0.32 respectively. Labour accounted for 91.3% of the variable cost of organic manure users and 93.8% of the inorganic fertilizer users. The higher labour cost associated to the use of inorganic fertilizer was partly due to the labour requirement needed to handle a much larger volume of output.

Table 2: Gross Margin Analysis in naira

Item	Organic manure users		Inorganic manure users	
Total revenue		63,777.50		85,232.10
Seed	(341.90)		(479.80)	
Organic manure/inorganic fertilizer	(337.50)		(777.10)	
Chemicals	(315)		(315)	
Labour	(10,450)		(23,942.92)	
Total variable cost		(11.444.40)		(25,514.82)
Gross margin		**52,333.10**		**59,717.28**
Fixed cost	(1,300)		(1,560.80)	
Net income		**51,033.10**		**58,156.48**

Source: Field survey, 2009

The gross margin for organic manure users and inorganic fertilizer users were ₦52,333.10 per acre and ₦59,717.28 per acre respectively while ₦51,033.10 per acre and ₦58,156.48 per acre were their respective net incomes. The t-statistics showed that the figures were all statistically significant at 5%.

The multiple regression analysis showed that 77% change in Amaranth output was jointly accounted for by the independent variables and the model was fit at 1%. Farm size and labour variables coefficients were positively and statistically significant at 1%. A unit change in these variables will increase the level of output of Amaranth by 200 kg and 29 kg respectively. The findings therefore agree with Ogundele (2003) where labour and farm size were found to be positively and statistically significantly associated with changes in crop output. The coefficients of organic manure and inorganic fertilizer variables were also positive and significant at the 10% and 5% levels respectively. A unit change in inorganic fertilizer variable increased the dependent variable by 48.86 kg and 27.62 kg increase in the level of output with a unit change in organic manure use. This indicated that fertilizer and organic manure were important factors in Amaranth production. The years of experience variable was significant at 5% and also had a direct relationship on the regressant. This implies that the more experienced farmers are, the higher the output of Amaranths. Seed, age, marital status and educational status did not significantly influence the output.

Table 3: Estimation of output coefficient

Variables	Coefficient	t-value
Constant	-83.31*	2.67
Age	-1.02	0.22
Marital status	0.69	1.21
Educational status	11.93	0.15
Years of experience	40.11**	2.59
Household size	25.81*	2.62
Farm size	2000.01*	3.44
Inorganic fertilizer	48.86**	2.36
Organic manure	27.62***	1.73
Pesticide	1.51	0.12
Seed	-0.32	-0.14
Labour	51.93*	4.95

*Significant at 1% **Significant at 5% ***Significant at 10%

$R^2 = 0.77$ Prob value = 0.000

still in their active years, mostly females with a significant proportion having no formal education

Source: Field survey, 2009

CONCLUSION

The results of the study showed that farmers of *Amaranthus cruentus* in the study were. The study showed that *Amaranthus cruentus* production was profitable under both organic and inorganic fertilizers administrations but more profitable under inorganic fertilizer regime. The contribution of both types of fertilizer to the level of profitability was also indicated by the outcomes of regression analysis for which the fertilizer estimates were positive and statistically significant. Indications from previous studies conducted by Ogundele (2003) however suggested that care must be exercised with inorganic fertilizer usage as excessive application may result in salt accumulation which in turn will be detrimental to crop growth and output.

The significant and positive influence of household size suggests availability of family labour for the farming enterprise. This was also corroborated by the by the significant estimate obtained for labour variable. The results therefore indicated that any policy thrust directed at promoting cropping of the crop where labour is available will boost its production. Since global demographic structure is undergoing a transformation process that requires basic priority assessments and development of a plan in which the issues relating to a consistent good food supply are properly addressed. Going by the high significance of farm size to the production of the crop therefore and, to effectively deal with the emerging challenges resulting from the distortions created by the rural-urban migration; urban and peri-urban agriculture should be given institutional support by consciously protecting the existing farm plots and deliberately carving out new farming areas within and around the cities to plant the crop. Since Amaranth production is also profitable with the use of organic manure and also considering the relative safety of organic manure to human health and environment; governments at different levels should embark on efforts to convert urban wastes to organic manure that will in turn be used in the production of vegetables. Distribution and sale of inorganic fertilizers should be done through farmers' groups and cooperatives to remove the bottlenecks created by the intermediaries.

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FARMERS WILLINGNESS TO PARTICIPATE IN GROUP MARKETING OF THEIR PRODUCE IN IFE EAST LOCAL GOVERNMENT

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Abstract

This study assessed the farmers' willingness to participate in group marketing of their produce in order to utilize the market forces better to their advantage. A multistage sampling procedure was used to select 150 respondents for the study. A pre-tested and validated interview schedule was used to obtain quantitative data from the respondents. Data were analyzed using descriptive and inferential statistical tools. Result of the findings revealed that the mean age of the respondent was 42.17 years and the mean annual income was ₦241, 000. The average household size was 5. Majority (62.5%) of the respondents sell their farm produce to middle men. Result of correlation analysis showed that distance of markets from farm ($r = 0.470$) and association membership ($r=0.360$) had positive and significant correlation with farmers' willingness to participate in group marketing at $P \leq 0.05$. Also, age has a negative but significant correlation with farmers' willingness to participate in group marketing ($r = -0.188$) at $P \leq 0.05$. Attitude of farmers towards group marketing of farm produce also showed a positive and significant correlation to farmers willingness to participate in group marketing of their farm produce ($r = 0.426$) at $P \leq 0.01$. Result of regression analysis confirmed age, membership of association, distance to market and attitude towards group marketing as determinants of farmers' willingness to participate in group marketing with R^2 value of 0.482. The study concluded that the peri-urban farmers in the study area should be educated on the gains of group marketing as it could help them to harness a better deal for their products.

INTRODUCTION

Cooperative or group marketing is a marketing strategy in which farmers collaborate with each other and pool their resources together to form a group where they decide on the unified price system at which their various farm produce would be sold with a unified standard of measurement. Cooperative marketing are indeed cooperative businesses owned by farmers, to undertake transformation, packaging, distribution, and marketing of farm products (both crop and livestock.) (Wikipedia, 2008). This invariably improves relationship between farm families and also helps farmers to create new products, expand markets and promote themselves. Although, it requires time and some legal process and cost for a cooperative marketing group to be recognized by the government, agricultural cooperatives help farmers to overcome the curse of smallness. Considering the importance of group marketing and its promised benefits to farmers, efforts should be made to analyze the willingness of farmers to participate in it.

The specific objectives of the study are to describe

- the socio-economic characteristics of the farmers in the study area;
- market and marketing related characteristics of farmers in the study area;
- farmers attitude to group marketing of farm produce in the study area; and
- determine farmers' willingness to participate in group marketing of their produce.

HYPOTHESIS FOR THE STUDY

There is no significant relationship between farmers' selected socio-economic characteristics and their willingness to participate in group marketing. This was the framework upon which the study was built and data collected was analyzed to accept or reject this hypothetical stand.

METHODOLOGY

Osun state in the South-west of Nigeria is the study area. It covers an approximate land area of 14,875 square kilometres. The indigenes of the State belong to the Yoruba tribe and the people engage in agriculture and produce sufficient food and cash crops for domestic consumption and as inputs for agro allied industries and for export.

Sampling and sample selection

Ife-East Local Government Area was selected for the study because it houses the University based Integrated Rural Development Programme- the Isoya project. Seven communities under the project were selected for the study. The communities are Iyanfoworogi, Erefe, Kudunrun, Akeredolu, Ita-osa and Owodo. These are peri-urban communities around Ile-Ife - transition or interaction communities where urban and rural activities are juxtaposed and landscape features are subject to rapid modifications, induced by human activities (Douglas, 2006). Arable farmers were then selected from the communities depending on the population and the number of arable farmers in them. In all, a total of 150 respondents were therefore, selected for the study. Validated and pre-tested interview schedule was used to elicit primary data from the respondents thus selected.

Measurement of variables

The dependent variable was farmers' willingness to participate in group marketing of their produce and it was measured using the Likert scale. Respondents were asked to respond to a set of questions on willingness to participate in group marketing activities of farm produce as established by Ajayi (2004). Responses were scored using strongly agree 5, agree 4, undecided 3, disagree 2 and strongly disagree 1. The maximum point for a respondent was 20 and the minimum was 4. The total score per respondents was taken as the score on willingness to participate in group farming. Selected socio- economic characteristics like age, sex, marital status, household size and so on were measured using their absolute values as given by the farmers.

Market related variables like point of sale of produce; buyers of produce, market distance and so on were also measured by farmers' responses to relevant questions on those variables. Farmers' attitude to group marketing of farm produce was also measured with responses to some standardized statements on a Likert scale which was scored as strongly agree 5, agree 4, undecided 3, disagree 2 and strongly disagree 1. The maximum score obtainable by a respondent was 40 and the minimum was 8. This was further classified into favourable, indifferent and unfavourable categories using mean and the standard deviation. Frequency, percentage, mean and standard deviation were used to summarize the data collected. Correlation and regression analyses were used to test the hypothesis stated.

RESULTS AND DISCUSSIONS

Data presented in Table 1 revealed that 33.1 per cent of the respondents were below 30 years of age. About 26.1 per cent of the farmers were between the ages of 31-40 years. The average age of the respondents was 42.17 years with a standard deviation of 8.97. This revealed a relatively younger group of people participating in farming in the peri-urban communities studied. The table also revealed that majority (70.0%) of the respondents was males while 30.0 per cent were female. Also, most of the respondents (88.0%) were married while 12.0 per cent were single. This means family consideration might be an influence on the respondents' decision to venture into farming activities.

Household size of the respondents revealed that majority (72.7%) of them had up to six members in the household while about 19.3 per cent had 7-9 members in the household. Majority (72.7%) of the respondents having family size of six people is in tandem with Ekong (2003) who reported that the average family size in rural south western Nigeria is six. The average family size of the respondents studied is 5 members with standard deviation of 2.8. The table also revealed that almost half (47.3%) of the respondents acquired land for farming activities by rent while 43.3 per cent acquired land through inheritance. Majority (71.6%) of the farmers sourced capital for farming activities from personal earnings while 18.2 per cent sourced capital from cooperative associations. The average annual income of the respondents was ₦ 241, 000 with a standard deviation of ₦35, 121. This is above the minimum wage of the Federal civil services in Nigeria, put at about N 84, 000 per annum. Data in Table 1 also revealed that more than half (54.7%) of the respondents had association membership score between 5-7 while 32.7 per cent of the respondents had association membership score, less or equal to 4.

Table 1: Distribution of respondents by selected socio-economic characteristics

Variables	Frequency	Percentage	Central tendency
Age			
≤ 30	50	33.1	
31 – 40	39	26.1	Mean = 42.17
41 – 50	21	14.1	Std. dev = 8.97
51 – 60	22	14.8	
60+	18	11.9	
Sex			
Male	105	70.0	
Female	45	30.0	
Marital status			
Single	18	12.0	
Married	132	88.0	
Household size			
≤ 6	109	72.7	
7-9	29	19.4	Mean = 5
10-12	8	5.3	Std. dev = 2.8
13+	4	2.6	
Land acquisition			
Leasehold	17	11.3	
Rent	71	47.3	
Inherited	62	41.3	
***Sources of capital**			
Personal earnings	114	71.6	
Local lenders	7	4.4	
Marketing cooperative	29	18.2	
Friends and family	9	5.6	
Association membership score			
< 4	49	32.7	Mean = 5.6
5 – 7	82	54.7	Std. dev = 2.3
7+	19	12.6	

Annual income (₦)			
≤ 200, 000	22	14.7	
200, 001 – 400, 000	89	59.3	Mean = 241, 000
400, 001 – 600, 000	28	18.7	Std. dev = 35, 121
600, 000 +	11	7.3	

* = multiple responses

Only 12.6 per cent of the respondents had association membership score above 7. This showed that farmers are not strange to participation in group activities in the study area. Groups are therefore in existence and could be advantageous to the introduction of group marketing of produce. Equally, it could also be a disadvantage if their previous experiences in group related matters had been discouraging and hence make activities to be suspicious.

Market and marketing related characteristics

Findings of the study revealed that almost half (49.6%) apiece of the respondents had farm gate and market place respectively as their points of sale of farm produce. This is an indication that mostly farmers in the study area either sell at the farm gate or take their produce to the market for sale. Also, many (62.5%) of the respondents sell farm produce to middlemen while 36.1 per cent of them sell to neighbors' who are categorized as consumers. The average distance to the nearest established farm produce markets in kilometer was 5.07 with a standard deviation of 1.19. The study showed that more than half (58.7%) of the farmers would travel less than 5.07 kilometers to the nearest market while 41.3 per cent of the farmers would travel more than 5.07 kilometers to the nearest market. The farm produce of the farmers are mostly food crops including maize, cassava, vegetables, cowpea, sweet potato and cocoyam.

Attitude of farmers towards group marketing of farm produce

Data in Table 2 revealed farmers responses to attitudinal statements. The table revealed that the weighted mean of the statement 'group marketing increases the income of farmers' was highest (4.53) while the weighted mean of the statement 'group marketing eliminates middlemen in marketing' was lowest (2.58). This showed that respondents did not believe that group marketing could reduce the effects of middle men in marketing of farm produce. The average attitudinal score of the respondents was 31.59 with a standard deviation of 4.35.

The attitudinal score of respondents was further classified and presented in Table 3. Majority (78.7%) of the respondents had indifferent attitude towards group marketing of farm produce while 15.3 per cent had unfavourable attitude towards group marketing of their farm produce. Only 6.0 per cent of the respondents had favourable attitude towards group marketing of farm produce in the study area.

Table 2: Distribution showing attitude of farmers towards group marketing of farm produce

Attitudinal statements	SA Freq. %	A Freq.%	U Freq.%	D Freq.%	SD Freq.%	Central Tendency
Group marketing increases the income of the farmers.	106(70.7)	28(18.7)	7(4.7)	8(5.3)	1(0.7)	Mean=4.53 Std=0.864
Group marketing enhances unity and cooperation among farmers.	28(18.7)	112(74.7)	4(2.7)	4(2.7)	2(1.3)	Mean=4.07 Std=0.662
Group marketing serves an avenue to enjoy government subsidies.	89(59.3)	47(31.3)	9(6.0)	4(2.7)	1(0.7)	Mean=4.46 Std=0.783
Group marketing is a worthwhile and lucrative venture for farmers.	27(18.0)	99(66.0)	13(8.7)	6(4.0)	5(3.3)	Mean=3.91 Std=0.851
Group marketing enhances price control of agricultural goods by farmers.	79(52.7)	47(31.3)	11(7.3)	11(7.3)	2(1.3)	Mean=4.27 Std=0.974
Group marketing eliminates middlemen in marketing.	9(6.0)	22(14.7)	26(17.3)	83(55.3)	10(6.7)	Mean=2.58 Std=1.018
Group marketing wastes time and energy	11(7.3)	15(10.0)	11(7.3)	62(41.3)	51(34.0)	Mean=3.85 Std=1.208
Individual marketing is better than group marketing.	94(62.7)	18(12.0)	8(5.3)	11(7.3)	19(12.7)	Mean=4.05 Std=1.458

Participation in group marketing of farm produce

Analysis revealed that the average score of respondents' willingness to participate in group marketing of farm produce was 14.39 with a standard deviation of 2.4. The table revealed that majority (70.0%) of the respondents have willingness score above the mean (14.4 – 18) and could be tagged high while 30.0 per cent of the respondents have willingness score below the mean (8.0 – 14.4) and could be tagged low.

The study also revealed that majority (84.0%) of the respondents said there is no hindrance to their participation in group marketing of farm produce while 4.0 and 3.3 per cents of the respondents pointed to disunity within the group and cheating respectively as likely hindrances to their participation in group marketing of farm produce. This revealed that majority of the farmers do not have any reason for not participating in group marketing of their farm produce.

Results of correlation analysis for hypothesis testing

Analysis revealed the outcome of correlation analysis carried out between the independent variables studied and the farmers willingness to participate in group marketing to establish the existence or otherwise of any relationships between them. It was revealed from the data that four of the studied independent variables had significant relationships with farmers' willingness to participate in group marketing of their farm produce. The variables are age, association membership, distance of farmers to nearest markets and attitude of farmers towards group marketing. Result of analysis revealed a negative but significant relationship between age ($r = -0.188$) and farmers willingness to participate in group marketing of farm produce at 5 per cent level of significance. Also, positive and significant relationships exist between association membership ($r = 0.360$) and distance to markets ($r = 0.470$) and farmers willingness to participate in group marketing of farm produce at 5 per cent level of significance.

Table 3: Correlation analysis showing relationship between selected variables and dependent variables

x-variables	Correlation coefficient (r)	Coefficient of determination (r^2)
Age	-0.188*	0.0354
Family size	-0.087	0.0076
Association membership	0.360*	0.1296
Annual income	0.014	0.0002
Attitude towards group marketing	0.426**	0.1815
Distance to markets	0.470*	0.2209

* = r significant at 5% level of significance, **= r significant at 1% level of significance

Attitude of farmers also showed a positive and significant relationship with their willingness to participate in group marketing (r = 0.426) at1 per cent level of significance. These could be explained to mean that the older the farmers, the lower their willingness to participate in group marketing of their farm produce. This might be as a result of the fact that the older people becomes the lower their tendencies of taking risks- the more averse to innovations they become. In addition, they might be used to the old ways of doing things and not willing to change.

Furthermore, the more farmers participate in associations, the more they are willing to participate in group marketing of their farm produce. This could further be explained to mean that membership of associations could easily induce participation in group marketing activities since most of the barriers to interpersonal relationship like suspicion would have been overcome. Also, the longer the distance of nearest markets to the farmers, the more their willingness to participate in group marketing of their farm produce. This could be as a result of the cost implication of transporting the produce to the markets individually since pulling resources together will eventually lower the individual farmers cost of marketing. It was also revealed that the more favourable the attitude of farmers towards group marketing of farm produce, the more the willingness of farmers to participate in group marketing of their farm produce. The coefficient of determination (r^2) which is the percentage contribution of each of the significant x-variables was given as 0.0354, 0.1296, 0.2209 and 0.1815 for age, association membership, distance to nearest market and attitude of farmers towards group marketing of farm produce respectively.

RESULT OF REGRESSION ANALYSIS

The result of the regression analysis showed that the four significant independent variables accounted for 48.2 per cent of the total change in the farmers' willingness to participate in group marketing of their farm produce. The values of the significant x- variables are age (b = -0.030), association membership (b = 0.189), attitude of farmers towards group marketing of farm produce (b = 0.227) and distance of nearest market to farmers (b = 0.142) respectively. This revealed that these four variables are crucial to farmers' willingness to participate in group marketing of their farm produce. The F-statistics was 5.807 and was also significant.

Table 4: Result of regression analysis

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	T	Sig.
(Constant)	7.982	1.543		5.173	.000
Age	-.030	.015	-.193	-1.997	.044
Family Size	.057	.078	.068	.728	.468
Association membership	.189	.264	.056	.714	.037
Annual income	-.029	.611	-.005	-.047	.963
Distance to markets	.209	.656	-.115	-1.069	.029
Attitude	.227	.042	.408	5.378	.000

Dependent Variable:
Willingness score; R = 0.694, R^2 = 0.482, Adjusted R^2 = 0.417, F = 5.807, Sig = 0.000

CONCLUSIONS

The study concluded among others that more than half of the respondents are less than 50 years of age. Also from the findings of the study, majority (70.0%) of the respondents was males and majority (88.0%) also was married with average household size of 5 members. This establishes the fact that family influences could be a major factor in farming activities and in decision making in the study area. Average annual income of the respondents was ₦241, 000 with a standard deviation of ₦35, 121. It was also established by the study that almost half (49.6%) of the respondents apiece had farm gate and markets as their points of sale respectively and many of them (62.5%) sell to middlemen.

On the average, farmers in the study area travelled 5.07 kilometers to the nearest markets to sell their produce and majority (86.0%) of them had indifferent attitude towards participation in group marketing of farm produce.

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REUSE OF ORGANIC SOLID WASTE IN IBADAN, OYO STATE, NIGERIA

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Abstract

Urbanization problems in Nigeria have reached serious proportions, cities like Lagos, Ibadan, Aba, a few have become problem cities. The environmental problems created by population pressure in these cities and towns with respect to waste management and re-use have reached critical levels. This study assessed the economics of waste re-use in urban agriculture in Ibadan, Oyo State. A total of one hundred farming households were selected using a stratified random sampling technique. Data were analyzed using statistical tools such as descriptive and regression analysis. The results showed that most of organic solid wastes found in urban area include manure from livestock and residues from crops. Use of much of these wastes was reintegration into the farming system. Majority of waste were destroyed at open dumps, landfills and incinerators. The regression results showed that females' respondents reused waste more than the males' counterpart. Moreover, as method of waste disposal increased the rate of waste reused also increase. The study concluded that conservational ways of treating some materials, which are regarded as waste by just discarding and throwing them away, should be re-evaluated in the face of intra and inter-sectoral competition in the economy.

INTRODUCTION

Urbanization problems in Nigeria have reached serious proportions, cities like Lagos, Ibadan, Aba, a few have become problem cities. The environmental problems created by population pressure in these cities and towns have reached critical levels. The standard of general sanitation according to Adedibu and Okekunle (1989) is poor in nearly all thickly populated areas of Nigerian cities and markets. Waste generation and disposal are of serious concern and an imminent environmental problem in many cities of the country. Waste management problem has also emerged as a visible and tangible measure in urban consumption (Brook and Davila, 2000). Effective strategies to address waste problem are often the first time action for those seeking to reverse the trends of deteriorating environmental condition.

Within the last four decades, the problem of wastes has become a major issue in Nigeria. The problem has become increasingly complex not only because of the quality involved but also due to the rapid rate of per capital waste generation.

The goal of waste management is to reduce to a minimum and possibly convert the inevitable waste to economic good. One issue that deserves attention is that what is regarded as waste in an operation is being turned into economic goods or useful input in another operation.

Urban agriculture can improve resource use as it reuses the nutrients contained in both liquid and solid waste products. FAO (1995) estimated that typical waste water effluent from domestic sources when appropriately treated could supply all of the nitrogen, phosphorus and potassium that are normally required. Urban agriculture can also improve the environment and human health through the production of trees, shrubs, flowers and ornamental plants to beautify the city cool its climate and absorb air pollution and odour. Its share of vegetables, fruits, meat, fish and dairy consumed in cities could rise from 33% to 50% and the number of farmers producing for the market might increase from 200 million to about 400 million (CFP, 1996).

In order to enhance the positive impact that urban livelihood, resources utilization, and the environment, there is the need to bridge the gap between urban agriculture research and practice with urban planning and policy issues. Moreover, it is fundamental to the health of any community that wastes be managed in the safest way (Olaniyi, 2004). All around the world, people have suffered a great deal from waste generated from household, agriculture and industry. These wastes affect nature directly and indirectly and the after-effects have been of great concern to the government and individuals. Consequently this study will examine the socio-economic characteristics of the farmers; explore the reuse of wastes and the waste management practices of the farmers

METHODOLOGY

The study was carried out in Ibadan metropolis which is generally referred to as the largest indigenous city in Nigeria and in West Africa. Ibadan lies within the humid zone of West Africa and located in low lying forested area with an average annual rainfall of between 1250 and 1800 mm. The metropolitan city which is on latitude $7^0 20'$ N and longitude $2^0 50'$E, has a bimodal type of rainy season with a peak in June and October. The dry season stretches from mid November to mid March. The temperature ranges from 27^0C to 32^0C and relative humidity average 85%. The climatic condition favours the production of arable crops, some tree crops, etc (FAO, 1995).Majority of people living in Ibadan metropolis engage in various occupations apart from agriculture.

The sampling was done by stratified random collection and a total of one hundred respondents were selected. The respondents were interviewed through structured questionnaires. Primary source was mainly used in the study and was complemented with secondary data. The primary data was obtained from respondents in the area via the use of questionnaires and the questions based on the objectives of the study. The source of secondary data was based on past records and literature.

The information obtained from interview and responses to questionnaires were analyzed using statistical tools such as descriptive and regression analysis. The descriptive analysis was employed to summarize and describe the data collected in percentages, frequency distribution and measures of central tendency. A regression model was fitted to examine the functional relationship among some selected variables. The model sought to estimate the relationship between independent variables and the dependent variables. The functional form of the model used in the study is multiple regressions.

$$Y= B_0+B_1X_1+B_2X_2+B_3X_3+B4X_4+B_5X_5+B_6X_6+B_7X_7+U$$

Where: Y =Rate of waste use (Dependent variable)

$X_{1=}$ Age; X_2 = Educational level; X_3= Occupation; X_4 = Farm size; X_5 =Income level; X_6 = Family size; X_7 = How waste is disposed; U = error term

RESULTS AND DISCUSSION

Socio-Economic characteristics of urban farmers

Table 1 showed that majority of the respondents (78.0%) were males, while (22.0%) of the respondents were females. The Table showed a marked progress of involvement in farming as an occupation across the age range with the majority (53.0%) of the farmers within the age range of 60 – 69 years while minority (1.0%)are in the 20 – 29 years age range. According to the Table, majority (92.0%) of the farmers were married, while minority (7.0%) was single which shows that the marriage institution is rampant among urban farmers. Most of the farmers (75.0%) have a household size of 7 – 9 members.

Table 1: Socio-Economic characteristics of urban farmers

Gender	Frequency	Percentage	Cumulative (%)
Male	78	78.0	78.0
Female	22	22.0	100.0
Total	100	100.0	
Age group (years)			
20 – 29	1	1.0	1.0
30 – 39	6	6.0	26.0
40 -49	13	13.0	37.0
50 – 59	20	20.0	42.0
60 – 69	53	53.0	83.0
70 and above	7	7.0	31.0
Total	100	100.0	
Marital status			
Married	92	92.0	92.0
Single	8	8	100.0
	100	100.0	
Household size			
1 -3	5	5.0	5.0
4 – 6	20	20.0	25.0
7 – 9	75	75.0	100.0
	100	100.0	

Source: Field Survey 2008

Educational, occupational and farming related characteristics of the respondents

Table 2 showed that 65.0% of the farmers were literate while 35.0% were illiterate which consistent with the fact that the farmers are in urban area. It showed that 62.0% of the farmers while 10.0% were civil servants which suggest that farmers will be the one interested in reuse of waste. Some of the respondents are engaged in poultry (37.8%), followed by cropping (34.4%) and cattle rearing (7.8%). The results showed that some urban farmers indulged in farming to generate income, that is, commercial purpose (14.0%), while some engaged in farming for both income generation and to provide fresh food for the home. Urban agriculture is one of the ways used by urban dwellers to ensure food security. Urban agriculture has great potential in provision of food, employment and income. Table 2 showed that nearly halve of the farmers (53.0%) had a farm size of less than 3 ha.

Table 2: Educational, occupational and farming related characteristics of the respondents

Educational level	Frequency	Percentage	Cumulative (%)
Literate	65	65.0	65.0
Illiterate	35	35.0	100.0
Total	100	100.0	
Occupation			
Farming	62	62.0	63.0
Trading	19	19.0	82.0
Civil servants	10	10.0	92.0
Others	8	8.0	100.0

TOTAL	100	100.0	
Type of farming			
Cropping	31	34.4	34.4
Poultry	34	37.8	72.2
Cattle rearing	7	7.8	80.0
Fishery	18	20.0	100.0
Total	90	100.0	
Aims of farming			
Subsistence	8	8.0	7.0
Commercial	14	14.0	21.0
Both	77	77.0	98.0
Total	100	100.0	
Farm size range (ha)			
1 – 3	53	53	53.0
4 – 6	40	40	40.0
7 – 8	7	7	7.0
Total	100	100.0	

Source: Field survey 2008

Waste management practices

Most of organic solid wastes found in urban area include manure from livestock and residues from crops. Use of much of these wastes is integrated into the farming system. Animal husbandry and cropping are the most popular form of agricultural activity in urban areas and many farmers enjoy income comparable with other professions.

The waste generated through farming activities overshadows other forms of waste generated by the farmer (80%), further strengthening the finding that farming is the primary source of activity amongst urban farmers.

Despite the volume of waste generated, the frequency of waste disposal was small and there were limited positive uses of waste. Majority of waste were destroyed at open dumps, landfills and incinerators. The sound knowledge of waste management amongst the farmers does not manifest in practice. The result also demonstrated that all farmers are fully aware of the environmental implications of improper waste disposal or benefit thereof. Nonetheless, few gave little regard to the environmental impact when disposing of waste. The issue of convenience and resource was over-riding in adopting appropriate disposal method.

As development occurs, and the urban population increases, the type of waste generated is likely to change and the amount increased. Productive use of these organic solid wastes is desirable to conserve resources and to protect the urban environment. Farmers are unwilling to change to organic fertilizers because of fear of failure or the risks involved. The uses of organic techniques including composts are perceived as providing too long-term results or are old-fashioned or obsolete.

Regression Analysis

The lead equation chosen out of the functional forms fitted was linear regression function. The choice of this was based on the economics theory, statistical and econometric criteria. The result of regression analysis for the postulated rate of waste use (dependent variable) is presented in table 3. The R^2 (0.766) shows that 76.6 % of the variability in the dependent variable (rate of waste use) are accounted for by the independent variables, which shows the explanatory power of the equation.

The analysis showed that only two variables are significant these are gender and waste disposed method at 1% and 10% respectively. The results indicated that females' respondents reused waste more than the males' counterpart. In addition, as method of waste disposal increased the rate of waste used also increased.

Table 3: Distribution of the independents variables

Variables	**Coefficient**	**T-value**
CONSTANT	0.231	0.568
SEX	-0.236**	-1.925**
AGE	-0.031	-0.262
EDUCATION	-0.120	-1.174
MARITAL STATUS	-0.169	1.555
OCCUPATION	-0.114	-0.856
FARMSIZE	-0.070	0.461
RELIGION	-0.052	-0.513
ASSOCIATION	-0.067	-0.657
INCOME LEVEL	-0.135	-1.066
FAMILY SIZE	0.098	0.785
WASTE DISPOSAL METHOD	0.306***	3.111***
R^2	0.77	
Adjusted R^2	0.65	

* = Significant level at 1%; ** = Significant level at 5%; ***= Significant level at 10%.

Source: Field survey Analysis, 2008

CONCLUSION

Most urban farmers are male. Aged less than 70 years, married and belong to small, medium sized families. Majority of the farmers were also primarily engaged in farming as an occupation, despite that most were educated beyond secondary school level. This dismisses insinuations that urban farmers practiced farming as a complementary occupation to other "white collar jobs" associated with urban regions.

The farmers possess good knowledge of waste managements and its uses. Despite the volume of waste generated, the frequency of waste disposal was small and there were limited positive uses of waste. Majority of waste were destroyed at open dumps, landfills and incinerators. Females' respondents used waste more than their males' counterparts and as the methods of males' disposal increased the rate of waste reuse also increased. Based on the results of this study, the following recommendations were made so that agricultural waste in urban area are reduced and properly managed.

(1) A decentralized integrated and participatory approach to solid waste reuse, management planning and urban cultivation.

(2) The conservational way of treating some materials, which are regarded as waste by just discarding and throwing them away, should be re-evaluated in the face of intral and inter-sectoral competition in the economy.

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URBAN AGRICULTURE AND HOUSEHOLD FOOD SECURITY IN LAGOS METROPOLIS, NIGERIA

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Abstract

This study attempted to examine the profitability and factors affecting productivity of vegetable production, poultry and fish farming in Lagos metropolis. A combination of purposive and random sampling techniques was used to select 140 respondents in the study area. Data were collected on socio-economic characteristics, input and output quantities, income and expenditure patterns of the respondents. Data were analysed using descriptive statistics, budgetary techniques and regression methods. Results showed that the gross margin per naira invested on vegetable production, poultry and fish farming were about ₦ 2.41, ₦ 0.15 and ₦ 1.27 respectively.

INTRODUCTION

Urban agriculture is not only a potentially significant source of income, food, energy, and micronutrients for family members, but it can also benefit the environment by providing a way to reuse urban water, plant and animal wastes. It can be characterised as a means of obtaining some amount of food through subsistence or non-market activities. It can also be described as a household survival strategy that is predominantly adopted by households whose monetary incomes are inadequate to purchase sufficient food. Households involved in urban agriculture are considered to be both producers and consumers. Such households are also considered to contribute to the food security of their cities and as major components of urban food systems (Armar-Klemesu, 2000). Furthermore, urban agriculture has positive roles in providing food, improving incomes, providing employment and therefore offers benefit to different classes of people and organisations.

With the realisation that the problem of hunger has more to do with inequalities in distribution and that increased food production is only part of the solution, the issue about food security has shifted from being only a question of availability of food (at the household or individual level). Food security therefore incorporate issues of adequacy of food, supplies, stability of supplies and secured access to available supplies. Food security therefore refers to secure access at all times to sufficient food for a healthy and active life (FAO, 1996).

Household food security depends not only on the availability of an adequate and sustainable supply of food but also on the means employed by households to acquire the needed food. Stability of household food supplies depends on the ability of a household even when faced with unpredictable crises to procure through income, production and transfers of adequate food supplies on a continuous basis. A household is food secure when it has adequate access to food for a healthy life for all its members (adequate in terms of quality, quantity, safety and cultural acceptability) and when it is not at an undue risk of losing such access.

Although most inhabitants of the urban areas especially the unemployed, low income earners and sometime middle income earners can barely cope with the expensive lifestyles in the urban areas and many of these people tend to depend on urban agriculture as additional means of income. Smit et al. (1996) claim that about 800 million people are engaged in UA worldwide; of these, about 200 million are market producers, employing about 150 million people full-time. It has been estimated that about 25 million out of the 65 million people living in urban areas of Eritrea, Ethiopia, Kenya, Tanzania, Uganda and Zambia obtained part of their food from UA and that, by 2020, at least 35-40 million urban residents in these areas will depend on UA to feed themselves (Denninger et al., 1998). The questions therefore are: Is urban agriculture an economically feasible means of ensuring food security especially in Lagos metropolis? This study will therefore determine the costs and returns involved in urban agricultural enterprises and determine the factors affecting the profitability of these enterprises.

RESEARCH METHODOLOGY

This study was conducted in Lagos state, Nigeria. Lagos is one of the most populated metropolises in Nigeria with high rate of urbanization. Three enterprises were identified in this area. These are vegetable production, fish farming and poultry farming. Vegetable production was carried out specifically for sale. Vegetable plots were either located besides streams or in wetlands. Vegetable production, in the study area, was considered a temporary off-season employment opportunity that was used to maintain a constant flow of income during the dry season (October to March). This is also the time when vegetables are most needed, especially in urban market, because of the decline in rural vegetable output.

Vegetables were grown on vegetable beds on plots of land of an average of about 0.2 hectare per farmer. Most of the farmers paid rent either to the local government council or to the landlords or purchased the urban land for their agricultural activities but majority depended solely on family labour.

Fish farming was carried out either in dugout ponds, ponds made of concrete or ponds made with plastic. These ponds were of different sizes and were located within the residence of the farmers. While majority of the farmers produced only Catfish, especially among the concrete and plastic ponds, few of them produced Tilapia in addition to Catfish.

Poultry production was done at commercial level and it was mainly for egg production. Although some of the farmers used the deep liter system, most of them were engaged in battery cage system of production. The production period was taken to be six months (October to march).

Data were collected using structured questionnaire drawn on 116 urban agriculture operators from four Local Government Areas (Mushin, Kosofe, Ikorodu and Agege) of Lagos State. The LGAs were purposively selected out of all the LGAs where urban agriculture was being practiced in the State, and 30 respondents were sampled (i.e 10 respondents randomly sampled within each of vegetable, fish and poultry egg producers) within each LGA. A total 120 farmers were interviewed for the study but only 116 respondents provided useful data for the study.

Data were analysed with using descriptive statistics which involved the use of mean, mode, and percentages to describe the study variables; budgetary technique to estimate the costs and returns involved in production; and the regression technique to estimate the factors affecting profitability of urban agriculture.

SPECIFICATION OF MODELS

The costs and returns involved in production were estimated through the computation of the gross margin as: $GM_{ij} = TR_{ij} – TVC_{ij}$ Where GM = gross margin, TR = Total revenue, TVC = Total variable costs, i = enterprise, j = farmer

The profitability of each enterprise was thereafter estimated as gross margin per naira invested in the enterprise i.e. profitability = GM/₦. The factors affecting the profitability of urban agriculture enterprises were determined using regression analysis. The model was implicitly stated as: $y_i = f(X_{ij})$ Where y = Gross margin from enterprise 'i', x_j = determinant 'j' of gross margin.

RESULTS AND DISCUSSIONS

The farmers involved in urban agriculture were predominantly middle aged (about 46 years old) married females and majority had some level of formal education (primary school education). Most of the farmers were engaged in urban agriculture as their primary occupation with farming experience of between 7and 9 years and mean household size of about 5 people. Majority of these farmers acquired their farmland through lease holding. This is consistent with Ezedinma and Chukuwezi (1999).

Table 1: Socio-economic characteristics of urban agriculture operators

Item	Frequency
Gender: Female	53.5%
Mean age (years)	45.5
Age range (years)	20 – 70
Modal level of education (Primary)	29.3%
Mean household size (Number)	5
Range of household size (Number)	1-13
Marital status:	
Married	67.2%
Single	11.2%
Farming as primary occupation	55.2%
Modal farming experience (years)	7-9
Mode of land acquisition:	
Leasehold	78.4%
Purchase	11.2
Inheritance	6.0
Borrow	4.3

Source: Field data, 2008

Table 2 shows the analysis of costs and returns of urban agriculture. While the total revenues were ₦115950.0, ₦3206941.0, and ₦289320.0 for vegetable, poultry egg and fish production respectively, the total variable costs were ₦34001.1, ₦2795389.0 and ₦127757.9 respectively. The gross margins from vegetable, poultry egg and fish production were therefore ₦81948.9, ₦411552.5, and ₦161563.0 respectively. Gross margin per naira of investment were 2.41, 0.15 and 1.26 for vegetable, poultry and fish production respectively. This implies that for every ₦1 invested in the production of vegetable, poultry egg and fish, gross margins of about ₦2.4, ₦0.15 and ₦1.26 were returned respectively. While vegetable production is therefore the most profitable urban agriculture enterprise, poultry production is the least profitable. The low profitability of poultry egg production may be due to the fact that some of the layers just started laying eggs and that production has not reached optimum level. This result is consistent with Ezedinma and Chukuwezi (1999) who also found out that vegetable production in Lagos state was profitable with return per naira invested of about 0.65. A similar revenue and gross margin of about ₦136667 and ₦67663 respectively were reported for an average urban vegetable farmer in Uyo Southeastern Nigeria by Umoh (2006).

Table 2: Estimates of profitability of urban agriculture enterprises

	Vegetable production	Poultry Production	Fish production
Total revenue	115950.0	3206941	289320.0
Total variable cost	34001.1	2795389	127757.9
Gross margin	81948.9	411552.5	161563.0
Gross magin/₦ of investment	2.41	0.15	1.26

Source: Data analysis, 2008

The profit function estimates in Table 3 show the relative importance of the variable inputs and socioeconomic factors in the production of vegetable, poultry and fish. The coefficients of the variables X_1, X_2, X_3, X_4, and X_5 were interpreted as the value of marginal productivity.

In vegetable production, all the significant variables are correctly signed. The marginal value productivity of age, education, farming experience and farm size were statistically significant at 5%. The farm size (X_5) with a coefficient of 21627.355 appears to be the most important variable determining the profit of the vegetable production. This meant that for an additional increase of 1 hectare in farm size, the profit obtainable from vegetable production will increase by about ₦53400. This result is in agreement with the findings of the study by Ayanwale and Alimi (2004) and Afolabi (2010). The estimated coefficient for mean profit with respect to age(X_1), education(X_2) and farming experience (X_3) were -494.526, 1506.975 and 1985.175 respectively. This also meant that while an additional increase of 1 year in education and farming experience will increase the profit obtainable in vegetable production by about ₦1507 and ₦1985 respectively, an additional increase of 1 year in farmer's age will decrease profit by about ₦495. The negative relationship between farmers' age and return is consistent with the findings of Afolobi (2010). Also the positive relationship between return and farming experience on one hand and return and level of education on the other hand are consistent with the findings of Okon and Enete (2009) among the urban vegetable farmers in Akwa Ibom State, Nigeria.

Household size (X_4) (a proxy for available labour) with a coefficient of 429993.92 was the only statistically significant factor affecting poultry production. This implied that for an additional increase of 1 person in household size, the profit obtainable from poultry production will increase by about ₦429993.

In fish production, the marginal value productivity of farming experience and farm size are statistically significant at 10% and 5% respectively. The farm size (X_5) with a coefficient of 145720.06 is the most important variable determining the profit of the fish production. The implication of this is that for an additional increase of 1 hectare in farm size, the profit obtainable from fish production will increase by about ₦359803. The estimated coefficient for mean profit with respect to farming experience (X_3) is 17765.169. This also implied that an additional increase of 1 year in farming experience will increase the profit obtainable in fish production by about ₦17765. The positive relationship between return and farm size or pond size and return and farming experience are consistent with the result of Ugwumba and Chukwuji (2010) where they found out that what matters in catfish production is not pond type (concrete or earthen) per say, but stock size, intensive feeding and sound management practices.

Table 3: Profit function for vegetable, poultry, and fish production

Variable	Vegetable production	Poultry production	Fish production
Intercept	11230.937	-3507.692	-253141.7**
	(1.038)	(-0.005)	(-2.049)
Age (X_1)	-494.526**	-8074.136	4819.180
	(-2.987)	(-0.902)	(1.422)
Education (X_2)	1506.975**	5280.254	1274.566
	(3.053)	(0.212)	(0.154)
Farming experience (X_3)	1985.175**	21132.390	17765.169*
	(2.671)	(0.776)	(1.948)
Household size (X_4)	-167.445	429993.92**	-5467.272
	(-0.180)	(6.356)	(-0.362)
Farm size (X_5)	53400.00**	-50890.28	635902.50**
	(5.385)	(-1.807)	(5.833)
Proximity (X_6)	3261.794	-88504.57	-12028.08
	(1.141)	(-0.654)	(-0.342))
R^2	0.81	0.67	0.69
Adj. R^2	0.72	0.60	0.64

Note : *, ** Significant at 10% and 5%. Figures in parenthesis represent t-values

Source: Data analysis, 2008

CONCLUSIONS AND RECOMMENDATION

This study has shown that urban agriculture contributed to the food security in Lagos State, Nigeria. The enterprises of vegetable production, poultry production and fish farming were profitable with vegetable production being the most profitable. The profitability of these enterprises can further be enhanced by encouraging younger people with higher levels of education and by increasing the farm sizes (i.e pond size for fish production, vegetable plots for vegetable production and herd size for poultry production).

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URBAN AGRICULTURE IN OJO LOCAL GOVERNMENT AREA OF LAGOS STATE NIGERIA

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Abstract

The study focused on the effects of urban agriculture in Ojo Local government area of Lagos State Nigeria. A total of one hundred respondents were selected through snow ball technique. Descriptive statistics and inferential statistics (chi-square and correlation analysis) were used to describe and analyze the data collected. Some of the findings revealed that over 80 percent of the urban farmers were immigrants from rural communities from various parts of the country. Their involvement in urban agriculture had improved the standard of living of 99 percent of the urban farmers while 76 percent of them agreed that their income increased appreciably. 86 percent of them were of the opinion that they could fulfill their social obligation to their families, friends and the society. About 68 percent could now repay their debts as a result of their involvement in urban agriculture. 74 percent of them had problems of land acquisition and finance to increase their productivity. A significant relationship existed between their average annual income and their involvement in urban agriculture ($r = 0.57$ at $p<0.05$).

INTRODUCTION

Food production in the city in many cases is a response of the urban poor to inadequate, unreliable and irregular access to food and lack of purchasing power. The depth and severity of extreme poverty increased more than seven-fold in urban areas in Nigeria compared with two-fold increase in rural areas (Osinubi, 2003). The poor are those who are unable to obtain an adequate income, find a stable job, own property, maintain healthy conditions, lack an adequate level of education, short life span and lack of self esteem among others (Sancho, 1996, World Bank, 1995, Olayemi, 1995, Nugent, 1997). Nigerian urban food security is largely sustained by women that engaged in off-farm activities (Ekong, 2003). Despite this, women were not entitled to own a parcel of land of theirs as they were bound by culture to be under the control of men except for cases where the head of the household was a woman (Jazairy *et al* quoted by Adereti (2000). Although, many efforts and interventions have been initiated by government, non-governmental organizations, individuals and parastatals to address the issue of poverty faced by the populace in urban areas, yet there is need to find out the effect of the involvement of urban dwellers in agriculture as far as their coming out to poverty is concerned.

The broad objective of the study was to assess the effect of urban agriculture on poverty alleviation among urban farmers in Ojo Local Government Area of Lagos State while the specific objectives were to: describe the demographic characteristics of the farmers; determine the nature of urban agriculture in the study area; identify the reasons for their involvement in urban agriculture; and the problems faced by the urban dwellers engaged in urban agriculture.

METHODOLOGY

The study was carried out in Ojo Local Government Area of Lagos State in which four locations were purposively selected because of the nature of agricultural practices embarked upon in the that locality. A snowball technique was used to contact one hundred respondents involved in farming practices in the study area. The data collected were analyzed using descriptive statistics such as frequency distribution and percentages and correlation was the inferential statistics used to test the hypothesis.

The dependent variable was the effect of urban agriculture. A five point rating scale was used to measure the dependent variable [strongly Agreed (1), Agreed (2) Undecided (3), Disagreed (4) and Strongly Disagreed was coded (5)]. The independent variables were measured as follows: the respondent ages were measured in years, sex was nominally measured, male was assigned 1 and female was assigned 2. Place of origin was assigned scores based on the part of the country they came from.

RESULTS AND DISCUSSIONS

Table 1 shows that 39 percent of the respondents were between the age range of 41 and 50, 24 percent were between 31 and 40 years, 15 percent were between 51 and 65, 13 percent were between 25 and 30 years of age while few (7% and 2%) were between 18 and 24 and less than 15 years respectively. The implication of this finding was that most of the urban dwellers that were involved in urban agriculture were adults and it can be deduced that the family responsibilities had made them to look for alternatives to meet up with this challenge. In addition, people of these age groups may have dependants that could provide them with labour support in their agricultural activities.

With respect to sex, male accounted for 57 percent of the respondents while the remaining 43 percent were females. This implies that urban farming activities was male dominated as much of the financial responsibilities of the household rest mostly on men and this finding was supported by Adereti (2000) on the myth about African women not being entitled to own a parcel of land of theirs as they were bound by culture to be under the control of men except for cases where the head of the household was a woman. Men most times, could withstand the enormous rigors associated with urban agriculture more than the women and this could also explain the reason for having more men than women. It is also generally believed that men stand a better chance of securing land, capital and other enterprise inputs because of the socio-economic system of most Nigerian communities which naturally favour the men.

On the level of educational attainment 16 percent of the respondents completed primary education, 50 percent of them completed secondary education while only 7 percent had post secondary school education. 23 percent did not have any formal education. The result further shows that most (77%) of the respondents were literate while only 23 percent were stag illiterate. This implies that the educational level of the respondents accounted for their involvement in agriculture as they needed to look for means of taking care of the education of their children.

Table 1: Demography characteristics of respondents

Variables	Frequency (N=100)	Percentage (%)
Age		
Less than 18	2	2.0
18-24	7	7.0
25-30	13	13.0
31-40	24	24.0
41-50	39	39.0
51-65	15	15.0
Above 65	0	0.0
Sex		
Male	57	57.0
Female	43	43.0
Educational status		
None	23	23.0
Primary	16	16.0
Secondary	50	50.0
Tertiary	7	7.0
Vocational	4	4.0

On the nature of urban agriculture they engaged in, it was found out that 49 percent of them engaged in the cultivation of vegetables, livestock production and fish farming. 23 percent were into marketing of agricultural produce, 16 percent engaged in processing activities while only 10 percent bought farm produce from rural areas for sale in urban areas. Ekong (2003) supported this when he found out that the Nigerian urban food security was largely sustained by women that engaged in off farm activities. The results further showed that 45 percent of them engaged in urban agriculture in order to reduce poverty in their families, 15 percent were involved in order to secure a stable employment, 32 percent did that in order to ensure an increase income while only 5 percent were involved in order to supplement their food consumption.

Table 2 shows the effects of urban agriculture on the lives of the urban dwellers involved in urban agriculture. 99 percent of them were of the opinion that it provided a stable employment for them while only one percent was not sure. 48 percent of them agreed that they had stable income while only 33 percent were undecided while 19 percent disagreed. On their level of income, 76 percent of the respondents agreed that it increased their income to an appreciable level while 13 percent of them were undecided while only 11 percent strongly disagreed. Also, 68 percent were of the opinion that urban agriculture provided the funds for other projects they were carrying out, 20 percent were undecided, while only 12 percent strongly disagreed. 68 percent of them agreed that their debts had reduced because of their involvement in urban agriculture while 10 percent strongly disagreed. 76 percent of them agreed that it has helped them to minimize expenses on other items. On the social aspect 74 percent of them agreed that they could now live in a better house with adequate facilities, 86 percent agreed that they could afford some leisure and recreation and that 86 percent could now fulfill their social obligation to their families, friends and society at large, while 85 percent of the respondents agreed that they could now afford some formal education for their household due to their involvement in urban agriculture.

Table 2: Economic Effects of Urban Agriculture on lives of Urban dwellers

	Agreed		Undecided		Disagreed			
VARIABLES	F	%	F	%	F	%		Total
Urban agriculture offers stable employment	99	99.0	1	1.0	0	0.0	100	100.0
Urban agriculture has increase my income	76	76.0	13	13.0	11	11.0	100	100.0
Urban agriculture provides funds for the projects I'm engaged in	68	68.0	20	20.0	12	12.0	100	100.0
My debts have reduced because of urban agriculture	68	68.0	22	22.0	10	10.0	100	100.0
With Urban Agriculture, I Have A Stable Income	48	48.0	33	33.0	19	19.0	100	100.0
Urban agriculture helped me minimize expenses on other items	76	76.0	13	13.0	11	11.0	100	100.0
I now live in a better house with basic facilities	74	74.0	7	7.0	19	19.0	100	100.0
I can now afford some leisure and recreation	86	86.0	7	7.0	7	7.0	100	100.0
I can now fulfill my social obligation to my family, friend and society	86	86.0	11	11.0	3	3.0	100	100.0

The results also revealed that 26 percent of the farmers were faced with the problems of high cost of rent. This could be attributed to the high standard of living in the cities resulting into high cost of renting a parcel of land particularly for farming activities characteristics of cities. 47 percent claimed that there was unavailability of land for increased production while 13 percent were of the opinion that the available land was not suitable for farming, 12 percent of them had frequent displacement as their problem as farmers who used open space along high ways or public land usually stand the risk of being displaced. Capital related constraint revealed that 76 percent of the respondents had problem of access to funds. 22 percent of them were of the opinion that they still found it difficult obtaining loan from banks mainly because of collateral and high interest rates while 25 percent of them felt that location was one of the problems facing them. Farmers who have their farms along roadsides find it difficult adopting some measures of security as 15 and 5 percent claimed that they lost their farm produce to poachers and animal devastation respectively.

In a similar vein, the result of the hypothesis tested indicates that there was significant relationship between the average annual income of the respondents and the effect of urban agriculture on them ($r – 0.57 \leq 0.05$). This then implies that the higher the income, the more the poverty situation of the respondents is reduced.

CONCLUSION

Most of the urban farmers had families with average size of between 3 and 5 children. The need to reduce poverty is a dominant factor that made people to engage in urban agriculture. Some of the challenges of urban agriculture have to do with land and access to fund.

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URBAN AGRICULTURE IN IBADAN METROPOLIS, NIGERIA

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Abstract

Structured interview were conducted with a sample of 100 respondents (farmers) made up of 64 males and 36 females involved in UA from Mokola and Odogbo barracks in Ibadan city. The samples were drawn using simple random techniques. Data were analyzed using descriptive statistics and tests of differences between means and proportion. The analysis of the respondents revealed that 37 of them were engaged in crop production, 41 vegetable growing and 14 small ruminant / poultry while 8 of the respondents were involved in commercial livestock production. The mean income earned by the farmers ranged from the highest mean annual income of N 1,200,000 earned by commercial livestock farmers to N180, 000 earned by small ruminant and poultry farmers. In most cases, the income earned quadrupled after embarking on urban farming. For instance, the earnings from crop farming rose from an average of N62, 000 per annum prior to the practice of UA to N250, 000 from UA Incomes from vegetable farming rose by 341.9 percent. The highest mean annual income prior to UA was N200,000 which was earned by commercial livestock farmers who could earned that because of their level of education and exposure, this farmers were able to earn a main annual income of N1,200,000.00 from UA. The small ruminant / poultry farmers recorded growth of 210.3 percent in their income. The lowest mean annual income of N85, 600.00 was earned by small ruminant farmers who were mainly women and school teachers and they were able to earn more than double of this income through UA.

Keywords: Urban Agriculture, Ibadan metropolis

INTRODUCTION

Urban Agriculture is defined as food production within the confines of cities. It uses resources, products and services found in and around the urban area and often supplies resources, products and services to that area. This production takes place in backyards, rooftops, community vegetable and fruit gardens and unused or public places (Nugent, 1997). Donor agencies and policy makers also use the term urban agriculture to refer to farming activity within city boundaries, which includes the cultivation of food cash crops, animal husbandry, forestry and the production of flowers and garden plants (Mougeot, 2000). Previous studies have pointed out that urban agriculture increases urban food security (Atkinson, 1995), serve as an important coping mechanism in the informal economy (Lourenco – Lindell, 1995) and may help in reducing urban malnutrition (Egziebher et al, 1994). Egbuna (2006) in a pilot survey verified the fact that urban agriculture is thriving and sustaining a large population of unemployed people in Abuja Nigeria.

Alberto and Tasciotti, (2008) in their study on urban agriculture and dietary diversity in fifteen centuries from Asia, Africa, Eastern Europe and Latin American found out that in 2004, 18.2% of the income from the agricultural sector in Nigeria came from urban agriculture. Smith, (1996) pointed out that in many Asian cities, food production is promoted and recognized as a critical urban function.

METHODOLOGY

The study was conducted in Ibadan metropolis, the capital city of Oyo State of Nigeria, the largest indigenous city in West Africa. It is located in South Western part of Oyo State in

Nigeria in a hilly settlement with urban and rural sectors covering a total land area of 3,123km2. Administratively, Ibadan municipality is divided into 11 Local Government Areas (LGA), namely Akinyele, Ido, Lagelu, Ibadan North, Egbeda, Ona Ara, Oluyole, Ibadan North – East, Ibadan South East, Ibadan West, Ibadan South West. The overall population density of the Ibadan metropolitant area is 586 person per km2. while the majority of the Ibadan people are traders, many are civil servant; while fewer still are farmers producing a variety of agricultural items to meet the food needs and other requirements of the urban population (Gbadegesin,1991).

Primary data were collected for the purpose of the study by use of structured *questionnaires. A random sampling technique was employed based on the farming system, viz crop production, vegetable growing, small ruminant / poultry and commercial* livestock. A total of 100 respondents were enlisted in the study comprising of 37 crop growers, vegetable growing (41), small ruminant / poultry (14) and commercial livestock (8). Data were analyzed using descriptive statistic and test of differences between mean and proportion. Whole farm and gross margin analysis was undertaken to ascertain income earned from the various farming system/enterprises.

RESULTS AND DISCUSSION

Table 1: Socioeconomic characteristics of urban agriculture farmers in Ibadan

Farming system	Sex		Average Year of education	year in farming	% of time put in
	Male	female			
Crop production	27	10	9	10	50
Vegetative growing	26	15	10	10	70
Small ruminant/poultry	5	9	14	5	40
Commercial livestock production	6	2	16	7	80
Total	64	36	12.3	8	60

Source: Field Survey, 2010

The socio economic characteristics of the respondents are shown in table 1. The table revealed that the farming system could be classified into four broad categories: Crop production, Vegetable growing, small ruminant/poultry and commercial livestock production. An analysis of the respondents revealed that 37 of them were engaged in crop production, 41 vegetables growing and 14 small ruminant/poultry while 8 of the respondents were involved in commercial livestock production.

Staple crops like maize, millet yam and cassava are the most common crops, grown by the farmers, it is carried out throughout the year and household wastes are used as fertilizer. Intercropping is normal practice, as several crops are usually planted on the same piece of land. For most vegetable growers, men domination was prevalent, most of them were young school leavers who could not find jobs. Each farmers has a small plot of land practices intensive crop rotation to maximize the use of land and maintain soil fertility by the heavy application of organic manure and fertilizer.

Both men and women are involved in keeping of small ruminant / poultry. The majority of those keeping livestock are women, assisted by their children. In some cases, livestock may provide a regular source of income to meet household need like payment of school fees, medical emergency or a funeral. The main livestock kept for commercial purposes include poultry, pigs and rabbits. A number of poultry farm exist in Ibadan and at the outskirts there are piggery farms. The urban nature of Ibadan provides ready market for the commercial livestock producers.

Educationally, the average number of years spent by the farmer in school was estimated at 12 years and 3 months for all the respondents. The commercial livestock farmers were the most educated group because eight of them spend an average of 16 years in school to get a first degree from the University. The least educated group was crop farmers who spent about 9 years only in school.

Table 2: Income from urban agriculture farmers in Ibadan

Farming system	mean annual income ₦ prior to the practice of urban agriculture	mean annual income from urban agriculture ₦	proportion of harvest consumed %	
Crop production	62,000	250,000	32.7	403.2
Vegetable growing	111,100	380,000	36.8	342.0
Small ruminant/poultry	85,600	180,000	24.2	210.3
Commercial livestock production	200,000	1,200,000	4.3	600

Source: Field Survey, 2010.

The income generated from UA in Ibadan is shown in table 2, the mean income earned by the farmers ranged from the highest mean annual income of ₦1,200,000.00 earned by commercial livestock farmers to ₦180,000.00 earned by small ruminant/poultry farmers. On the contrary, the highest mean annual income prior to urban agriculture was ₦200,000 (Two Hundred Thousand Naira only) which was earned by commercial livestock farmers who could earn that because of their level of education and exposure. But these farmers where able to earn a mean income of ₦1,200,000 (One million Two Hundred Thousand Naira only) from urban agriculture. Actually, the commercial livestock is for income purpose, there is ready market and the proportion of output consumed is only 4.3 percent. The lowest mean annual income of ₦85,600 was earned by small ruminant/poultry farmers who were mostly women and school teachers, and they were able to earn more than double of this income through urban agriculture.

The proportion of produce consumed by the household from crop farming, vegetable growing and small ruminant/poultry was 32.7, 36, 8 and 24.4 percent respectively, showing that they are important source of household food demands. The other aspect too is for market which is an important source of household income.

Ukeje, (2004) reported that urban agriculture also generated employment and incomes for farm labourers that were employed to weed, harvest and market the crops in the Federal Capital Territory, Abuja. Generally, in the study area, there was intensive use of cow dung and poultry droppings as fertilizer because they are cheaper and readily available, some use agrochemicals to treat crops while mulching is also practiced. Increase in crop output through increase in the area under cultivated is limited as, the land area cannot be increased easily. The average area cultivated varies from less than 2 hectares to about 3 hectares.

The major constraints to the development of urban agriculture as mentioned by the farmers in the studied area include land in terms of access and tenure security; prohibitive urban policies and regulations coupled with Harassment by local/state government tax and environmental authorities. High production costs combined with lack of credit facilities is also a constraint because most agricultural based credit are targeted towards rural farmers without paying adequate attention to farmers in the urban areas.

In conclusion, there is an urgent need to integrate UA. into the city system in a more viable and sustainable way. To achieve this, there is need to conduct a comprehensive study of urban agricultural systems in Nigeria in order to gather data for planning and research.

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URBAN AGRICULTURE IN NIGERIA: THE CHALLENGE OF CLIMATE CHANGE

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Abstract

Data for this study were collected from a random sample of 180 farmers in two cities (Ibadan and Akure) in southwest Nigeria. Data analysis revealed average age of the farmers to be 48 years with a mean household size of 7. Distribution of respondents by gender revealed that there were more males than females with about one-third relying on horticultural crop production as their main source of livelihood. Educational distribution of respondents indicated that about 37.6 percent had no formal education with less than one third educated up to tertiary level. Also, more than half of the respondents practiced urban agriculture as secondary occupation to augment income from the primary occupation. However, a regression analysis employed to ascertain the effects of climate change on urban agriculture revealed that climate change negatively affect urban agriculture especially in the area of water availability and storability (shelf life) of raw agricultural produce (fruits and vegetables in particular).

INTRODUCTION

Climate change has become one of the greatest challenges facing sub-Sahara African countries in spite of the fact that the region seems to contribute the least to greenhouse gasses. The region is uniquely vulnerable to climate change because it already suffers from high temperatures, less predictable precipitation and substantially greater environmental stresses than other continents (IPCC, 2001b; 2007b). Africa and its inhabitants also share with other developing countries the fact of being "especially vulnerable to climate change because of their geographic exposure, low incomes and greater reliance on climate sensitive sectors such as agriculture" (Stern, 2007). Again, the lack of appropriate safety nets and social protection mechanisms to cater for the needs of vulnerable members constitute another serious issue. There is therefore no gainsaying the fact that climate change will worsen the living conditions of many households, who are already vulnerable and food insecure.

On the other hand, the degree to which a particular individual, household, locality, agro-ecosystem, country or region in sub-Saharan Africa will be affected by climate change depends on a range of local, regional and global scale factors (FAO, 2007a) including the *magnitude* of the change, *probability* of the change, *rate* of change, *duration* of the change, *tolerance* and *capacity characteristics of the system* (ability to adapt). Worse still, a number of sub-Saharan countries (Nigeria inclusive) already face climatic conditions that make agriculture challenging. Climate change is likely to reduce the length of growing seasons, particularly in certain parts of the continent (Thornton, 2006), and at worst may force large regions of marginal agriculture out of production (IPCC, 2007b). Projected reductions in crop yields in some countries could be as much as 50 percent by 2020. Crop net revenues could fall by as much as 90 percent by 2100, with small-scale farmers being the most affected. Meanwhile, urban agriculture seems to have gained importance especially in developing economies basically because it has been discovered to be a viable intervention strategy for the urban poor to earn extra income and therefore reduces their reliance on cash income for food by growing their own food. It is a major component of the urban food system by providing the diversity needed to ensure dietary quality, which is an important aspect of food security.

Urban agriculture is an important source of supply in urban food systems and only one of the several food security options available to households.

Despite limited support and heavy losses, urban agriculture is generating produce valued in the tens of millions of US Dollars, year in year out, in major cities of developing countries (Mougeot, 2000). However in Nigeria for instance, despite the glaring facts on the presence and potentials of urban agriculture, especially in the big cities like Abuja, Lagos, Kano and Ibadan, policy makers and government have deliberately neglected this aspect and have not made enough concerted efforts to acknowledge its importance and contributions to urban food supply.

Thus, considering the current and emerging threat posed by climate change coupled with the widening rural-urban gap resulting from migration of able bodied youths to city centres and the attendant rising food prices, it is therefore pertinent to examine the place of urban agriculture in enhancing food security in the face of the current challenges posed by climate variability. This study therefore examined the effects of climate change on urban agriculture and how it has affected the food security status of households in southwest Nigeria.

LITERATURE REVIEW AND DEFINITION OF TERMS

Urban agriculture is an informal-sector activity that urban dwellers engage in as a means of livelihood. It involves the cultivation of food crops, farm animals and fish in public and private open spaces in cities. Obosu-Mensah, (1998) defined urban agriculture as the practice of farming within the boundaries of towns or cities. In a comparison between rural and urban agriculture Moustier (1998), defined urban agriculture as agriculture that is carried out within or on the outskirts of a city where a non-agricultural use of local resources is real option; rural agriculture is found in areas where this option is not an issue. In the Agri-Congo study of (open space) market vegetable farming in Brazzaville gardens within the city limit are known as 'intra-urban' whereas that off-limit are called 'peri-urban' (Moustier, 1999).

On urban agriculture as a tool for poverty reduction, studies by Zakariah et al (1998), Lourenco-Lindell (1995) have shown that self-produced food in cities provides nutritious food otherwise unaffordable, replaces purchased food staples and affords savings as much as 20 percent of income which can be spent on non-produced food stuff or on other needs such as school fees, transportation e.t.c. It also generates supplemental or principal income, which can be reinvested in other urban businesses e.g. sewing, machine, typewriter, and kitchen appliances.

On gender composition of urban farmers, about 65 percent of the world's urban farmers are women (Veenhuizen, 2006). However in Nigeria, the reverse is the case; urban agriculture is dominated by men (Anosike and Fasona, 2004). In Nigeria, Anosike and Fasona (2004) found in their survey of farmers in Lagos that women hold relatively small parcels of less fertile land that are less conducive to efficient farming practices. This has led to the adoption of different farming methods associated with adverse environmental impacts and poor yields. Most farms headed by women in Lagos State are often located in unsafe and insecure areas on the edges of the cities and lack basic services such as water and electricity. Denninger et al (1998) estimated that nearly 25 out of the 65 million people living in urban areas of Eritrea, Ethiopia, Kenya, Tanzania, Uganda and Zambia currently obtain part of their food from urban agriculture and that by 2020, at least 35-40 million residents will depend on urban agriculture to feed themselves. From the foregoing, it is very clear that urban agriculture should be given a pride of place especially in Nigeria if the much clamoured food self-sufficiency and attainment of the Millennium Development Goals (MDGs) are anything to go by.

RESEARCH METHODOLOGY

The study area is southwest Nigeria. Southwest Nigeria is one of the six geopolitical zones of the country. The southwestern states are: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo. Two states, Oyo and Ondo states were randomly selected among the states while two cities, Ibadan and Akure in Oyo and Ondo states, respectively that were dominated by urban agriculture were purposively selected for the study. Data for this study were collected through questionnaire from a random sample of 180 farmers in the two cities.

In this study, three analytical techniques were employed: Descriptive statistics, food poverty measures and ordinary least squares regression model.

Descriptive statistics was used to analyse, describe and summarise respondents' socioeconomic characteristics.

Food poverty measure (two-third mean per-capita food consumption expenditure), World Bank (1996b) was used to categorise respondents into food secure and non-food secure class and,

Ordinary least squares regression model was employed to examine the effects of climate change on urban agriculture and food security status of respondents in the study area.

For the food poverty measures;

Per-capita food expenditure (PCE) = Total food expenditure divided by number of respondents

Food poor = respondents whose food expenditure is $< 2/3$ of PCE

Non-food poor = respondents whose food expenditure is $\geq 2/3$ of PCE

The implicit form of the regression model (Gujarati, 1995) used is:

$Y = f(Xi, ei)$,

Where, Y = Dependent variable (revenue from agricultural produce in Naira) in the study area, $Xi - X_{11}$ = Independent variables (socioeconomic variables and climate related variables) and ei = Stochastic error term.

Thus,

X_1 = Age (years)

X_2 = Gender (male = 1, female = 0)

X_3 = Household size

X_4 = Years of formal education

X_5 = Amount of credit accessed (Naira)

X_6 = Season (off-season =1, on-season = 0)

X_7 = Adequacy of rainfall (yes =1, no = 0)

X_8 = Primary occupation (farming =1, non-farm = 0)

X_9 = Number of contacts with extension officer

X_{10} = Distance of home to farm (km)

X_{11} = Distance of farm to market (km)

Note: X_6 and X_7 are climate related variables (proxies)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

A number of respondents' socioeconomic characteristics were analysed using descriptive statistics as depicted in Table 1. The result of the analysis revealed average age of the farmers to be 48 years with a mean household size of 7. Thus, majority of the respondents are young and still in their active working age. Distribution of respondents by gender revealed that there were more males than females involved in agricultural activities in the study area with about one-third relying on horticultural crop production as their main source of livelihood. Educational distribution of respondents indicated that about 37.8 percent had no formal education with less than one-third educated up to tertiary level. The rest had either primary or secondary education. Also, more than half of the respondents practiced urban agriculture as secondary occupation to augment income from the primary occupation. In fact, this distribution further explains the relative importance of agriculture as the largest employer of labour in Nigeria when compared with other available occupations in the study area.

Table 1: Distribution of Respondents by Socioeconomic Characteristics

Variable	Frequency	Percentage (%)
Age		
$\leq$ 30	25	13.8
31-40	37	20.6
41-50	59	32.8
51-60	28	15.6
> 60	31	17.2
Gender		
Male	109	60.6
Female	71	39.4
Marital Status		
Married	96	53.3
Single	43	23.9
Divorced	25	13.9
Widowed	16	8.9
Household Size		
1-3	28	15.6
4-6	54	30.0
7-9	67	37.2
10-12	21	11.7
> 12	10	5.5
Educational Status		
No formal education	68	37.8
Primary	31	17.2
Secondary	24	13.3
Tertiary	57	31.7
Primary Occupation		
Farming	71	39.4
Trading	40	22.2
Civil Service	23	12.8
Private salaried job	19	10.6
Artisans	25	13.9
Others	2	1.1
Secondary Occupation		
Farming	97	53.9
Trading	31	17.2
Civil Service	23	12.8
Private salaried job	15	8.3
Artisans	12	6.7
Others	2	1.1
Total	**180**	**100.0**

Explaining Influence of Climate Change on Urban Agriculture

The result of regression analysis (Table 2) employed to ascertain the effects of climate change and other socioeconomic variables on urban agriculture (Y) revealed that climate change negatively affect urban agriculture especially in the area of water availability and storability (shelf life) of raw agricultural produce (fruits and vegetables in particular). It is assumed that and increase in the yield of agricultural produce (Y) obtained from urban farming activities will enhance the food security status of respondents/households in the study area. From the result in Table 2, the coefficients of age – X_1 ($p<0.10$), education - X_4 ($p<0.01$), amount of credit accessed - X_5 ($p<0.10$)), and number of contacts with extension officer - X_{10} ($p<0.05$) were positively related to respondents revenue generated from agricultural produce in the study area. Thus, an increase in any of these variables affected the revenue (Y) of respondents positively. However, the coefficients of household size - X_3 ($p<0.01$), distance of farm to market (X_{12}), season of the year (X_7) and adequacy of rainfall - X_8 ($p<0.05$) (proxies for climate change) were negative indicating that a change in any of these variables negatively affected the revenue (Y) of respondents relying on urban agriculture either as primary or secondary occupation in the study area. Thus, losses incurred especially during glut were attributable to climate change and decaying infrastructural facilities in the study area. Again, the levels of significance depicted by each of the explanatory variables indicate how important they are in explaining variation in the dependent variable.

Table 2: Regression Result Showing Influence of Climate Change on Urban Agriculture

Variable	Coefficient
Constant	0.1255
	(0.1074)
X_1 Age	0.2045*
	(0.1067)
X_2 Gender	0.9413
	(0.3670)
X_3 Household size	-0.4401**
	(0.2196)
X_4 Years of formal education	0.0153***
	(0.0049)
X_5 Amount of credit accessed (Naira)	0.3075*
	(0.1571)
X_6 Season	-0.6708
	(0.5299)
X_7 Adequacy of rainfall	-0.9027**
	(0.4110)
X_8 Primary occupation	0.2325
	(0.3304)
X_9 Number of contacts with extension officers	0.7451**
	(0.3620)
X_{10} Distance of home to farm (Km)	0.0023
	(0.1769)
X_{11} Distance of farm to market (Km)	-0.8013
	(0.4912)

***Coefficients significant at 1%, **Coefficients significant at 5%, *Coefficients significant at 1%
$R^2 = 0.7671$, Figures in parenthesis are standard errors, Number of observations = 180

CONCLUSION AND RECOMMENDATIONS

Findings from the study generally revealed that climate change has a profound effect on urban agriculture. Thus, if the threat posed by climate change is not halted the clamour for increased/enhanced food production – a precursor to food security may forever remain a mirage. It is therefore suggested that; Efforts should be geared towards improving on the existing infrastructural facilities by upgrading dilapidated ones and constructing or building new ones where necessary. Also, investment in technologies that will help improve the yield of crops grown will also enhance the income of respondents which will in turn boost their food security status. Investment in education, credit facilities and contact with extension will enhance revenue of urban farmers. Also, sensitisation and awareness creation among farmers on climate change and weather variables will also assist in proper scheduling of farming activities in the study area.

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URBAN FARMING AND MALARIA RISK FACTORS IN OYO STATE

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Abstract

The purpose of this study was to investigate malaria risk factors in urban farming communities in Oyo State to malaria in the study area. A total of 114 respondents were selected through the use of multi-stage sampling technique. Stage one is the selection of one block from the six blocks in Oyo State Agricultural Development Programme, Stage two is the selection of 2 cells in each of the blocks. Stage three is the selection of 3 metropolises from each of the cells and the fourth stage is the selection of 12 respondents from each of the metropolis totaling 144 respondents. Data were elicited from households through structured questionnaire on agricultural land use, farming practices, access to safe dinking water, water storage, sanitation facilities, means of refuse disposal and socioeconomic status. Finger prick blood sample was also taken from all household members and examined for the occurrence and density of *Plasmodia*. The data were analyzed using simple descriptive statistics and ordinary least square regression analysis.

The overall incidence of *P. falciparum* was 32.1%. Majority (59.2%) of household's in the study area prevents malaria through the planting of mosquito repellant crops. Risk factors for *P. falciparum* infection included age of household head, having no formal education, household sanitation index, close proximity to permanent ponds and fish ponds, number of nights spent in temporary farm huts.

INTRODUCTION

Malaria is currently the most important parasite infection in people accounting for more than one million deaths a year throughout the world. It is the leading cause and of deaths and illness in Africa afflicting people across all ages from young infant to the aged (kilama 2005). Its ability to develop resistance makes malaria a formidable adversary. Malaria causes widespread premature death and suffering, imposes financial hardship on poor households, and holds back economic growth and improvements in living standards (WHR 1999). It thus has a direct impact on households' income, wealth, labour productivity and labour market participation of both the sick and the care givers. In terms of resource loss, households spend between \$2 and \$25 on malaria treatment and between \$10 and \$15 on prevention each month (Mills 1998). Malaria makes the farmer weak, unable to work, reduces efficiency, causes loss of time and income to both the farmers and his household. Sub-Sahara Africa (of which Nigeria is part of) accounts for 90% of the world's 300-500 million cases of malaria (WHO, 2000). As much as 13 percent of total small farming households expenditure in Nigeria is currently being used in treating malaria, while many are simply too poor to pay for adequate prevention and treatment of the disease (World Health Report, 1999).

Malaria therefore does not only poses a high risk to the healthy, but the repeated clinical consequences of infection in endemic areas during early life and adulthood and outbreak in endemic areas place a burden on households, on the health services and on the nation at large. Studies (Sachs 2002, Snow *et al* 2005 and Worrall *et al* 2005) have also shown that malaria delays the socioeconomic development of affected regions and is a major roadblock on the path toward achieving several of the targets embodied in the Millennium Development Goals, particularly in sub-Saharan Africa

This study sets out to examine the incidence of and factors that determines the incidence of malaria among farming households in Nigeria by proffering solutions to the following pertinent questions; what is the incidence and severity of malaria among farming households in the study area? What are the measures households adopt in preventing malaria? Finally what are the factors that make households vulnerable to malaria? This will help to suggest effective control against malaria among farming households who are most vulnerable to poverty in order for the country to be able to achieve the Millennium Development Goals (MDG) 4, 5, 6 – which are to reduce child mortality, improve maternal health, combat HIV/AIDS, malaria and other diseases

RESEARCH METHODOLOGY

This study was carried out in Oyo State. It has 33 Local Government Area and it covers a total land area of 35, 743Km^2. It shares boundary with Kwara State to the North, Osun State in the East, Ogun state in the South and Republic of Benin in the West. It has a population of 5,591,589 (2006 National Population Census) and the major economic activity of people includes wage paying jobs, trading, artisan and agriculture. It has a minimum and maximum temperature of 21^{o}C and 32^{o}C respectively.

A multi-stage sampling technique was employed in the selection of the respondents. Stage one is the random selection of two blocks from the six blocks in the Oyo State Agricultural Development Programme, Stage two is the random selection of 2 cells in each of the blocks. Stage three is the random selection of 3 metropolises from each of the cells and the fourth stage is the selection of 12 respondents from each of the metropolis totaling 144 respondents. 130 households with completed questionnaires consisting of 542 individuals that were available for the malaria test served as the sample size for the study. Structured questionnaire was used to elicit information from the respondents on their socio-economic characteristics which includes gender of the household head, marital status of the household heads, age of the household head and their household size, types of crops cultivated, farming practices, distance to ponds and fish ponds, distance to source of water, water storage technique, sanitation facilities like access to safe drinking, means of refuse disposal, method of preventing malaria i.e. curative measures.

All members of the selected households were invited to provide a finger prick blood sample. Thick and thin blood smears were prepared on microscope slides. They were air-dried and transferred to the health laboratory where they were stained with Giemsa, following routine procedures. Within four weeks, the slides were read under a light microscope for the presence and density of *Plasmodia* parasitemia by an experienced laboratory technician, assuming for a standard white blood cell count of 8,000/_L of blood was read and recorded.

The incidence of *P. falciparum* among individuals that were engaged in urban farming, severity of malaria among them and the precautionary measure that was employed were analyzed using descriptive statistics such as frequency, percentages, means and tables.

The severity of the incidence of malaria was categorized based on presence and density of *Plasmodia* parasitemia in the blood. The severity of the incidence of malaria was categorized into light, average and high following Raso et al 2004.The three categories are

- light infection (1–50 parasites/L of blood)
- moderate infection (51–500 parasites/L of blood)
- heavy infection (> 500 parasites/L of blood).

The factor that determines the incidence of malaria was analyzed with the aid of Ordinary Least Square Regression Analysis. The empirical model for determining the incidence is given as $Y = a + b X_i + \mu$ ....(1)

Y = Dependent variable which is the mean parasitemia of parasites/L of blood for each household.

= parasitemia of parasites/L of blood for each household.

Household size…………………………………………..……………………… …(2)

a = Constant term

Where Xi are the independent variables which are defined as follows

X_1 = Gender (1= Male, 0 = Female)

X_2 = Age (Actual age in years)

X_3 = Household size

X_4= Educational level (0= No formal education, 1= Primary, 2 = Secondary, 3 = Tertiary)

X_5 = Type of crop planted

X_6 = Distance to pond or fish pond (Km's)

X_7 = Method of storing water (1= Pots/bucket with lid, 0 = otherwise)

X_8 = Method of preventing malaria

X_9 = Sanitation index

X_{10} = Number of nights spent on the farm

μ = Error term

The household sanitation index was constructed through the use of Principal Component Analysis. PCA assists in statistically identifying and weighing the most important indicators in order to calculate an aggregate index for a specific sample household attributes. the principal component technique slices information contained in a set of indicators into several components. Each component is constructed as a unique index based on the values of all the indicators. The main idea is to formulate a new variable, $z_{1,}$ which is the linear combination of the original indicators so that it accounts for the maximum of the total variance in the original indicators (Basilevsky, 1994).

Mathematically, it is expressed as

$PC_1= a_{11}X_1 + a_{12}X_2 +\_ \_ \_+ a_{1n}X_n$ ……………………………………………………………(3)

Where a_{11} to a_{1n} represents the weight for the first principal component and the n^{th} variable. The weights for each principal component are given by the eigen vectors of the correlation matrix

The indicators that were used in measuring the sanitation/health index and the weights attached to each of the indicators are given below

Type of toilet facilities: (4= Flush into septic, 3= Flush into sewage, 2 = Pit latrine, 1= Pail/toilet on water, 0= none)

Source of water (4 = Pipe borne, 3= Bore hole, 2 = Well, 1 = River/Lake/Rain)

Method of treating water before drinking

(4 = Use of chemicals, 3= Boiling, 2= filtering/sedimentation, 1 = others, 0 = none)

Method of waste disposal: (5= Private, 4 = Government, 3 = Dispose off within the compound, 2 = authorized heap, 1= unauthorized heap/river)

RESULT AND DISCUSSION

Incidence of Malaria

The result of the incidence of malaria among the respondents showed that of the 542 respondents that were interviewed, 174 were infected with *P. falciparum*, resulting in a prevalence of 32.1%. This indicates that about a third of individuals from farming households in urban areas have malaria parasite in their blood. This is likely to have negative effect on the productivity of farming households in urban centers due to mandays lost as a result of ill health and care giving.

Decomposition of Incidence of Malaria among Urban Farmers by age group

Of the 174 respondents that were infected with *P. falciparum*, 97 (55.7%) of them were children that were under the age of 13 years. This indicates that children under the age of 13 have the highest incidence of malaria. Adult between the ages of 36-60 years of age have the least incidence (8.1%) of malaria. The outcome of the analysis conforms to the study of Barbara et al (2006) were children had the highest incidence of malaria and people in the older age group had lower incidence of malaria. High incidence of malaria among children might be due to the fact that their immunity level which helps them in resisting diseases is low.

Severity of malaria

The result of the severity of malaria is presented in table 1. The result indicates that among those people who were infected with *P. falciparum*, 14.9% had light infection intensity with mean parasitemia of 46.8 parasites/L of blood, 36.8% had moderate infection intensity with mean parasitemia of 188.9 parasites/L of blood and 48.3% had heavy infection intensity (mean parasitemia of 1,121.8parasites/L of blood. This implies that majority of individuals in the households had high infection intensity. This is likely to have negative effect on the labour productivity of the individuals in the households that were infected with malaria and their care givers.

Table 1: Severity of incidence of *P. falciparum*

Severity of incidence of P. *falciparum*	*Frequency*	*Percentage*
Light (1–50 parasites/L of blood),	26	14.9
Moderate (51–500 parasites/L of blood),	64	36.8
High (> 500 parasites/L of blood),	84	48.3
Total	174	100

Source: Field Survey 2010 and Laboratory test result 2010

METHODS OF PREVENTING MALARIA

Table presents the major method employed in the prevention of malaria among farming households in urban centres. The result revealed that the major method of preventing malaria by the respondent's is through the planting of mosquito repellant crops. This implies that majority of the respondents still relies on the traditional means of preventing malaria which might not be the most efficient method of preventing malaria. This is coupled with the fact that the malaria parasites have even developed resistance to the conventional curative measures (WHO 2000).

Table 2: Precautionary measures against malaria

Precautionary measures against malaria	*Frequency*	*Percentage*
None	25	**19.2**
Proper Sanitation	11	**8.5**
Mosquito nets	4	**3.1**
Planting of mosquito repellant crops	77	**59.2**
Anti-malaria prevention drugs	8	**6.2**
Use of insecticides	5	**3.8**
Total	**130**	**100**

Source: Field Survey 2010

Majority (59.2%) of the households buys drugs over the canter/self medications in treating malaria while only few (8.5%) of the households treat malaria in hospitals. This indicates that when household members have malaria they first administer drugs until when the situation becomes severe before they seek help from medical personnel's which increases the rate of morbidity and mortality among farming households in urban centers.

Factors that determines incidence of malaria among urban farmers

An ordinary least square regression analysis that consists of 10 regressors with the mean per capita was used in the identification of the factors that determines the incidence of *P. falciparum*. The result shows that 71.4% of total variation in incidence of *P. falciparum* among the respondents can be attributed to the significant variables which are age of household head, educational status of household head, household sanitation index, planting of cereals, close proximity to permanent ponds and fish ponds, number of nights spent in temporary farm huts and poor household sanitation index. The result of the regression analysis further shows that close proximity to permanent ponds and fish ponds and number of nights spent in temporary farm huts would increase the incidence of *P. falciparum* significantly ($p = 0.05$). Having formal education and household sanitation index reduces the incidence of *P. falciparum* ($p = 0.01$).

The result of the regression analysis further shows that a unit increase in the number of nights spent on the farm and household size would increase the incidence of malaria by 4.9736 and 0.2702 while a percentage increase in educational level of household heads and household sanitation index would reduce the incidence of malaria by 48.8234 and 1.1153 respectively.

Table 3: Determinant of incidence of malaria among urban farmers

Variables	Coefficient	Std. error	*T*- stat
Constant	3664.507	560.5846	6.5369***
Gender	0.4970	0.2286	2.1780
Educational level	-48.8234	6.2134	6.8921***
Household size	-0.2702	0.1317	2.0513*
Age	58.7342	26.0408	2.2555
Type of crops planted	26.6818	17.0336	1.5664
Proximity to ponds/fish ponds	51.0270	7.3897	6.9052***
Method of storing water	2.3596	2.9639	0.7961
Sanitation index	- 1.1153	0.1319	8.4531***
Method of preventing malaria	1.2729	2.9034	0.4384
Number of nights spent on the farm	4.9736	1.4561	3.4155***
R^2 = 72.4 F-stat = 73.30			

SUMMARY, CONCLUSION AND RECOMMENDATION

The study therefore concludes that in order to reduce the incidence of malaria among urban households who are into farming, the children who are most vulnerable should be targeted for health intervention programs. Furthermore, households should be given literacy programmes on the need for and effective methods of preventing malaria. There is also the need to sensitize Community Health Officers to ensure that households keep their environment clean. This is very important because household sanitation index significantly affect the incidence of malaria and only few of the households interviewed ensures proper sanitation as precautionary measure against malaria.

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DOMESTIC ENERGY CRISIS IN SELECTED URBAN HOUSEHOLDS OF SOUTHWEST NIGERIA

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Abstract

The study evaluates domestic energy consumption pattern and implications of such on the welfare and cooking pattern of the people in selected urban communities of Oyo, Ogun, and Ondo states, Southwest Nigeria. Structured questionnaires were administered to women who are responsible for cooking in the households. The identified energy carriers in the study areas include kerosene (45.0%), firewood (30.4%), electricity (11.1%), charcoal (6.4%), gas (LPG) (3.9%), and others (sawdust, agricultural waste, etc) (2.5%). Increase in the prices of the petroleum products within the past three decades is having adverse effects on the type of energy carriers used by households. Cooking is done largely in built-in kitchens within the main house (42.1%). About 26.1% of the women informed that the use of firewood has health implications because most of smoke was retained within the house. Transformation of firewood into less polluting forms or through improved stoves and better ventilation will reduce harmful effects of domestic energy and create better environment for welfare of households.

INTRODUCTION

Households generally use a combination of energy sources for cooking that can be categorised as traditional (such as dung, agricultural residues and fuelwood), intermediate (such as charcoal and kerosene) or modern (such as LPG, biogas, ethanol gel, plant oils, dimethyl ether (DME) and electricity) (Evans, 1986; DFID, 2002). Electricity is mainly used for lighting and small appliances, rather than cooking, and represents a small share of total household consumption in energy terms (IEA, 2006). In many African countries, including Nigeria, fuelwood continues to account for over 80% of energy consumption (IEA, 2006). The use of fuelwood is now found to be detrimental to socio-economic life in Third World nations (Aina and Odebiyi, 1998). One problem of overdependence of fuelwood is deforestation. Trees are cut indiscriminately to meet the basic needs of the teeming population (Oppong, 1992). Beyond demographic factors are other factors such as inequality in access to resources; change from subsistence to large-scale commercial farming; and the gradual collapse of the traditional resource management system; all of these have further compounded the growing rate of deforestation in the Third World countries (Aina and Odebiyi, 1998).

Focusing on the energy consumption, the Nigeria economy can be disaggregated into industry, transport, commercial, household or residential and agricultural sectors. Significantly, the household sector continues to dominate energy consumption in the country. In a national survey finding by Oladosu (1994), this sector consistently accounts for over half of Nigeria's total domestic energy consumption. He found that in 1989, the household sector had a consumptions share of about 65%, with cooking taking 91% of this share, followed by lighting (6%), and operation of electrical appliances (3%). The total consumption was 487J; over three-quarter of which was consumed in rural areas. The major energy carriers in the country are fuelwood, kerosene, Liquefied Petroleum Gas (LPG), and electricity. Small amount of charcoal and coal were used, while fuelwood (which accounted for over half of the national energy consumption in 1989) is reportedly consumed in the domestic sector. Also Oladosu (1994) discovered that fuelwood constitutes about 80% of total residential final energy consumption, while kerosene is the major national energy carrier in the sector.

Kerosene is not only use for cooking but for lighting in rural households, and in urban households during power outage. Liquefied Petroleum Gas (LPG) and electricity are mostly used in the urban centres, mainly by rich households. The household sector also accounted for about 60% of electricity sales by the National Electric Power Authority (NEPA) [now Power Holding Company of Nigeria (PHCN)] in 1989 (Aina and Odebiyi, 1998).

The classification of fuelwood as non-commercial energy resource has been found to be location-specific. Fuelwood is now blamed for deforestation and increase soil erosion/depletion while fuelwood is becoming very scarce both in the cities and small towns (Douglas and Qian, 1992). The direct effect of this is consumer vulnerability to fuelwood price increases, and a general commercialisation of fuelwood. Also, kerosene, like other petroleum products in Nigeria, is sold at subsidised prices so as to encourage low income households to substitute it for fuelwood. This policy, in the wake of the economic crisis and structural adjustment programs in the country, has been found ineffective. This is direct effect of high rate of smuggling of petroleum products across Nigeria's boarders in search of higher monetary gains, and as a way of sidetracking the devaluation of the Naira. LPG and electricity sources, though efficient, have been found to be very expensive and only affordable to middle and high income households. According to Douglas and Qian (1992), only about 25% of Nigerian household have access to electricity from the national grid.

Energy has also an equity dimension (Foster, 1986). Poor households use less useful energy per household than wealthier ones in absolute terms (Reddy and Reddy, 1983). One consequence is that less food is being cooked and less water is boiled for drinking and other hygienic purposes. This increases the likelihood of water-borne diseases, which in turn, reduces the ability of poor people to improve their livelihoods, by not only preventing adults from working effectively but also negatively affecting their health (Reddy and Reddy, 1983).

Fuelwood, roots, agricultural residues and animal dung all produce high emissions of carbon monoxide, hydrocarbons and particulate matter (WHO, 2007). Hydrocarbon emissions are highest from the burning of dung for fuel, while particulate emissions are highest from agricultural residues (Bruce *et al.*, 2002; Bailis *et al.*, 2007). Women and children suffer most from indoor air pollution because they are traditionally responsible for cooking and other household chores, which involve spending hours by the cooking fire exposed to smoke (Haile, 1989.). Young children are particularly susceptible to disease, which accounts for their predominance in the statistics for premature deaths due to the use of biomass for cooking (IEA, 2006).

This study therefore evaluates the households' energy consumption pattern in the face of the energy crisis in urban areas of Southwest Nigeria and the implications of such on the welfare and standard of living of the people.

METHODOLOGY

The study was conducted in selected urban communities in Oyo, Ogun, and Ondo States of Southwest Nigeria. Within each of the States, two Local Government Areas (LGAs) were selected, then two urban areas were selected from each of the two LGAs, totaling twelve communities for the study. Twenty five structured questionnaires were administered in each of the community, making a total of 300 questionnaires. The questionnaires were administered to women who are responsible for cooking in the sampled households. Men were not interviewed because in the Nigerian society, especially in the Southwestern part of the country, culturally it is not a man's responsibility to cook. Only one household was sampled in situation where more than one households exist in a building. In all, 280 (93.3%) questionnaires were retrieved out of the 300 administered.

RESULTS AND DISCUSSION

As indicated in Table 1, many of the respondents were Yoruba (77.1%). The dominant age distribution of the respondents was 41 - 50 years (37.1%). On marital status, many of the respondents were married and this accounted for 88.9%. The highest level of education for majority of the respondents was secondary school (52.1%).

For the amount spent monthly to purchase the domestic cooking energy carriers, 42.5% of the respondents indicated that they spent between ₦100 - ₦500 per month. Despite of these outcomes, it was discovered that with increasing disposable income and changes in lifestyles, households tend to move up the energy ladder (in terms of quality, convenience to use and cost (Reddy, 2004). The income of households influences energy consumption in many ways. Firstly, with the rise of income levels, energy consumption increases due to increase of dishes prepared. Secondly, with increasing incomes, the price of the fuel is less of a constraint. Reddy (2004) observed positive relationship between growth in per capita income and household demand for commercial fuels. For most developing countries, demand for commercial fuels has risen more rapidly than per capita incomes since 1970. This reflects the increasing desire for comfort and discretionary energy consumption.

Table 1: Demographic information on female energy users in Southwest Nigeria

	Demographic variables	Freq N = 280	%
1	Ethnic Group		
	Ibo	25	8.9
	Hausa	39	13.9
	Yoruba	216	77.1
2	Age distribution		
	(Years)	18	6.2
	< 20	34	12.1
	21 – 31	66	23.6
	31 – 41	104	37.1
	41 – 50	58	20.7
	> 51		
3	Marital Status		
	Single	15	5.4
	Married	249	88.9
	Widowed	14	5.0
	Divorced	2	0.7
4	Educational		
	Background	26	9.3
	None	76	27.1
	Primary	146	52.1
	Secondary	20	7.1
	NCE/ND	12	4.3
	Degree		
5	Monthly expenditure on		
	energy carriers		
	<100	51	18.2
	100 – 500	119	42.5
	501 – 1000	85	30.4
	>1000	25	8.9

Source: Field survey, 2009

Main energy carriers in the households

As shown in Table 2, kerosene ranked the highest in the sampled households (45.0%). This was closely followed by firewood (30.4%). Electricity and charcoal were also used in the households and they accounted for 11.1% and 6.4% respectively. Only 3.9% of the sampled households in used gas (LPG) for cooking, this was due to its high price. Other sources of energy carriers like sawdust, animal dung, agricultural waste, etc were also used by household.

The energy carriers are used for multiple purposes, viz., cooking, water heating and lighting. Despite of the high ranking of kerosene as the main source of cooking energy, many of the sampled households still used firewood in addition to the other sources of energy. The households that used fuelwood was for both cooking and water heating while other households who used kerosene and LPG was for cooking; water heating is done with either fuelwood or electricity. For the households that used firewood, few of them indicated that they collected the firewood from adjoining forests while many purchased from retailers.

Table 2: Main Cooking Energy Carriers used by Urban Households in Southwest Nigeria

Energy carriers in households	Frequency N = 280	%
Firewood	85	30.4
Charcoal	18	6.4
Kerosene	126	45.0
Gas (LPG)	11	3.9
Electricity	31	11.1
Others (sawdust, etc)	7	2.5
No response	2	0.1

Source: Field survey, 2009

Trend in the prices of petroleum products and impacts on households

Increases in the prices of oil products have reversed this process for many poor households, forcing them to either consume less of these products, or to fall back upon inferior sources of energy (UNDP, 2007; 2008). Tomori *et al.* (2005) in an assessment of the effect of some selected macro-economic shocks on poverty showed that the increase in prices of petroleum products impacted badly on majority (72.9%) of poor households in Nigeria. As reported by Adelekan and Jerome (2006), the effect of the economic policies embarked upon by the Nigerian government is that within the past two decades, a litre of petrol increased in price first from N0.60 in 1991 to ₦11.00 in 1994 and ₦20.00 in 1998 (an increase of nearly 3000 percent in less than ten years!). The price currently stands at ₦64.00 per litre. Concomitantly, kerosene also increased in price from ₦0.27 per litre in 1993 to ₦6.00 in 1994 and ₦17.00 in 1998, and currently ₦84.00. While a 12.5kg cylinder gas rose in price initially from ₦200 in 1993 to N450 in 1998 and later to ₦1000 by the year 2000 (Table 3).

There has been a steady rise in the prices of all the petroleum products in the year 2000s with extreme negative impacts on the people. Each time the price is increased; all parts of the economy are affected ranging from prices of food stuffs and other household commodities in the markets, transportation fares, among others. On each occasion that the government increased the prices of petroleum products, workers use to go on strike to press their demand on reduction of such prices; meanwhile government was always adamant and on the winning side. Effects of this on household energy carrier, most especially kerosene, is far fetch and with many implications on households' welfare and standard of living. The economic impact on households therefore led to either a switch in the choice of energy preferred for domestic use or a situation of energy combination by different income groups.

With regard to household consumption of energy for cooking purposes, Adelekan and Jerome (2006) discovered in their study that the proportion of consumers of firewood has continued to be on the increase. This is because consumers of kerosene especially those belonging to the low-income class, are constrained to switch over to firewood or other fuels as an alternative energy source. Consequently, an increased participation of both men and women in the fuelwood business was witnessed in the city with a concomitant increase in cost of firewood. A bundle of fuelwood that cost ₦25 in 1992 was sold for ₦50 in 1994 and ₦40 in 1999. This quantity of firewood is just about enough for the cooking needs of an average household in a day.

Table 3: Price of petroleum products in Nigeria (1973–2007)

Year	Petrol		Kerosene		LPG (Cooking gas)	
	Naira (₦) per litre	% change	Naira (₦) per litre	% change	Naira (₦) per litre	% change
1973-78	0.10	-	0.08	-	31.2	-
1979-85	0.15	61.1	0.11	30.0	32.3	3.5
1986-89	0.40	158.0	0.11	0.0	40.0	24.0
1990	0.51	29.01.	0.15	42.9	40.0	0.0
1991-92	0.60	17.6	0.40	166.7	80.0	100.0
1993	3.25	442.0	2.75	587.5	200.0	150.0
1994-97	11.00	238.5	6.00	118.2	200.0	0.0
1998-99	20.00	81.8	17.00	183.3	450.0	125.0
2000-01	22.00	10.0	17.00	0.0	1000.0	122.2
2002	26.00	18.2	24.00	41.2	1200.0	20.0
2003	40.00	53.0	38.00	58.3	1500.0	25.0
2004	43.00	7.5	51.00	34.2	1700.0	13.3
2005-2009	65.00	33.9	50.00	-2.0	-	-

Sources: 1. Nigerian National Petroleum Corporation, Lagos.
2. Central Bank of Nigeria: Annual Reports and Statements of Accounts, various issues.

Household energy consumption and environmental implications

Production and consumption of almost any type of energy inevitably have environmental impacts. Harvesting of fuelwood, in particular, contributes to deforestation, soil erosion, and desertification. An estimated 96 million people in Nigeria, about three quarters of the population use fuelwood as cooking fuel. The pressure on the country's forests is immense as 450,000 hectares of woodland are lost every year and if current trend continues, the country's forest resources could be completely depleted by 2020 (Oladosu and Adegbulugbe, 1994).

The significance of the energy sector within the broader poverty-energy-environment-nexus is well established (Adelekan and Jerome, 2006). Reliance on traditional biomass energy is particularly high in sub-Saharan Africa, accounting in some countries for 70 to 90% of primary energy supply and up to 95% of the total consumption. Even oil rich sub-Saharan African countries continue to rely on biomass energy to meet the bulk of their household energy requirements as result of issues surrounding affordability and availability. In Nigeria, it is estimated that about 91% of the household energy needs are met by biomass (Karekezi, 1999). Use of fuelwood as an energy source can also contribute to the accumulation of CO_2, the main greenhouse gas, both because burning fuelwood produces CO_2, and because deforestation destroys an important CO_2 sink. In addition, use of biomass in traditional stoves exposes the users, mainlywomen and children, to high levels of indoor air pollution. Indeed, the World Health Organization estimates that indoor air pollution tagged 'the Killer in the kitchen' results in 1.6 million deaths worldwide per year due to indoor air pollution, 24% occurring in Africa alone (Warwick and Doig, 2004).

Moreover, there is a difference between the usage of biofuels in urban and rural areas. Rural households depend on twigs and branches whereas urban households use logs which usually require the felling of trees. Thus, urban firewood consumption has a much greater negative environmental impact as compared to rural use.

Cooking units in homes and indoor air pollution

Cooking is done largely in built-in kitchens within the main house (42.1%) followed by cooking on corridors within dwelling units (19.3%). A considerable number of the households did their cooking outside in open space (14.3%), kitchen detached from main house (14.3%) and inside room (10.0%). On the whole, many of the respondents carried out their cooking in built-in kitchen of the building compartment (Table 4). A major problem associated with majority of the housing structure in the communities includes poor indoor ventilation resulting from inadequate spacing between houses, which also reduces ventilation. Many of the households in the study areas also do their cooking indoor. Cooking in rooms or corridors within dwelling units has health implications for such households as occupants are exposed directly to high levels of pollution as pollutants are retained indoors. The inadequate ventilation in most buildings also aggravates the situation. Pollutants typically found in biomass smoke are suspended particulate matter (SPM), carbon monoxide, nitrogen oxides, formaldehyde and compounds such as polyaromatic hydrocarbons (Adelekan and Jerome, 2006). Burning fuel wood therefore fills houses with smoke swirling with toxic substances.

Implications for usage of firewood as domestic energy

Figure 1 shows the response of the interviewed women on the implications of using firewood as source of domestic cooking energy. About 26.1% of the women informed that the use of firewood has effect on health while 22.5% indicated that it causes extra burden on cleaning of cooking utensils. The women are also aware of environmental impacts of firewood extraction and this response constituted about 19.7%. The activities involved in the collection and usage of firewood is time consuming and this was indicated by 8.4% of the sampled women.

Although all members of the household experienced health implication from using of firewood, nevertheless, more women and children were especially vulnerable. Most women noted that when the effects of the smoke became more than they could bear they usually stopped cooking even when the food was not yet done. Sometimes, because of the ordeal of cooking under a covering of smoke they became exhausted and even lost their appetite. Both men and women noted that the use of fuel wood in their households was by compulsion and not by choice.

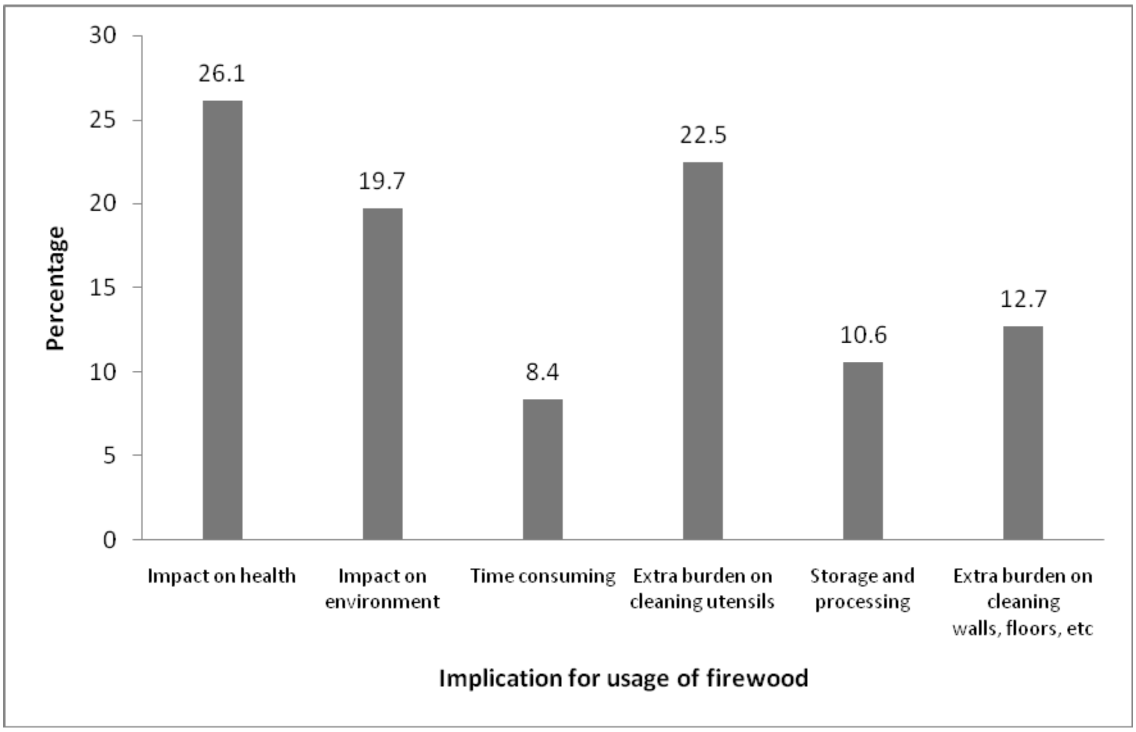

Figure 1: Perceptions of both the rural and urban women on the implications of using firewood as cooking energy (*Source*: Field survey, 2009)

CONCLUSION AND RECOMMENDATIONS

The environmental effect of the energy use pattern among urban populace indicated increase in indoor air pollution and degradation of forests within the city and outskirts of the city. Kerosene was the major energy carrier in both rural and urban areas. In addition to its potential to reduction in the exploitation of forest resources, government should try as much as possible to formulate policy that will enhance proper distribution and availability of kerosene with proper monitoring and enforcement strategies. Although many efforts geared toward affordability and accessibility of kerosene through subsidy has failed, other strategy that would aid its distribution and marketing should be the major focus. Improving the way firewood is supplied and used for cooking is, therefore, an important way of reducing its harmful effects. This can be achieved either through transformation of firewood into less polluting forms or through improved stoves and better ventilation.

Policies on capacity building and empowerment are essential for widening women’s access to modern services and sources and to address the issues of poverty. By integrating renewable energy into rural electrification, rural development, poverty-alleviation, and social welfare programmes, the effectiveness of these programmes can in many cases be advanced.

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ENVIRONMENTAL RISKS ASSOCIATED WITH THE USE OF BUILDING SERVICES EQUIPMENT

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Abstract

This paper takes a general look at the basic performance expectations of buildings in terms of design, and the need to provide building services equipments located within the building envelope to enhance the functional requirements of buildings in order to achieve comfort drive of the occupants in view of the constantly changing external environmental conditions. It shows the interrelated operational pattern of the equipments that culminate in the discharge of effluents that have high rate of environmental risks to both internal and external building space. It also recommends the likely measures to be taken to mitigate the risks directly associated with the use of the building services equipment.

INTRODUCTION

As man advances in knowledge, the form, pattern and technology of constructing buildings increase from stone-age to iron-age, and to what obtain after industrial revolution. The main reason for the provision of shelter is to protect man and his belongings from various forces that may exist in his surroundings (BS 7750, 1992). A building also serves as an environmental filter by modifying the external natural environment so that the building occupants can enjoy the required level of comfort. The expected comfort level is not achievable every now and then in a building through the building envelope because of the constantly changing environmental parameters. Hence, the building services equipments are used to address the likely inadequacies and achieve the required internal comfort. According to Curwell et al (2002), the life cycle operation of buildings contributes to or inhibits the sustainability of the environment much more than the initial construction does.

Buildings significantly and often negatively impact the environment and consumption of natural resources. Building operation accounts for 40% of the United States of America energy use. This number increases to an estimated 48% when energy required to make building materials and construct new buildings is included. Building operations also contribute over 38% of the U.S.'s carbondioxide emissions and over 12% of its water consumption (Annual Energy Review, 2005). Energy is the largest operational expense for most facilities, contributing to at least 30% of a typical office building's expenses. The U.S. Green Building Council estimates that commercial office buildings use 20% more energy on average than necessary. Therefore, it is evident that these facilities are wasting natural resources, which is detrimental to urban environment (Louise, 2008). Buildings have historically caused much environmental degradation, particularly by the operation of their technology components. Heating by coal, and oil produced by burning fuels, sewage dumped directly into streams, and various other pollutants produced as by-products of building services have all contributed to local, regional and global problems. With greenhouse gas emissions now acknowledged as a global problem and with the cost of energy predicted to continuously cater for the nearest future, building owners are generally concerned with improving efficiencies. New and improved technologies can reduce consumption of energy as well as reduce environmental impact of every building. A building fulfils its purpose by harmonizing well with the climate and the functions it is designed for. Szokolay (1982) asserted that it is axiomatic that climate is (or should be) a major determinant in house design. A building can thus be climate-responsive. According to Hyde (2000), climate responsive design is part of environmental approach to building development called Ecological Sustainable Design (EDS).

ROLES OF BUILDINGS IN URBAN DEVELOPMENT

Building spaces are to provide the occupants desirable environmental conditions. The level of thermal comfort within a space determines to a large extent, the level of functionality of the space. This is because human activities within building spaces can only be satisfying when the thermal environment is conducive to performers. Comfort within living spaces is highly desirable for building sustainability and environmental quality. Spatial comfort must be sustainable for the overall sustainability of the building (Ademola and Ajibola, 2007). The performance of a building cannot be absolute if it was left to the exclusive dictate of the environmental factors and the only determinant to know the optional functional and comfort state of a building space. Hence, there is need for complimentary installation and use of relevant appurtenances in the building to enhance functional and comfort state of a building space. The common classifications of the relevant equipment are: HVAC + R (Heating, Ventilating & Air-Conditioning + Refrigeration); fire services; gas and steam supply; electrical service; lighting systems; security; communication; acoustics; vertical transportation; and building management and control systems. The uses of the building services equipment may lead to pollution and other likely environmental risks. Pollution is the introduction of contaminants into an environment, of whatever pre-determined or agreed proportions or frame of reference. These contaminants cause instability, disorder, harm or comfort to the physical systems or living organisms therein. Pollution can take the form of chemical sustenance, or energy such as noise, heat or light energy. Pollution is often classed as point source or non-point source. Sometimes, the term pollution is extended to include any substance when it occurs at such unnaturally high concentration within a system, that it endangers the stability of that system and cause likely risks to the users of built environment.

EFFECTS OF POLLUTION POTENTIALS OF BUILDING SERVICES EQUIPMENT ON THE INDOOR OF BUILDING ENVIRONMENT

Many office environments give rise to complaints relating to thermal and ventilation conditions. The common problems experienced include discomfort, draughts, stuffiness, headaches, general malaise and even illness. The phenomenon is being termed as ‘Sick Building Syndrome’. Effects of air pollution on buildings have been noticed since the beginning of the Industrial Revolution. Many outbreaks of illnesses have been attributed to some aspects of internal building environment, the building fabric or building tightness and lack of sufficient ventilation. Building related problems may be due to contamination of indoor air by emissions of volatile organic compounds (VOCs), from building fabrics, furnishings and equipment. Because many of these compounds are toxic, knowledge of the levels of such materials in the indoor environment is required in order to determine human health impacts and methodology needs to be developed in order to detect positively, identify and quantitate the VOCs in the air. According to Roger (1998), the growing complexity of modern buildings and the contribution made by building services have superficially made contemporary structures more comfortable to use, live and work in. But under the surface, the ‘Intelligent Building’, it is not universally considered as such. There are serious concerns that the health and safety of modern building users are threatened. The principal areas of concern are:

Legionnaires' Disease

Legionnaaires' disease is a killer with its first notable outbreak recorded in 1976 during an American Legionnaires' convention at Philadelphia, USA where 29 people died out of the 182 that contracted the bacterial infection. The bacteria thrive naturally in the warm moist conditions of swamps and similar humid conditions, but have readily adapted to the artificial climate and environment found in man-made air-conditioning and other service systems. Any permanently moist warm situation such as dead lengths of pipe and trapped water in shower roses could attract the bacteria.

Humidifier Fever

Humidifier fever is an allergy causing temporary discomfort with symptoms similar to influenza. The source has been found in the water reservoirs of humidifiers where micro organisms of the amoebae species breed while the water-spray air-humidifier plant is shut for weekends and holidays. The dead husks of the amoebae are drawn into the air stream and dry air into a fine dust, which is inhaled by the building occupants.

Sick Building Syndrome

Sick Building Syndrome (SBS) may manifest through a collection of ailments such as headaches, lethargy, skin irritations, dry or running nose and throat inflammation. It is common in contemporary buildings that are sealed and have artificially controlled environments. It is not deadly or disabling but could contribute to absenteeism from work and reduce productivity of occupants. Likely areas of its source are background humming from air movement in ductwork and buzzing from fluorescent lights, artificial lighting, glare from computer monitors and lack of direct control of the internal environment through intelligent and fully automated building.

EFFECTS OF POLLUTION POTENTIALS OF BUILDING SERVICES EQUIPMENT ON THE OUTDOOR OF BUILDING ENVIRONMENT

A number of appliances used in buildings contribute significantly to the production of green house gases that tend to negatively affect the ecological stability of the external environment. According to Mannion and Bowlby (1993), it is now expected that chlorofluorocarbons (CFCs) contribute 15% of the green house effect, and are produced from a wide range of processed compounds used for air-conditioners, foam blowing agents, refrigerators and foam hard plastics. Chlorofluorocarbons are particularly strong absorbers in the atmospheric window where carbondioxide is ineffective. There are growing scientific evidence that green house gas emissions caused by human activities are having an effect on the earth's climate. The evidence suggests that the earth's climate has warmed by almost 0.7^0C since the end of the nineteenth century and that the pace of this warming is increasing (WMO, 1998). It is generally accepted that the rapid rise in global temperature experienced during the latter part of the century is due, in part, to atmospheric pollution arising from human activity, which is accelerating the earth's green house effect.

Quite a number of installations and equipments used within building spaces do generate effluents that have direct link with the building up of gases that have potentials in causing green house effects. The most important green house gases are the water vapour (H_2O) and carbondioxide (CO_2). Other gases are methane (CH_4), nitrous oxide (N_2O) and Ozone (O_3). Also, there are several manufactured gases of which the most important are the chlorofluorocarbons (CFCs), which have an extremely potent green house effect (Dokun, 1995; Department of the Environment, 2000). The combined roles of the green house gases have led to the disturbance of the ecological stability which is significantly noticed in the occurrence of the following phenomena in urban studies:

Climate Change

Weather refers to the complete state of the atmosphere at a particular instant in time. A synthesis of weather over a period of time long enough to establish statistical attributes is referred to as climate. Climate is always varying, making it difficult to have anything like a normal climate of a place or a region. Where a year to year variation is observed, we have 'short time'. A long statistical significance persistence in the fluctuation indicates a climate change (Ibrahim, 2006). Pidwirny (2004) classified the identified causes of climate change extra as extra terrestrial system which may be anthropogenic. This includes the discharge of gases from man's activities and production processes like the greenhouse gas from the electrical and mechanical appliances used in buildings.

Depletion of the ozone layer

Ozone (O_3) in the earth's stratosphere performs the vital function of protecting the surface of the planet from ultraviolet (UV) radiation which would otherwise be extremely harmful to human and animal life. Ozone is produced in the stratosphere by the absorption of solar UV radiation by oxygen molecules to produce oxygen through a series of complex photochemical reactions (Harrison, 1990). The ozone produced absorbs both incoming solar UV radiation and outgoing terrestrial long-wave radiation. In doing so, the ozone in the stratosphere is converted back to oxygen. The process is therefore both continuous and transient, with ozone continually being created and destroyed. The process is dependent on the amount of solar radiation incident on the earth; consequently, ozone levels in the stratosphere are strongly influenced by factors such as latitude and season (Clive, 2002). Blame for the recent and rapid deterioration of the ozone layer has been placed on escaping gases such as CFCs and nitrous oxide. Until recently, CFCs were widely used in many applications including aerosols propellants, cooling equipments used in buildings; refrigerants, solvents and insulation foam. CFCs, especially CFC-11 and CFC-12, as well as being strong green house gases are also potent ozone depletors. The lifetime of CFC-11 in the stratosphere is about 65 years, while that for CFC-12 is estimated to be 130 years (Climate Change, 1990).

Global Warming

There is a growing scientific evidence that green house gas emissions caused by human activities are having effects on the earth's climate. The evidence suggests that the earth's climate was warmed by almost 0.7^{o}C since the end of the nineteenth century (WMO, 1998), and that the pace of this warming is increasing. Globally, the1990s were the warmest years on record, with seven of the ten warmest years recorded in that decade (WMO, 1998; NASA, 1998). The main naturally occurring greenhouse gases in the earth's atmosphere are water vapour and carbondioxide. Of these, it is water vapour that has the greatest greenhouse action. The extent to which global warming is likely to occur as a result of the build-up of green house gases is a matter of much scientific debate. The Hardley Center of the UK Meteorological Office predicts that, under the 'business as usual' scenario, the world's climate will warm by about 3^{o}C over the next 100 years (Department of the Environment, 2000).

Pollution

Anthropogenic air pollution originates from a variety of sources, including households; vehicles; large stationary sources, and small and medium-sized industries. Pollution from many of these sources is closely related to the production and consumption of energy (Masami and Magda, 2001). A number of emissions are released into the environment by the installations and equipment used in buildings. The contributory roles of carbondioxide (CO_2) nitrous oxide (N_2O), hydrocarbons and sulphurdioxide (SO_2), cause significant pollution in the atmosphere.

MITIGATING RISKS ASSOCIATED WITH THE USE OF BUILDING SERVICES EQUIPMENT

The risks associated with the use of building services equipment have caused many designers of buildings in Europe to question, the need for vapour compression refrigeration machines to air condition buildings, with the result that alternative passive ventilation strategies are now being adopted in many new buildings. The means to prevent or mitigate the pollution potentials and environmental risks associated with the various building services equipment must be from the holistic point of view so as to take into consideration relevant measures. In recent years, intergovernmental agreements particularly the Montreal Protocol (1987), have phased out the production and use of CFCs. However, CFCs are very long lived in the stratosphere and hence, any reduction in CFC release will have little effect in the near future. The phasing out of CFCs has caused a greater reliance on HCFCs, in particular HCFC-22, which although is a more ozone 'friendly refrigerant'. Some other measures that can be adopted are:

Emissions and Pollution avoidance

There is need to avoid manufacturing of building services equipment that are potent sources of pollution; by not using refrigerants that can damage ozone layer, fuel oil tanks provided with containment leak detections and alarms, and discharges from heating and other cooling substances should be drained only to the suitable foul sewers.

Human Environment

There is need to ensure adequate and enhanced ventilation and outdoor air-take, direct occupant control of HVAC and lighting, advanced HVAC controls, isolation and venting of spaces involving use of hazardous materials, and outdoor light pollution reduction by means of light fixtures, shadings and controls.

Energy Conservation

This entails prevention of the generation of pollution through the use of energy used in the built environment through on-site photovoltaic, wind, geothermal and bio-based electricity generation, purchasing of "green power" by building owner, automatic lighting control zones and occupancy sensors, and use of hybrid natural/mechanical ventilation with automatic controls.

INTEGRATED BUILDING DESIGN

Integrated Environmental Design (IED) helps to have a building described as 'intelligent' by having the following features: Automated Building Services such as those for energy management, security and fire precautions; Information Management: such as telecommunication systems and computer systems for IT (Information Technology); Control: the environment can be controlled by monitoring the building services by the Building

Automation System (BAS) and Premises Management achieved by the controlled monitoring and scheduling of maintenance and other building functions.

CONCLUSION AND RECOMMENDATIONS

In view of the growing need for the construction of more buildings to cater for more demand for housing and allow urban development, buildings have been discovered to cause much environmental degradation, particularly by the operation of their technology components. Heating by coal and oil, electricity produced by burning fuels, sewage dumped directly into streams and various other pollutants and contaminants produced, are by-product of building services and have all contributed to local, regional and global concerns. Equally, many building environments give rise to complaints from occupants relating to thermal and ventilation conditions, which has led to the phenomenon of sick building syndrome and other associated health risks on the occupants. There is need to pay attention to the design, specification and detailing of mechanical systems, adequate in service operations and maintenance of modern equipments comprising advances in controls technology and implementation of energy conservation measures that could help to mitigate some of the pollution potentials and environment risks associated with the use of building services equipment in the built environment. Also, the philosophy of Integrated Environmental Design should be adopted by professionals involved in the design and construction of buildings so that buildings can achieve the optimum environmental decisions.

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OPERATIONAL ATTRIBUTES OF URBAN AQUACULTURE SYSTEMS IN IBADAN MUNICIPAL, OYO STATE, NIGERIA

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Abstract

The study evaluated the operational attributes and the associated factors affecting operation of three urban aquaculture systems in Ibadan City. Multi-stage sampling technique was used to select nine Local Government Areas from eleven based on intensity of fish farming activity. The second stage involved random selection of fish farms within the Local Government Areas from list of fish farmers compiled by Federal and State Departments of Fisheries, Oyo State. A sample of 59 fish farmers composed of 19 earthen pond fish farmer, 25 flow-through fish farmers and 15 re-circulatory system operators was used for the study. Structured questionnaires were administered to collect primary data and analyzed using descriptive statistics. Fish farmers had 1 – 5 years experience (64.4%) and 66.1% were between the ages of 31 – 50 years. Empirical evidence from the analysis reveal that 55.9% are small farm-holders (≤0.25 ha) and 59.3% combine fish farming with other occupation for sustainable livelihood. Analysis of pooled data and its ranking indicates that poaching and transportation were ranked topmost by the farmer and followed by input procurement. Earthen pond, flow-through and re-circulatory system farmers ranked transportation/lack of technical personnel, high cost of input procurement and inconsistency of electric power supply as the topmost constraints respectively. In conclusion, production, social and environmental factors are constraints for urban aquaculture.

INTRODUCTION

The fisheries sector in Nigeria is a vital source of food, employment, recreation and foreign exchange earnings. According to the 2007 Fishery Statistics (FDF, 2007) fisheries contributed 4.0% to Agricultural GDP and US$38.3million as export earnings. In terms of domestic fish production, artisanal fisheries contribute 81.9%, while aquaculture produces 13.3%. The per capita fish consumption has remained low at 9.68 Kg per person per annum due to the decreasing fish catch from the wild and increasing human population. Inadequate domestic fish supply has resulted to the importation of frozen fish to offset the gap in the domestic demand (Ojo *et al.* 2006). Due to the decrease in artisanal fish supply as a result of overfishing and pollution, aquaculture has been identified as a solution to meeting the fish demand. The aquaculture industry in Nigeria has become an important source of income and employment generator, source of animal protein in the urban and rural areas (FDF, 2007). Oyo State as a land locked state depends on aquaculture to supply cultured fish to meet the demand for animal protein. Aquaculture has also become a vital source of animal protein, food security, employment and trade for the people of Ibadan Municipal, despite the prevailing evidence of climate change as rain fall delay, decline of fish catch from inland water bodies and other constraints (Fregene and Adesola, 2008; WorldFish Center, 2007 and FAO, 2008).

Urban aquaculture has become a solution to food insecurity in the cities. In a study by Adeogun *et al* (2007) growing fish in and around the major cities of Lagos State appear to meet the growing needs among urban people for fresh and culturally preferred types of fish.

But the production systems used are confronted with some of the challenges such as economical, technical, ecological and institutional factors. It has become imperative to understand the operational status of variety of systems of aquaculture in Ibadan Municipal and the main constraints confronting these systems. The objective of the study was therefore to evaluate the socio-economic characteristics of fish farmers, production

Study Area

Attributes of three urban aquaculture systems in Ibadan City and rank the factors affecting their operation. The urban aquaculture systems are earthen pond, flow-through and re-circulatory system operators.

RESEARCH METHODOLOGY

The study was carried out in Ibadan Municipal or Region, the largest urbanized region in Oyo State of the South-Western part of Nigeria. Ibadan Municipal is made of eleven Local Government Areas (LGA), namely: Ibadan North East, Ibadan North, Ibadan South East, Ibadan South-West, Ibadan South, Oluyole, Egbeda, Lagelu, Iddo, Ono-Ara and Akinyele; and has a population of 1,228,663 from 1991 population census. The area is located on Longitude 3 54'E and Latitude 7 23'N with the total land area of 130 km^2 and 750m above sea level. Major seasons are the rainy season being from March to October, while the dry season runs through November to February. Maximum temperature is 37^0C and has mean minimum temperature of 22^0C. Its landforms are characterized by hills, which constitute about 5%, plains about 80% and the rest made up of valleys. The city is drained mainly by Rivers Ogunpa and Ona.

Sampling Technique and Data

Multi-stage sampling technique was used to select 9 LGAs from 11based on intensity of fish farming activity. These are Ibadan Northeast, Ibadan North, Ibadan Southwest, Ibadan South, Oluyole, Egbeda, Lagelu, Ono-Ara and Akinyele. The second stage entailed selection of fish farms was from list of fish farmers compiled by Federal and State Departments of Fisheries in Oyo State. Total sample of 80 fish farms were selected for the study, but 21 were rejected because they were invalid for analysis due to incomplete information, inconsistency, and spurious response. A sample of 59 fish farmers composed of 19 earthen pond fish farmer, 25 flow-through fish farmers and 15 re-circulatory system operators were used for analysis. Structured questionnaires were administered to collect primary data. Descriptive statistics was used to analyze the data.

RESULTS AND DISCUSSIONS

Demographic Characteristics of Farmers of the Urban Aquaculture Systems

Presented in Table 1 are the demographic characteristics of fish farmers based on the type of aquaculture system practiced. Most of the fish farmers are male (89.8%), within the productive age of 31-50 years (66.1%) and married (79.7%). These age groups in the society are often described as most socially and economically active. The pooled data analysis revealed that 52.5% have attained university degree. It was also observed by Fregene and Digun-Aweto (2007) in their study in Osun State that 60% of the fish farmers have university degree.

Table 1: Distribution of Farmers Based on their Demographic Characteristics

Demographic Characteristics	Earthen Pond		Flow Through		Re-circulatory		Pooled	
	N (27)	% (45.8)	N (15)	% (27.1)	N (16)	% (26.1)	N (59)	% (100)
Sex								
Male	25	42.4	13	22.0	15	25.4	53	89.8
Female	2	3.4	3	5.1	1	1.7	6	10.2
Age								
< 30	5	8.5	1	1.7	7	11.9	13	22.0
31-40	10	16.9	5	8.5	6	10.2	21	35.6
41-50	9	15.3	7	11.9	2	3.4	18	30.5
51-60	3	5.1	2	3.4	1	1.7	6	10.2
>60	0.0	0.0	1	1.7	0.0	0.0	1	1.7
Educational status								
Primary	3	5.1	1	1.7	0.0	0.0	4	6.8
Secondary	3	5.1	2	3.4	1	1.7	6	10.2
Polytechnic	12	20.3	3	5.1	3	5.1	18	30.5
University	9	15.3	10	17	12	20.4	31	52.5
Marital Status								
Single	5	8.5	1	1.7	6	10.2	12	20.3
Married	22	37.3	15	25.4	10	16.9	47	79.7
Household size								
≤ 5	16	27.1	8	13.6	9	15.3	33	55.9
6-10	10	16.9	6	10.2	7	11.9	23	39.0
11-15	1	1.7	2	3.4	0.0	0.0	3	5.1
Years of Experience								
1-5	16	27.1	11	18.6	11	18.6	38	64.4
6-10	10	16.9	5	8.5	3	5.1	18	30.5
11-15	0.0	0.0	0.0	0.0	2	3.4	2	3.4
16-20	1	1.7	0.0	0.0	0.0	0.0	1	1.7
As a mode of Livelihood								
Fulltime	9	15.3	6	10.2	9	15.3	24	40.7
Part-time	18	30.5	10	16.9	7	11.9	35	59.3

Majority (64.4 %) of the fish farmers have been into production activities for not more than five years. Earthen pond farmers dominate the distribution as well as those practicing flow through and re-circulatory system. It was observed that as years of experience increased, population of farmers reduced. Fish farming have become a major source of livelihood because 40.7% practice it on full-time basis while 59.3 % combine it with other occupation for sustainable livelihood. This will likely enhance household fish food security and sufficiency.

Operational Attributes of Urban Aquaculture Systems in the Region

Operational attributes are shown in Table 2. Fish farmers in Ibadan metropolis are small farm-holders of ≤0.25 ha (55.9%) on land that was purchased (62.7%) by themselves. The major source of financing the fish farm is through own savings (71.2%).

Sole producers of *Clarias species* producers are 62.7 %, Tilapia (5.1 %) and Carp (1.7%). Very few combine *Clarias* with Tilapia (6.8 percent) for more economic returns. According to

Atanda (2007) more than 80 % of cultured fish in Nigeria is catfish, mainly *Clarias* spp., *Heterobranchus* spp. and their hybrids. Brood-stock for breeding (93.2%) and fingerlings for stocking (62.7%) are bought from other fish farms. It is interesting to note that 32.2% of fish farmers breed their fingerling themselves. The data confirms that farmers are conscious of buying or raising species that grow fast and can be profitably marketed. This could be due to the effort of the Training and Visit (T&V) system of extension services adopted by the Agriculture Development Programme (ADP) in Nigeria that has ensured that improved production technology reach a larger proportion of fish farmers for increased aquaculture production to meet national fish demand (Bolorunduro and Fregene, 2000). But 39.0% of the fish farmer do have problem of sourcing for fingerlings to stock their rearing systems. Investment financing and indebtedness has been one of the sources of worry for aquaculture entrepreneurs in Nigeria. Level of investment in any sector could also be influenced by the market attractiveness, price stability and information. Majority (64.4%) indicated they enjoyed stable market situation which is required for sustainable aquaculture development.

Table 2: Operational Status of Aquaculture Production Systems in the Urban Region

Demographic Characteristics	**Earthen Pond**		**Flow Through**		**Re-circulatory**		**Pooled**	
	N (27)	**% (45.8)**	**N (15)**	**% (27.1)**	**N (16)**	**% (26.1)**	**N (59)**	**% (100)**
Farm Size								
≤ 0.25	14	23.7	9	15.3	10	16.9	35	55.9
0.26-0.5	11	18.6	5	8.5	4	6.8	20	33.9
0.51-0.75	2	3.4	1	1.7	1	1.7	4	6.8
0.76-1	-	-	1	1.7	1	1.7	2	3.4
Form of Land Acquisition								
Inherited		6.8		5.1		3.4		15.3
Lease		11.9		3.4		6.8		22.0
Purchased		27.1		18.6		16.9		62.7
Sources of Finance								
Own Saving	20	23.9	13	22.0	9	15.3	42	71.2
Bank Loan	4	6.8	2	3.4	5	8.5	11	18.6
Cooperatives	3	5.1	1	1.7	2	3.4	6	10.2
Species Cultured								
Clarias spp	17	28.9	8	13.6	12	20.4	37	62.7
Tilapia spp	3	5.1	-	-	-	-	3	5.1
Carp	1	1.7	-	-	-	-	1	1.7
Clarias spp and Tilapia spp	2	3.4	1	1.7	1	1.7	4	6.8
Clarias spp and Carp	2	3.4	-	-	-	-	2	3.4
Sources of brood stocks								
The Wild	-	-	1	1.7	-	-	1	1.7
Other fish farms	26	44.1	13	22	16	27.1	55	93.2
On-farm breeding	1	1.7	2	3.4	-	-	3	5.1
Sources of Fingerlings								
The Wild	1	1.7	1	1.7	1	1.7	3	5.1
On-farm breeding	5	8.5	4	6.8	10	16.9	19	32.2
Other fish farms	21	35.6	11	18.6	5	8.5	37	62.7
Availability of Fingerlings								
Yes	18	30.5	10	16.9	8	13.6	36	61.0
No	9	15.3	6	10.2	8	13.6	23	39.0
Stability of Market								
Yes	15	25.4	11	18.6	12	20.3	38	64.4
No	12	20.3	5	8.5	4	6.8	21	35.6

Relative Ranking of Factors Affecting Operation of Fish Farm

Table 3 shows the mean rating response and the corresponding ranking positions of the aquaculture systems and pooled data. Challenges of earthen pond system of aquaculture identified by fish farmers are lack of access to technical personnel, poaching and transportation as most severe constraints. In the fourth position is marketing while cost of feed ranked fifth position. The flow-through system fish farmer ranked input procurement topmost while poaching and inconsistent electricity supply were ranked in second position, transportation (fourth) and high cost of feed (fifth) among other factors. Inconsistent electric power supply was the topmost ranked constraint for the re-circulatory system; others are cost of feed and supply of energy (2nd), high cost of fuel (fourth), inadequacy of feed (fifth) and transportation (sixth). Analysis of pooled data and its ranking indicates that poaching and transportation were ranked topmost by the farmers. It was followed by input procurement in third position; cost of feed and supply of energy was fourth, while scarcity of fingerlings, and inconsistent electricity supply occupied the sixth position.

Table 3: The Relative Ranking of Factor Affecting Operation of Fish Farming

FACTOR	ES	n^{th}	FT	n^{th}	RS	n^{th}	Pooled	n^{th}
Cost of feed	2.59*	5	2.13*	10	2.94*	2	2.56*	4
Inadequacy of feed	2.41	7	2.56	7	2.50	5	2.47	10
Scarcity of fingerlings	2.41	7	2.06	11	2.25	7	2.54	6
Marketing	2.63	4	2.44	9	2.06	11	2.42	11
Transportation	2.67	1	2.90	4	2.38	6	2.64	1
Lack of Technical Personnel	2.67	1	2.63	5	2.13	10	2.51	8
Input procurement	2.56	6	3.06	1	2.19	9	2.59	3
Poaching	2.67	1	3.00	2	2.25	7	2.64	1
Inconsistent power supply	2.37	9	3.00	2	3.08	1	2.54	6
Supply of energy	2.37	9	2.50	8	2.94	2	2.56	4
High cost of fuel	2.30	10	2.63	5	2.75	4	2.51	8

N/B
n^{th} = The ranked position
* = The rating mean index of factors affecting aquaculture

ES = Earthen Pond System
FT = Flow through System
RS = Recirculatory System

CONCLUSION

The study has shown that fish farmers are mainly male and highly educated. *Clarias species* is the main species cultured using personal savings. Sizes of the farms are relatively of small size holdings on purchased land. Production, social and environmental factors are constraints which must be taken into consideration for urban aquaculture. Provision of security of fish farms must be ensured to guide against poaching. Stable electricity is essential for sustenance of the re-circulatory system. Extension activities should disseminate and build technical knowledge for adoption of flow-through and re-circulatory systems.

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URBAN WASTE MANAGEMENT IN LAGOS METROPOLIS

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Abstract

Urban centre is facing serious environmental degradation and public-health risk due to indiscriminate disposal of waste on streets and other public areas, drainage congestion and contamination of water resources near uncontrolled dumping sites. Solid waste disposal poses a greater problem because it leads to land pollution if openly dumped, water pollution if dumped in low lands, and air pollution if burnt. This paper examines strategies for waste management. Data were collected from agencies involved in waste management. Interviews were also conducted on a personal basis. Water samples were collected using grab sampling technique and analysed in the laboratory. Results shows that BOD values of 22 and 8.5 were obtained for landfill one and two respectively and nothing was obtained for the references, while the values for iron are 3.5 and 5.3 for landfill one and two respectively and 0.02 and 3.2 was obtained for Ketu and Apapa. In terms of hardness the results shows that the total hardness for landfill one (532.5) is greater than the WHO limit of <350. Suggestion for an improved waste management is offered.

INTRODUCTION

Waste hierarchy refers to the "3 Rs", that is, reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste. *Waste minimization* is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products (such as disposable cutlery), removing any food/liquid remains from cans, packaging, and designing products that use less material to achieve the same purpose (for example, light weighting of beverage cans (http://www.psc.edu/science). Reuse is to use an item more than once. This includes conventional reuse where the item is used again for the same function and new-life reuse where it is used for a new function. In contrast, recycling is the breaking down of the used item into raw materials which are used to make new items. By taking useful products and exchanging them, without reprocessing, reuse help save time, money, energy, and resources. In broader economic terms, reuse offers quality products to people and organizations with limited means, while generating jobs and business activity that contribute to the economy. Recycling involves processing used materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from land filling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to virgin production.

Extended producer responsibility (EPR) is a strategy designed to promote the integration of all costs associated with products throughout their life cycle (including end-of-life disposal costs) into the market price of the product. Extended producer responsibility is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market. This means that firms which manufacture, import and/or sell products are required to be responsible for the products after their useful life as well as during manufacture. Polluter pays principle is a principle where the polluting party pays for the impact caused to the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the waste. Zero waste is a philosophy that encourages the redesign of resource life cycles so that all products are reused. Any trash sent to landfills is minimal. The process recommended is one similar to the way that resources are reused in nature. In industry this process involves creating commodities out of traditional waste products, essentially making old outputs new inputs for similar or different industrial sectors. An example might be the cycle of a glass milk bottle. The primary input (or resource) is silica-sand, which is formed into glass and then into a bottle. The bottle is filled with milk and distributed to the consumer. At this point, normal waste methods would see the bottle disposed in a landfill or similar. But with a zero-waste method, the bottle can be saddled at the time of sale with a deposit, which is returned to the bearer upon redemption. The bottle is then washed, refilled, and resold. The only material waste is the wash water, and energy loss has been minimized (see container deposit legislation). Zero waste can represent an economical alternative to waste systems, where new resources are continually required to replenish wasted raw materials. It can also represent an environmental alternative to waste since waste represents a significant amount of pollution in the world.

STUDY AREA

The study was carried out in Lagos metropolis which lies approximately between latitudes $6^{0}22'$N and $6^{0}52'$N and longitude $6^{0}42'$E and $3^{0}42'$E. The 180 km long Atlantic coastline forms the southern boundary of the state; Ogun State shares its northern and eastern boundaries while Republic of Benin sets the boundary in the west. The city has been selected because of the increased heterogeneous population over the years. Wilbur Smith (1980) revealed that population in lagos grows in excess of 9 percent per annum in recent years thus adding about 300, 000 persons per annum or 25, 000 per month or 833 per day or 34 per hour. At the inception of Lagos State Waste Management Agency (LAWMA), in 1977 there were five existing landfill/dumpsites in operation within Lagos metropolis which were open swamps but progressively reclaimed with refuse. Under World Bank assisted project in 1988 three sites were proposed for sanitary land fill development in Lagos. These are: Olushosun (42 hectares) in Ikeja Local Government sitting to the north of the state; Abule Egba (10.5 hectares) in Alimosho Local Government sits to the north west of the state; and Solous (3.0 hectares) in Alimosho Local Government sitting to the south west of the State.

Olushosun as a case study

Olushosun occupies approximately 42 hectares of state owned property in the metropolitan Lagos Area with a life span of 35 years from the date of establishment in 1992. More precisely, it is located within the Oregun area, Ikeja Local Government about 4km east of the Muritala Muhammed International Airport at the North West corner of the intersection of the Lagos-Ibadan Express Way, Ikorodu Road. The site boundaries can generally be described, as abutting into the back of privately owned industries and commercial lands. Olushosun receives an average 1 000 000 tonnes of waste annually. A sufficient cover material for waste is available both in quantity and quality, but the waste is uncovered because of lack of necessary equipments. The leachate generated from this site is ponded at the lowest level of the void space and often recirculated to reduce microbial load for waste degradation. Thus, proper monitory programmes for leachate, surface water, ground water and landfill gas control is inevitable. Despite the fact that the lateritic nature of the soil provides natural attenuation for water movement and the rate of percolation it conforms to international standards that could protect and prevent underground water contamination. The current operation is up to 24 hours per day. The gate records manually by the landfill site manager for each sift show the number of trips, arrival, departure, times, vehicle type, registration number and owner of the truck.

Most of the waste from Lagos is dumped at this site, which is now usually accessible during the rainy season as a result of the construction of a new access road. Lavalin in 1992 produced a design and operation report to manage and engineer the sanitary landfill. When the World Bank financing ran out, necessary construction works at the site, such as drainage and leachate treatment of the landfill base degassing and biogas facilities, final covering and so on were abandoned. Currently, the site might best be described as three distinct smaller areas. The Northern area is approximately 14 hectares in size and was used in the past as a burrow pit for laterite sand. But the vegetation present on the site revealed that it has not been used as a burrow pit for a long time.

METHODOLOGY

Both qualitative and quantitative methods were adopted in data collection. The qualitative method involves physical visits to the agencies involved and interviews were conducted on a personal basis. Water samples were taken from four different well: two sites around the landfill and the other two sites located in Ketu and Apapa. This is done between 7.00 a.m and 11.00.a.m in the morning. The sample method used was the Grab Sampling technique. The method is used conventionally to sample water from sources as well as rivers, streams, lakes, oceans, reservoir, pipeline, and conduits processing tanks, vats, stream, generators, spray pond, fillers at atmospheric or higher pressures for chemical, physical, bacteriology or radiological analysis. Grab samples are taken with a depth sampler at a specified depth. From each of the four wells (i.e. the two around the landfills and the two far away) 2 litres keg of water samples were collected. The water properties tested for include Biological Oxygen Demand (BOD), conductivity, PH Appearance, Nitrate/Nitrite Nitrogen, Iron content (Fe) odour and colour.

RESULTS AND DISCUSSIONS

Biological Oxygen Demand (BOD) measures the amount of oxygen consumed by bacteria as they oxidise organic matter in the water sample. The test is most commonly used to measure waste loading or treatment of plants and in evaluating the efficiency of waste water treatment. It is conducted over a five day period usually at a temperature of 20^{0}C within a controlled environment.

The result of the test analysis is divided into three (see Table 1). Under the physical test, we have-the appearance, pH, colour and odour. The appearances of all the four samples are clear. The acceptable pH for natural waters as given by WHO ranges between 6.0- 9.0 values but the values obtained in the laboratory are 6.1 and 6.2 for landfills one and two respectively while the values for the reference samples are 6.1 and 6.1 for Ketu and Apapa respectively. Going by the acceptable standard, all the samples have tolerate limits of pH and are therefore safe for human consumption. In terms of odour, the laboratory result of the four samples reveals that all the samples are odourless. In term of Chemical test the following parameters were measured: BOD, conductivity, iron (Fe), Nitrate/Nitrite/Nitrogen and total hardness (see Table 1).

Table 1: Physical-Chemical Analysis of Raw Water

S/N	**Physical Test**	Landfill Sample 1	Landfill Sample 2	Ketu Sample 3	Apapa Sample 4
1.	Appearance	Clear	Clear	Clear	Clear
2.	pH	6.1	6.2	6.1	6.1
3.	Colour	Colourless	Colourless	Colourless	Colourless
4.	Odour	Nil	Nil	Nil	Nil
	Chemical Test				
5.	BOD	22	8.5	-	-
6.	Conductivity	158	240	154	151
7.	Iron (fe)	3.5	5.3	0.02	`3.2
8.	Nitrate Nitrite Nitrogen	0	0	0	0
9.	Total hardness	532.5	167.5	-	265
	Trace /Heavy Metals				
10.	Copper	0.5ppm	0.4ppm	-	0.5ppm
11.	Lead	0	0	0	0
12.	Zinc	2.8	1.4	-	8.5

N.B: Unit of Measurement – Mg/L except otherwise stated

The laboratory assessment of BOD gives a value of 22 for landfill one and 8.5 for landfill two and nothing for the references. BOD in landfill one is far above the WHO standard while that of the second is below the standard. As far as BOD is concerned, the results show that the water quality may not be safe around many of the landfills operated by the Lagos State Government. In terms of conductivity, the values are 158 and 240 for landfills one and two, while the values for the references samples are 154 and 151 for Ketu and Apapa respectively. In terms of conductivity, the water quality may be adjudged safe in all the four sites. The values of iron are 3.5 and 5.3 for landfill one and landfill two respectively and 0.02 and 3.2 for ketu and Apapa respectively. All the values are higher than the tolerable limits, but the samples taken round the landfills are greater. For Nitrate/Nitrite/Nitrogen levels, the analysis is nil i.e. zero for the four samples, thus they are not present in any of the samples. The laboratory results for total hardness are 532.5 and 167.5 for landfill one and landfill two respectively. Total hardness for landfill one is greater than the WHO limit of <350 while the value for landfill two is still within the set limits. The third component tested is trace elements and heavy metals. Under this we have copper, lead and zinc. The laboratory values for copper are 0.5ppm, 0.4pp, and 0.5ppm for landfill one, landfill two, and Apapa respectively. In terms of this element, the water quality may be considered safe in all the four cases. The values obtained for lead is zero in all the four samples. This shows the absence of lead in them. The laboratory values obtain for zinc are 2.8, 1.4 and 8.5 for landfill one, landfill two and Apapa respectively. The water quality around the three samples can be adjudged safe, because they fall within WHO standards value of 5.0-15.

IMPLICATION OF THE STUDY

It could be established from the study that:

i. neither the quantity of waste buried at the landfill site nor the amount leached into the ground and surface is known, therefore, pollution of groundwater or surface water is likely to result;

ii. operation of the municipal solid waste disposal site is not in strict accordance with current standards for sanitary landfills, therefore, toxic chemical wastes may pollute groundwater supplies, surface waters, and surface environs even though large quantities of waste do not migrate from the site;

iii. many land disposal sites are leaching heavy metals, biological contaminants, and other pollutants into the groundwater, on which we are becoming increasingly dependent for drinking water.

All these have a lot of implication for healthy and sustainable environment. The government should adequately provide pipe borne water from earth dam to make water safe for public consumption.

CONCLUSION

From the ongoing the differences between waste disposal and management have been observed to be basically an environmental problem as a result of poor sanitary conditions in Lagos metropolis over the few years. But the importance of landfill if well managed and effectively implemented cannot be underestimated in guaranteed a healthy environment. Therefore, the paper concludes that the negative impact of urban waste will only be resolved through a deeper public understanding of the issues involved in waste management and by societal shift in attitudes and behaviour towards better approach for waste disposition that will minimize waste induced environmental problems

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CHALLENGES TO THE PROVISION OF INFRASTRUCTURAL SERVICES IN NIGERIA'S URBAN AREAS

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Abstract

Data for the study were sourced from the existing data published by both public and private organisations such as the United Nations Urbanisation Prospects and the National Population Commission of Nigeria. Fourteen out of the thirty-six states in Nigeria and the Federal Capital Territory were selected for analysis. The 14 states were randomly selected from the six geo-political zones of the country. All data extracted were calculated based on the percentages of urban populations of each state.

The paper identified problems of poor and inadequate housing and urban infrastructural services such as cooking and lighting fuel, water, sanitation, toilet facilities and drainage. The paper noted that in order for the urban infrastructural services to keep pace with the growing population, there is the need for governments at the various levels and private organisations to increase their capacities to provide and manage urban infrastructural services.

INTRODUCTION

The success or failure of any human settlement, whether urban or rural, is strongly linked to the level of its serviceability and liveability. Serviceability, in this context, implies the quality of being able to provide good services and the extent to which these services are adequately available in an area. Liveability, on the other hand, connotes the ability to overcome poverty, provide basic public services, maintain minimum level of environmental standards, adequate housing, security and safe environment, access to amenity and learning institutions. Therefore, carefully thought out mechanism that ensures functional nexus of infrastructural services and economic activities are rudimentary ingredients for liveable human settlements.

The most noticeable problems in many African countries are those that relate to economic, political and social challenges. The economic problems relate to poverty, political problems have to do with bad governance and corruption while the social problem is more of the rapid population increases especially within the major urban areas where more than half of the population live. China has about 500 million urban residents, India has 302 millions and Brazil 154 millions; and by the year 2030, Africa is projected to have 787 millions urban residents (United Nations Population Report 2008). In effect, urban poverty will be rising and spreading. For instance, in Africa, 30 % of the population live below poverty line, 46% in Zambia, Niger (52%) and 63% in Chad (World Bank, 2002).

As the populations rise and challenges increase, governments and the residents face a growing need of making these urban areas work. The problems and challenges posed by this situation are not just shortage of resources but that the resources are used inefficiently. It is against this background that this study was carried out to examine the challenges to the provision of infrastructural facilities in Nigeria's major urban areas with the aim of examining the level of usage of the different infrastructural services among the geographical areas of Nigeria in order to assess the degree of their efficiency. The paper also looked into the involvement of government and private agencies in the provision of infrastructural services; and the key constraints limiting infrastructural services delivery with a view to proffering solutions that will aid improved accessibility to infrastructural services in Nigeria's urban centres.

MATERIALS AND METHODS

The study was based on Nigeria using secondary data sourced majorly from the 2006 National Population Census results. Nigeria is composed of 36 states and the Federal Capital Territory and 774 Local Government Areas (LGAs). From these, 14 states and the Federal Capital Territory were selected for analysis. The 14 states were randomly selected from the six geo-political zones of the country. Also, data were extracted from the United Nations Urbanisation Prospects (2008), which allowed cross-referencing with some other developing countries, in Africa, South America and Asia.

Data relating to infrastructural services such as housing, environmental sanitation, water supply, cooking fuel, lighting fuel, drainage and toilet facilities were analysed at sub-national level for easy comparison. All calculations were based on the percentages of urban populations of each state.

The Issue of Infrastructural Services

The infrastructural services under consideration are the housing stocks, portable water, cooking fuel, lighting fuel, wastes, transport, drainage, pollution and toilet facilities.

Housing (Shelter)

In Africa, the issue of shelter is a major challenge. However, the major concern in this study is how the issue of shelter is related to the provision of adequate and affordable housing stocks. This involves the maintenance and upgrading of existing stocks and building of new ones. There are enough studies that revealed the inadequacies of the problem (Onibokun, 1985; Stern and White, 1989). A high proportion of the houses in various parts of Nigeria are not in good conditions. This is particularly true of the slum areas of the major urban centres like Abuja, Lagos, Port Harcourt and some others.

Environmental Sanitation

As shown in Table 1, most urban dwellers in the selected states dispose their wastes in unapproved dump sites, by burning and/or by burying the wastes. The reasons for this situation are that refuse collectors are few and the few facilities that are available are not in good conditions. Equipments such as buses and hearses are inadequate. In fact, there is a wide gap between refuse generation and collection.

Table 1: Wastes Disposal Methods in Urban Houses in Selected States in Nigeria, 2006 (in percentage of Urban Population)

s/n	Selected States	Burying	Unapproved Dumpsites	Burning
1	Abia	11.05	30.92	12.83
2	Adamawa	8.55	29.48	24.45
3	Akwa Ibom	21.89	37.99	19.55
4	Bauchi	14.12	16.67	28.16
5	Bayelsa	4.20	45.85	6.58
6	Borno	13.13	21.28	24.07
7	Ebonyi	8.75	36.91	17.25
8	Ekiti	5.36	40.28	26.72
9	Kaduna	10.89	19.23	26.50
10	Kano	12.06	13.85	22.44
11	Kogi	8.00	45.81	18.67
12	Lagos	2.76	12.63	8.02
13	Niger	6.93	38.82	15.42
14	Osun	5.88	38.37	30.08
15	FCT, Abuja	3.51	42.55	11.67

Source: National Population Commission, 2006.

Toilet Facilities

Residents of Nigeria's urban centres still rely mostly on unhygienic means of easing themselves. Majority still use pit latrine and bush/beach/field while a few use bucket/pan (see Table 2). For instance, in Akwa Ibom State the percentage was 74.41, 73.18% in Kano and Bauchi 64.54%. Those that rely on the pit system are found mostly in the poor neighbourhoods in the urban centres. Even those that rely on water closets have to cope with irregularity or absence of domestic water supply. This is corroborated by the study of Onibokun and Aguda (1991) which revealed that 72.5 percent of the people of Port Harcourt used pit and pail systems while it was 69.6 percent for Abeokuta and 40 percent for Kano.

Table 2: Types of Toilet Facility in Urban Houses in Selected States in Nigeria, 2006 (in percentage of Urban Population)

S/N	Selected States	Pit Latrine	Bucket/Pan	Bush/Beach/Field
1	Abia	51.96	3.08	3.35
2	Adamawa	51.83	2.95	29.51
3	Akwa Ibom	74.41	3.86	3.81
4	Bauchi	64.54	3.34	15.30
5	Bayelsa	6.28	1.22	37.70
6	Borno	63.51	3.82	17.16
7	Ebonyi	32.99	7.49	26.29
8	Ekiti	44.36	1.84	32.46
9	Kaduna	62.77	1.99	12.03
10	Kano	73.18	6.45	2.40
11	Kogi	34.14	1.55	46.46
12	Lagos	39.67	2.13	5/54
13	Niger	41.80	2.36	36.94
14	Osun	41.56	2.02	33.14
15	FCT, Abuja	29.49	1.63	19.48

Source: National Population Commission, 2006.

Water Supply Problem

The problem of water supply has reached a crisis stage in Nigeria's urban centres. Most houses do not have in-house water supply. Those that have do not have regular supply. Most urban residents rely on wells, rivers/streams and tanker/water vendors. In Bayelsa State, these three sources accounted for about 67% while it was 69% in Adamawa and about 78% in Kogi State (see Table 3). Plenty of energy, time and money are involved in looking for water by women and children; the processes which are also very dangerous and hazardous to health. The implications of this are the prevalence of diseases that are associated with poor water supply such as cholera, typhoid fever, dysentery, diarrhoea, and guinea-worm etc.

Table 3: Main Sources of Water Supply for Domestic use in Urban Houses in Selected States, Nigeria, 2006. (in percentage of Urban Population)

s/n	Selected States	Tanker Supply/ Water Vendor	Well	Rain Water	River/Stream	Dugout/Pond/ Lake
1	Abia	3.19	2.22	3.51	38.78	0.43
2	Adamawa	7.78	32.96	6.48	28.78	1.87
3	Akwa Ibom	1.42	4.33	4.35	48.45	1.11
4	Bauchi	2.55	58.90	12.39	9.27	0.82
5	Bayelsa	4.41	12.98	3.53	53.14	4.20
6	Borno	12.86	45.54	6.76	5.77	1.48
7	Ebonyi	1.43	15.76	7.27	32.70	10.43
8	Ekiti	1.71	43.37	5.87	23.36	0.89
9	Kaduna	2.29	2.29	5.67	11.84	0.38
10	Kano	7.13	48.11	18.80	4.99	0.89
11	Kogi	14.67	27.36	4.10	35.22	0.99
12	Lagos	14.87	33.84	1.62	1.59	0.15
13	Niger	3.41	36.75	4.26	27.27	0.92
14	Osun	1.21	46.61	6.69	31.51	0.62
15	FCT, Abuja	27.02	17.89	1.50	16.21	0.29

Source: National Population Commission, 2006.

Drainage

Most roads in the urban centres are in poor conditions. This is particularly so with the intra-urban roads especially within the poor neighbourhoods. The problems find expressions in pot-holes, bad bridges/culverts, and earth-surfaced roads. The results are flooding during the rainy seasons, air pollution during the dry seasons, and the deterioration in the conditions of vehicles and attendant consequences.

Fuel

The major lighting fuel in most Nigerian urban centres is kerosene. As shown in Table 4, the use of kerosene as lighting fuel is as high as 83.87% in Ebonyi State, Bauchi (77.85%), Bayelsa (76.34%) and75.56% in Adamawa. In fact, the percentage is below average in just three states, these are: Osun (40%), FCT, Abuja (34.27%), and Lagos (10.95%). The use of candle is fading gradually in Nigerian cities as just 3.38% was identified as the highest in Bauchi (see Table 4).

Table 4 further shows that firewood is still the major source of cooking fuel in Nigerian cities. The use of firewood as cooking fuel is very high in all the selected states except Osun (47.81%), FCT, Abuja (34.78%) and Lagos (6.41%). Adamawa State recorded 79.09%, Bauchi (75.19%), Niger (78.26%), Borno (78.13%), Kaduna (72.02%), and Kogi (68. 26%).

Incidentally, all these states are found in the hinterland within the savanna (grassland) region of the country. Kerosene is used mostly as cooking fuel in Lagos (80.65%) followed by Bayelsa (43.87%). The use of sawdust as cooking fuel is disappearing very fast in the Nigerian urban centres. Highest use of sawdust was recorded in Bauchi with just 1.98%.

Affordability of Urban Infrastructure

The problems confronting Nigeria's urban centres in terms of infrastructural services inadequacies have been identified. It is obvious that most governments (national, state and local/municipal) cannot afford the construction and maintenance of these facilities. Worse still, and in most cases, the urban residents themselves especially the majority who are poor cannot afford to construct new ones or maintain the existing ones. Reasons adduced for these predicaments include the debt burden, foreign exchange problems, undeveloped indigenous technology and high level of corruption in public institutions.

Table 4: Types of used Fuel in Urban Houses in Selected States in Nigeria, 2006

s/n	Selected States	Main Lighting Fuel (in percentage of Urban Population)		Main Cooking Fuel (in percentage of Urban Population)		
		Kerosene	**Candle**	**Kerosene**	**Fire-wood**	**Animal Dung/ Sawdust**
1	Abia	59.36	1.37	37.83	57.20	0.22
2	Adamawa	75.56	3.06	10.14	79.09	0.42
3	Akwa Ibom	73.51	1.54	27.04	62.47	0.22
4	Bauchi	77.85	3.38	11.01	75.19	1.98
5	Bayelsa	76.34	2.26	43.87	50.31	0.22
6	Borno	72.25	3.03	11.14	78.13	1.91
7	Ebonyi	83.87	2.56	15.59	67.47	0.50
8	Ekiti	58.57	3.28	35.94	54.75	0.27
9	Kaduna	60.93	1.74	19.59	72.62	0.33
10	Kano	63.75	5.32	15.04	59.30	0.71
11	Kogi	58.46	1.51	25.09	68.26	0.26
12	Lagos	10.95	1.57	80.65	6.41	0.14
13	Niger	60.64	1.39	14.02	78.26	0.28
14	Osun	40.31	1.95	37.39	47.81	0.37
15	FCT, Abuja	34.27	3.24	47.25	34.78	0.11

Source: National Population Commission, 2006.

The Challenge

Demands for appropriate and affordable infrastructure services by the vast majority of the inhabitants of Nigerian cities have consistently outstripped the supply. In order to achieve a minimum level of production of urban infrastructure in Nigeria, some important steps must be taken otherwise the situation will continue to deteriorate. One of the major bottlenecks for this imbalance in the demand for and supply of infrastructural services has undoubtedly been the inadequate availability of appropriate finance. Some of the avenues through which urban infrastructure can be financed include:

i. Infrastructure Development Fund of the World Bank (Onibokun and Aguda, 1991).

ii. Cost Recovery in Urban Infrastructure.

iii. Urban Development Bank of the Federal Government of Nigeria.

iv. Financial and technological aid to service Nigerian cities.

v. Innovative ways of revenue collection.

vi. Autonomy to Local/Municipal Governments.

Since the 1990's, there had been moves away from public provision of infrastructural services as a result of declining investment flows. In a study by Anas, Kyu and Murray (1996) in Nigeria, Thailand and Indonesia private manufacturers undertook significant expenditure to offset deficiencies in publicly-provided infrastructural services.

Despite the misgiving against Private Participation in infrastructural services provision, new perspectives have emerged that either support Public-Private Participation (PPP) or full Private Service Delivery (PSD) (see Harris, 2003). Cases of private participation studied in Latin America in the telecommunication, power, water, sanitation and port sectors showed substantial welfare gains to the government, consumers, investors and even the workers (Galal et al, 1994; Newbery and Pollitt, 1997). The main areas of benefits are:

i. increased investment to bring service to new consumers (service expansion)

ii. improved quality of service, iii lower prices, iv improved electricity, v improved operational and technical efficiency and vi imparts of tax payments and reduction in subsidies..

This development has been very spectacular in Nigeria's telecommunication industry. The licensing of private mobile companies has led to a major increase in the number of connections, employment (both direct and indirect) and many other benefits. It is hoped that the Federal Government's plan to do same with the power sector will succeed and bring in positive benefits.

CONCLUSION

Efforts have been made in this paper to look at the challenges of providing affordable infrastructural services in Nigeria's urban centres. The problems that arose as a result of rapid population increase and urban explosion were discussed. The paper recognised the inadequate provision of housing (shelter) and the facilities to service them. These facilities include fuel, water, sanitation and drainage, toilet, etc. The opinion raised is that since governments in Nigeria (Federal, State and Local/Municipal) and people are aware of the problem, the issue then is: what should be done to redress the situation? The paper recognised and suggested some solutions on how infrastructural services can be adequately built and maintained. These include adequate funding, Public-Private Participation and Private-Service Delivery. Others are autonomy to the lower levels of governments especially the local/municipal in terms of fiscal and administrative independence.

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MANAGING NIGERIA URBAN GROUNDWATER POLLUTION: CRITICAL LESSONS FROM UNITED KINGDOM'S APPROACH

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Abstract

The competent authority has been Environment Agency (EA) with responsibility for maintaining the quality of fresh, marine, surface and underground water in England and Wales. They do this with the aim of preventing and reducing the risk of water pollution wherever possible, and to This paper is suggesting an adoption, by concerned Nigerian authority, of United Kingdom's approach of managing urban groundwater pollution. Review of Groundwater related policies and analysis of planning application form the research methodologies employed. Critical lessons learnt revealed that Nigeria can manage her urban groundwater pollution by first initiating African regional discussion, which should produce Regional Groundwater Directives, wherein a policy framework in form of an Water Resources Act could be developed, from which Groundwater Policy and Practice documents can then be developed by a competent authority, in the case of Nigeria- FEPA. This should be followed by development of a groundwater vulnerability map- which shall characterize the towns in question into either polluting, not polluting status using aquifer vulnerability concepts.

INTRODUCTION

Cities of the world are prone to groundwater quality deterioration due to pollution from both point sources and diffuse pollution. However, diffuse pollution remains the most increasing form of groundwater pollution in urban centre and most difficult to control (EA, 2005). The main sources of pollution in cities are: leakage from sewers (Cronin, 2005), mine discharge water, industrial discharge, inorganic pollution and extensive chlorination (Lerner, 1994), infiltration from urban runoff, septic tanks, urban runoff, landfills, gasoline spills, de-icing products and storage tanks (Rivett et al., 2001). The problem of groundwater pollution is exacerbated by the movement from rural to urban areas leading to urban population growth. Unfortunately many of these cities are sited on unconfined or semi-confined aquifer (Foster, 1999), which depend on groundwater for much of their water supply, horticultural activity, liquid effluent disposal and sewage disposal on land (Hector et al, 1998).Location of the industries in the cities allows maximum groundwater mining and in return they pollute the water 'due to leaks and spills' (Lerner, 1996).

Construction of underground structures common in Nigeria cities also affect the local and large scale increase or decrease in groundwater levels (Marinos and Kavvadas, 1997). Unexpected rises of groundwater levels in regional or perched aquifers can have costly side effects on urban buildings and infrastructures, including the operation of deep collector sewers, mains water supplies and septic tanks (Foster, 1999).The case of the recent trend of rising water tables in urban area in United Kingdom, resulting from reduced industrial abstraction since the 1960's, which led to well documented basement and tunnel flooding, and geotechnical problems (Lerner and Tellam, 1997) justified this. Decreasing water levels can threaten buildings foundations, tunnels, trenches and cofferdams (Downing, 1999). Depleted water levels can lead to seawater intrusion which brings saline water rich in sulphate, into contact with concrete and metallic foundations and buried structures (Powrie, 1994), thus accelerating corrosion rates. Rising groundwater on the other hand has been a problem common to many cities developed on artesian structures. Groundwater levels are rising in many urban areas primarily because of reduced pumping from the underlying aquifers for industrial processes (Johnson, 1994). Hooker et al (1999) reported in their research on integrated hydro-geological study on Wolverhampton (West Midland of England) that groundwater levels were significantly lowered earlier this century due to groundwater abstraction by industry and coal mine dewatering. The closure of the many industries in Nigeria, according to Hooker et al., (1999), and the increased infiltration to groundwater through urbanization can cause groundwater levels to recover to those at the start of the century. Similar experience has occurred in Birmingham, London, Liverpool (Knipe et al., 1993) and Nottingham (Johnson, 1994).

Another urban groundwater menace being witnessed in Nigeria is water flowing into mine/quarry workings originating from the aquifers by leakage through shafts, drifts, faults, unsealed boreholes and recharge by shallow groundwater of the extensive interconnections of the coal working areas, thereby causing major groundwater pollution problems (IMC, 2000). At present, three potential risks from mine/quarry water have been identified. They are surface discharge of mine/quarry from mine entries or shallow working into surface water courses, contamination of aquifers hydraulically connected with mine workings. The last potential risks are the contamination of water courses by mine water following treatment, principally in relation to high chloride levels. Green, 2005 suggested drilling of two dedicated monitoring boreholes to check the aquifer contamination around quarry/mining sites of Nigeria.

To this end, sustainable management calls for using resources in a manner that does not compromise future use. This also related to protection of water resources quality and quantity, enforcement and compliance. This concept should assist in recognising groundwater as a resource that needs to be protected and reasonably exploited, especially in exploring its irrigation-ability purposes. Ground water resources sustainability should involve development of manmade infrastructure based on an understanding of the natural hydrologic system, wise and efficient water use, and fair distribution and monitoring of water for human as well as environmental and ecological needs (NGA, 2005). Thus, ground water sustainability for a particular situation should be a policy question that requires not only merging scientific information and principles, but also legal, social, environmental, and economic considerations. Other methods of sustainability is to increase ground water recharge to aquifers through well injection systems and using ground water as an underground storage and used during dry periods.

GROUNDWATER RESOURCES MANAGEMENT IN NIGERIA

Ground Water in Nigeria supplies potable water to over 90% of the population, in situ, through boreholes, hand dug-wells and springs. Ground water, because of these advantages, provides the immediate panacea for the provision of potable water to the majority of Nigerians despite the varied climatic environments.

While the northern parts of the country fall under the, typically harsh Sahelian Climatic zone, with predominantly high relief underlain by essentially impermeable rocky formations, the southern areas are marked generally, by high humidity with much higher rainfall, low lands and plains underlain by much more permeable sedimentary formations. Each zone is characterized by its peculiar hydrogeological characteristic and ground water potentials, which need to be explored. In the Sahelian region of the north, surface water is either not available, or is only seasonal. The cost of development of ground water is cheaper than that of surface water and the quality of the water reasonably good requiring only minimal treatment, and in most areas readily potable. Hence it is relevant in the supply of water to the rural and semi urban areas of the country and in some cases the urban towns, where surface water is not available. A fruitful exploitation strategy cannot be possible without proper planning backed by a suitable policies and exploration program.

The average total precipitation in Nigeria is 1,150km per year with total precipitation of 1,062,336 cubic kilometers per year for the whole country (Aquastat, 2005). The total water resource available in the country is estimated at 286,200 cubic kilometers per year (Aminu, 2000). The average surface and groundwater annual yield across the six hydrological areas was given by Orubu (2006) as 267.30 and 51.90 cubic metres respectively. Despite its small quantity compared to surface yield, it is unevenly distributed across the different region of the country. The highest of 13.40 cubic metres was found around Lower Nigeria followed by Upper Lower Benue of 11.40 cubic metres respectively. The lowest annual groundwater yield was at North West 4.30 cubic metres, followed by Chad basin 0f 5.60 cubic metres. This gives challenges for efficiency in use and productivity improvement in the water scarce regions.

Even with this, the development of Nigeria's ground water resources is still very poor. A lot of effort and money has been wasted over the years on ill planned, uncoordinated and unfulfilled ground water development programs. The Decree 101 otherwise known as Water Resources decree did not clearly defined the authorities that would be managing groundwater resources development in Nigeria (Offodile, 1988).

For instance, the Federal Ministry of Water Resources in 1979 carried out a pre-drilling hydrogeological Investigation of the whole country. This study led to the preparation of a "Provisional National Master Plan for the Development of Ground Water Resources" in Nigeria (Basil and Associates 1979). In 2002, a hydrogeological mapping programme of the country was embarked upon and appears to have been abandoned. The same Water Resources decree sets up a National River Basin Development Coordinating Committee to "ensure integrated development of each basin and even development of the different basins". The River Basin Authorities were expected to 'undertake comprehensive development of ground water resources for multipurpose use'. This I want to presume should include development of pollution management strategies and possible monitoring action plans. Not only had this, the National Water Council, the Water Boards among others engaged in one or two activities relating to groundwater resources management. Regional reference laboratories that were established to monitor the quality of water in the Nigerian rivers, streams, lakes and boreholes to ensure acceptable quality water for irrigation, industrial and domestic purposes are equally moribund. The obvious implication of this is the inconsistencies in the policies and implementation related to groundwater resources management in the country.

The essence of this paper is to suggest an adoption of United Kingdom's approach of managing urban groundwater resources by Nigeria regulatory body (Ministry of Water Resources, FEPA, River Basins Authority and NESREA) so as to achieve reduction in pollution level, unsustainable withdrawal of groundwater and management of this resource for future population.

URBAN GROUNDWATER POLLUTION MANAGEMENT IN UNITED KINGDOM

Groundwater pollution management, especially historic pollution from pre industrial and industrial developmental age, has been a major problem in European countries and specifically United Kingdom. An attempt to tackle this led to enactment of European Union Water Framework Directives (WFD). Water Framework directive has called for strategic groundwater monitoring which are strictly being adhered to by European Union member states' through their various Environment Agencies. The essence of the Water Framework Directive (WFD) was to protect and enhance water environment, promote sustainable water consumption, reduce water pollution and lessen the effects of floods and droughts. This directive thus covers all surface water and groundwater bodies. Under this Directive, three types of monitoring systems are required:

Surveillance – to validate the characterization pressure and impact assessments, detect long-term trends; operational – to help classify those water bodies which are at risk of failing to meet ‘good status’; and investigative – to ascertain the cause and effects of a failure to meet ‘good statuses’ where it is not clear.

Water framework directive was very realistic in solving point sources of pollution in the country while combination of regulations, general binding rules and code of practices, such as sheep dip, petrol etc has been in place to checkmate and reduce the diffuse pollution. Based on these directives individual member states’ are obliged to enact various policies for implementation purposes. As for the case of United Kingdom, the figure below shows various act and policies that had been formulated to achieve the goal of Water Framework directives.

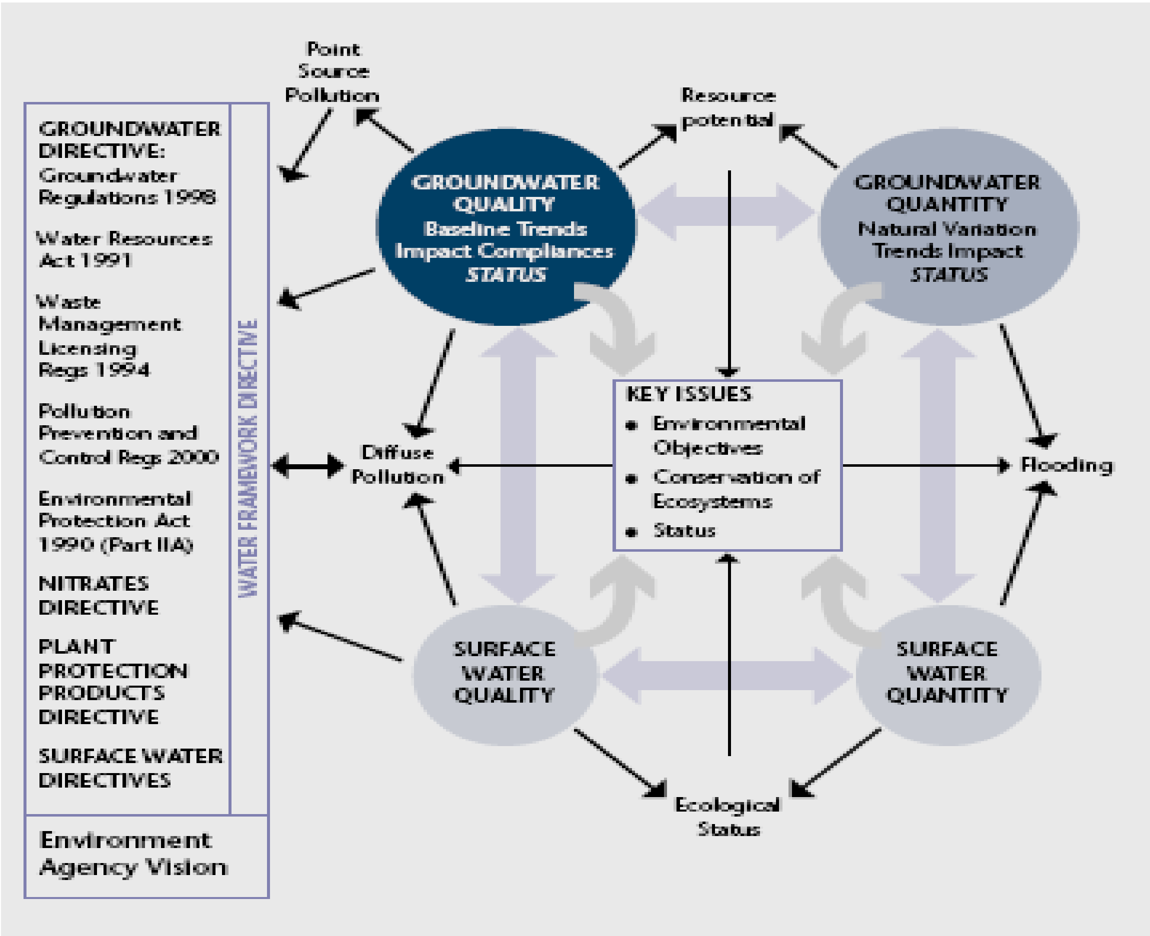

Figure 1: Interrelationship between Water framework directive and groundwater protection.

To achieve the goal of WFD, EA developed policy documents for the management and protection of groundwater titled *Groundwater Protection: Policy and Practice.* This policy is obtained from their digest of the Water framework directives.

This document, as shown below is divided into four parts. Part one- core policy is basically revealing the overview and overall position of the Environment Agency (EA) on the management and protection of groundwater. Part two- Technical Framework shows the key conceptual framework, management framework, pollutants as well as groundwater monitoring techniques and risk assessment methodologies. Part three-Tools introduce and list the tools available for analyzing and assessing the risks to groundwater. Among these are vulnerability maps and tools to assess risks from specific activities or sites, such as landfill or groundwater abstraction. Part 4 – Legislation and policies summarizes the key legislation on groundwater and how Environment Agency interprets it. Each section has a policy statement and outlines the risks to groundwater from the activity.

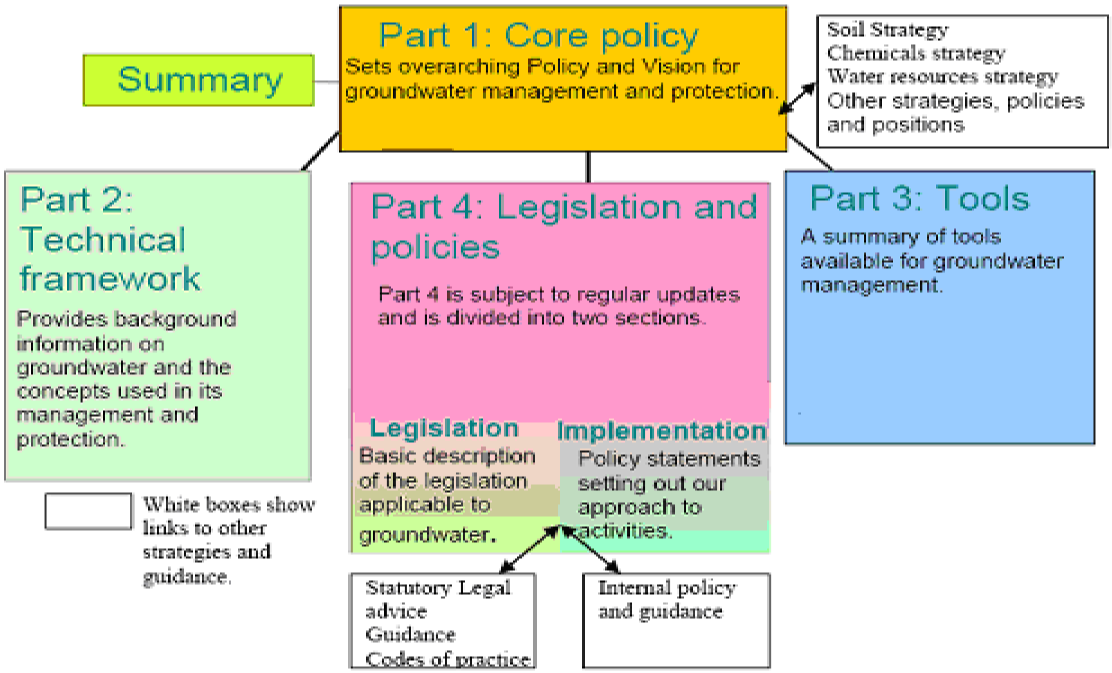

Figure 2: 'Groundwater Protection: Policy and Practice' document structure. Adapted from Groundwater Protection: Policy and Practice (GP3) - Core Policy

The policy, which is preventative in nature, emphasizes carrying out investigation before development as well as regular monitoring of the activities of the companies through regular visitation to the company. The day to day operations of the EA in relation to groundwater monitoring involves provision of an early warning system in the form of monitoring network that comprises boreholes, wells and springs were constructed across England and Wales. A risk-based approach is used as a strategy in combination with local knowledge and conceptual models to identify potential locations of monitoring sites and what pollutants may be present (Ward, 2006). Based on this, out of 357 groundwater bodies that are across England and Wales requiring an estimated 3500 monitoring sites, over 3000 sites have been established and more networks are expected to be operating by next year. Two important techniques are being used by Environment Agency in achieving this. They are strategic and defensive monitoring. The strategic monitoring is focused on gaining an understanding of the overall conditions within a groundwater body. This allows monitoring groundwater bodies that are most likely to fall short of the environmental objectives of Water Framework Directives. The defensive monitoring, on the other hand, focused on licensed activities where non compliance with permits would result in the greatest risk to the environment. The final stages in groundwater monitoring process are data analysis and reporting.

Furthermore, the groundwater source protection zones were being used as technical tools to assess the risks to groundwater. These tools include groundwater vulnerability maps that show the dangers from polluting groundwater in a particular area. More than Fifty three (53) maps covering the whole of England and Wale have been produced so far. The map is also being used for an initial screening assessment of the vulnerability of groundwater to contaminants applied to ground surface. They show, by means of colours coding, those areas of the county where aquifers are present.

Mathematical models such as FLOWPATH and MODFLOW/MODPATH have been created to assist in data analysis and reporting. While specific tools, such as hydrogeological risk assessment for landfills, Landsim, Resource Assessment and Management framework (RAM), IGARF (Impact of groundwater abstractions on river flows), were developed to assess groundwater impacts at individual sites, or at a catchment scale.

Locally, EA monitor groundwater resources through recommendation of planning applications management. In England and Wales, a plan-led system outlines what can be built and where. Most new buildings or major changes to existing buildings or to the local environment, including building on groundwater polluted area, need consent - known as planning permission**.** Thus, before accepting any proposals that have to do with pollutions, approval of the Environment Agency is sought. This activity serves as one of the ways Environment Agency uses in ensuring compliance with the various environmental directives and monitor groundwater pollution through local planners.

RECOMMENDATIONS FOR AN ADOPTION

Having x-rayed the approaches employed by United Kingdom Government through Environment Agency and the state of environmental protection in Nigeria viz a viz groundwater pollution, the following suggestions are being proffered;

- Nigeria can manage her urban groundwater pollution by first initiating deliberations on menace of urban groundwater pollutions at AU, ECOWAS, National and local levels. This should, at AU/ECOWAS level lead to formulation of a directive that will address the groundwater pollution problems at Africa/Regional level. Nigeria can then develop a framework in form of Water Resources Act which shall among others address groundwater problems.
- An agency like Environment Agency of UK can then be set up to monitor and give authorization to either industry, residential or commercial developments that needs to be developed using aquifer vulnerability concepts. This agency responsibility among others will ensure minimizing pollution and net losses from the hydrologic reservoir and managing ground water as an integrated part of the hydrologic cycle.
- The like of Groundwater Protection: Policy and Practice (GPP) documents of UK can then be developed out of framework enlisted in the Water Resources Act. This policy should develop out of scientific findings, legal, social, environmental, and economic considerations of managing groundwater pollution. It should be developed as a working document explaining in detail how groundwater pollution at urban and rural would be managed. Such document should be such that it could be replicated anywhere in the world.
- This should be followed by development of a groundwater vulnerability map- which shall characterize the areas, towns, regions and cities into either polluting, not polluting status. This is useful to monitor aquifer exploitation and future pollution related problems.
- Specifically, there is need to situate clearly the management of groundwater pollution either at rural and urban setting within the purview of an agency of government to achieve the sustainable urban groundwater pollution management. The realities of present management approach revealed a clash between the roles of agencies of government. While Federal Ministry of Water Resources (FMWR) is responsible for

the development and management of underground water resources for various purposes, Federal Environmental Protection Agencies (FEPA) coordinates various impact programmes emanating from the use of environment-groundwater resources inclusive, River basin Authority provides water to people through digging of boreholes and management of baseline flows of water to adjourning rivers and aquifers. At this point, management of groundwater pollution needs to be clearly clarified. FEPA interfaces with industries at the point of development through Environmental Impact Assessment instrumentation. This will permit knowing the state of the environment at the point of start of major activities on the property. Subsequently, FEPA also conduct post EIA programme aside regular visitation to the companies for compliances. However, companies ranging from SME's to multinational are responsible for major pollution to groundwater resources in Nigeria. Thus, in line with UK's approach, this paper is suggesting strategically placing management and control of groundwater pollution control on FEPA, especially management of point source pollution. While diffuse pollution could be handled through the effort of management team created by combination of various agencies like NESREA, Ministries of Agriculture, Environment, Commerce, Mines and steels, Petroleum, Water Resources etc.

- Among the roles of the Groundwater Management department of FEPA will be the need to establish of Water well monitoring fields for group or collective water schemes for Urban, rural and semi rural cities. Stoppage of all wasteful ground Water discharges particularly from artesian basins, to avoid wastes and depletion of the Storage. Protection of recharge areas of Nigeria's most important aquifers from environmental pollution and extensive civil engineering structures and buildings that can deplete surface water replenishment of the aquifers.
- Local planning offices, where various permissions to build or reuse land was being sought, should be conditioned to work hand in hand with FEPA (Groundwater Management Office) in the State offices, in cases relating to groundwater, to ensure enforcement and compliance, while complicated cases should be escalated for professional handling.
- The management of groundwater pollution should be such that it would be measured, analyzed, presented and available for official and public scrutiny.
- Historic pollution sites, such as abandoned quarries, mine and borehole sites should be identified and programmes of remediation are appropriately planned, documented and implemented.
- Finally, massive orientation and community awareness programme should be organized to ensure buying in.

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THE CHALLENGES OF THERMAL DISCOMFORT AND HEAT STRESS IN NIGERIAN CITIES: IMPLICATIONS FOR BUILDING DESIGN

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Abstract

An indoor thermal comfort assessment was carried out in 7 selected central areas in Ile-Ife, Nigeria. Results indicated high level of thermal discomfort with afternoon mean comfort vote of 1.75 (warm) and a maximum mean vote of 2.33 (hot) for the residents. A climatic analysis for some selected cities in Nigeria was done using the Control Potential Zone technique. Results indicated high levels of thermal stress on the cities. The respective passive design strategies deduced from the analysis were recommended for building design in the cities considered in the study. The paper submits that there is need to ensure climate-responsiveness in urban buildings to attain indoor comfort.

INTRODUCTION

The importance of climate to man cannot be overemphasized. The urban microclimate, relating to a particular city environment, is generated from the general regional climate. Similarly, from the prevailing local climate is generated a building endoclimate relating to the indoor conditions within particular buildings in the urban environment. When people are inside buildings they experience the modified climatic conditions as defined by the building and the outdoor climate. Climate, architecture and man can therefore be said to have a dynamic interrelationship. Buildings as products of architecture relate to people's comfort and health. They must therefore reflect the human needs for thermal comfort and health. According to Buchberger (2008), many researches have demonstrated how the thermal environment and the air quality in buildings affect occupants' comfort, health and productivity. Inside a building, people are affected either positively or negatively because of their innate physiological reactions and psychological responses to the thermal environment.

The level of heat produced in cities is increasingly a challenge as the rate of industrialization increases. Climate change is also of concern as the implications have more pronounced extent. Urban building structures and urban processes modify the atmospheric background. The modification can be regarded as a function depending on different factors like weather, time of day and year, urban land use, street design and type of building structure. By this modification, a specific urban climate consisting of different urban microclimates within the urban canopy layer is formed.

According to Mayer et al (2009), large-scale heat in summer represents one of the worst atmospheric background conditions for cities in Central Europe. The results of regional climate simulations indicate the reliable likelihood that extreme heat waves in summer will be more intense, more frequent and longer lasting in subsequent years. Mayer et al (2009) further stated that the thermal stress caused by this climate evolution will be strengthened within cities by their different dynamics. Consequent to developments, efficiency, well-being and health of citizens would be affected in a crucial way. The result of Haase and Amato's (2009) analysis of thermal comfort in buildings in the warm-humid climate also confirmed climatic condition as the most important factor in the determination of thermal comfort. The indoor conditions in cities will therefore be highly affected by the impending heat waves. With an increase in the mean outdoor temperatures in cities as a result of climate change, there will be a much harsher indoor climate if proper measures are not devised to reduce the effect.

HEAT STRESS AND RELATED HEALTH PROBLEMS

According to Aynsley et al (1996), heat stress may be defined as that combination of air temperature, radiation, moisture content of the air, air movement, clothing and behaviour that induces a physiological inability of the body to maintain its temperature within limits that permit normal physiological performance. Heat stress occurs when one gains heat faster than one can lose it. Heat disorders listed by Aynsley et al (1996) include prickly heat, extreme sweating, giddiness, weakness, irregular breathing, nausea and heat cramps from loss of salt in muscle tissue. Heat stroke, which can lead to unconsciousness and dehydration, due to loss of body fluids, must be identified and treated immediately.

According to Prescott (2001), research suggests that school children are susceptible to heat stress, although cultural factors and acclimatization can minimize this. Heat stress can have an impact on learning capacity. At high temperatures children are less able to concentrate and can exhibit irritable or aggressive behaviours. Adults can be similarly affected. Prescott (2001) reported surveys carried out at schools. At high temperatures children were tired, restless, sweaty, lethargic and not responsive.

When heat stress persists without relief, there is the danger of heat prostration. According to Aynsley et al (1996), a person's tolerance to high temperature may be limited if he or she cannot (1) sense temperature, (2) lose heat by regulatory sweating, and (3) move heat by blood flow from the body core to the skin surface where cooling can occur. It can be deduced therefore that there is pertinent need for cooling strategies in tropical climates in relation to human health and comfort requirements to avoid heat stress and related health problems.

CASE STUDY: INDOOR THERMAL COMFORT SURVEY IN ILE-IFE

A thermal comfort field survey was conducted in Ile-Ife, a city in the warm-humid climatic zone in Nigeria to assess indoor thermal condition of residential buildings. One month characterized with average thermal discomfort in the study area was considered sufficient and appropriate to make all respondents experience the same conditions. The climatic data for Ile-Ife was obtained from a meteorological station and bio-climatic analysis was used to determine values of maximum and minimum effective temperatures. The hourly temperature calculator was used to determine the hourly values of effective temperature from 8am to 8pm according to the procedure in Koenigsberger et al (1973).

A purposive sampling was done to select central areas within the city having residential estates, each with a good number of similar buildings. In each area, 50 residents were randomly selected to fill questionnaires concerning the indoor thermal conditions. The seven estates or areas selected were Moremi, Asherifa, Omole, Ikoyi, Oni/Ajebandele, Sijuade and Road 20. For this thermal comfort survey, a seven-point thermal comfort scale as developed by the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) was used. Respondents indicated their subjective thermal response for the different periods of the day from 8 a.m. to 8 p.m for their respective buildings. The mean values of thermal assessments for the building spaces in the areas were determined. The overall means were also determined.

The results obtained for the indoor thermal response of the residents in the 7 areas are presented in Figure 1. Results show that the afternoon period was a period of discomfort for the respondents in all areas in the city. The afternoon mean vote was 1.753 (warm) for an afternoon mean ET value of 26.63 ^{o}C ET. This was in the region of warm discomfort. Buildings in Moremi, Ikoyi and Sijuade had the highest discomfort votes of 1.953, 1.943 and

1.933 respectively while Road 20 had the least discomfort vote of 1.420. At the time (2pm) of maximum ET of 26.9 °C ET, the overall mean vote of the Ile-Ife residents surveyed was 2.33 which fell into the hot discomfort category. The results of the survey indicated thermal discomfort of the respondents with the afternoon overall mean vote of 1.753 (warm) and a maximum overall mean vote of 2.33 (hot). With the high level of indoor discomfort, it can be deduced that there is need for improvement in the design and fabric composition of the buildings.

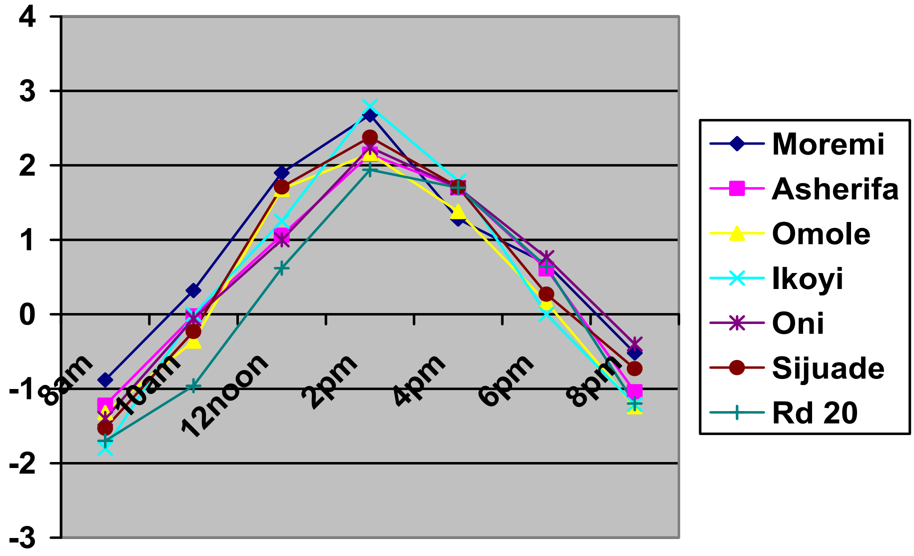

Figure 1: Graph showing variation of Mean Votes with the time of the day

CONTROL POTENTIAL ZONE ANALYSIS FOR SOME SELECTED NIGERIAN CITIES

The conceptual basis of the Control Potential Zone (CPZ) technique as presented by Szokolay (1986) was that the climate of a given location should be analyzed in its own terms and that this analysis should infer certain passive design strategies. The method consists of three steps: 1. defining the comfort zone - the range of acceptable indoor conditions, 2. plotting the prevailing climatic conditions and comparing these with the comfort zone, in order to ascertain the climatic problem and 3. indicating the control potential zones. The CPZ describes the range of outdoor atmospheric conditions within which indoor comfort could be achieved by the various passive control techniques.

The technique was applied on 17 selected Nigerian cities. The cities were selected on the basis of geographical spread. This was to ensure that all the types of local climates in the country were covered by the study to an appreciable extent. The relevant climatic data for each city were obtained from meteorological records and these were used in the analysis. The CPZ technique of climate analysis for the different locations gave indications of the best design strategy on the bioclimatic psychrometric charts. The summary of the results are presented in Table 1.

The results show that cities that are geographically located in the same part of the country have similar problem and similar inference of passive design strategies. The majority of the cities is overheated and therefore need passive cooling strategies. Only Jos requires passive heating combination with the passive cooling. Most cities need a combination of two or more passive cooling strategies. However, while the southern cities need one or two cooling strategies, the northern cities need a combination of four or five cooling strategies while middle – belt cities need a combination of two or three cooling strategies. The hot-arid cities require evaporative cooling or indirect evaporative cooling as part of the combination. All the cities generally require the air movement strategy although it is of more primary importance for the hot-humid cities.

Table 1: Control Potential Zone Analysis Recommendations of Passive Design Strategies for Selected Cities in Nigeria

CITY	GEOGRAPHICAL BELT	THERMAL CONDITION INFERENCE	HUMIDITY CONDITION INFERENCE	RECOMMENDED PASSIVE DESIGN STRATEGIES
KANO	NORTH	OVERHEATED	ARID	2,3,4,5,6
SOKOTO	NORTH	OVERHEATED	ARID	2,3,4,5,6
MAIDUGURI	NORTH	OVERHEATED	ARID	2,3,4,5,6
YOLA	NORTH	OVERHEATED	ARID	2,3,4,5
KADUNA	NORTH	OVERHEATED	HUMID	2,3,4,5
BAUCHI	NORTH	OVERHEATED	HUMID	2,3,4,6
MINNA	MIDDLE BELT	OVERHEATED	HUMID	2,3,4
JOS	MIDDLE BELT	UNDERHEATED	ARID	1,2,5
ILORIN	MIDDLE BELT	OVERHEATED	HUMID	2,4
SHAKI	MIDDLE BELT	OVERHEATED	HUMID	2,4
MAKURDI	MIDDLE BELT	OVERHEATED	HUMID	2,4
ILE-IFE	SOUTH	OVERHEATED	HUMID	2,4
ENUGU	SOUTH	OVERHEATED	HUMID	4,6
WARRI	SOUTH	OVERHEATED	HUMID	4
LAGOS	SOUTH	OVERHEATED	HUMID	4
PORT HARCOURT	SOUTH	OVERHEATED	HUMID	4
CALABAR	SOUTH	OVERHEATED	HUMID	4

Source: Authors' Analysis

Legend

1-PASSIVE SOLAR HEATING, 2-MASS EFFECT, 3-MASS EFFECT WITH NIGHT VENTILATION, 4-AIR MOVEMENT EFFECT, 5-EVAPORATIVE COOLING, 6-INDIRECT EVAPORATIVE COOLING

The cooling strategies that are recommended for design of buildings in Nigerian cities are the following: mass effect, mass effect with night ventilation, air movement effect, evaporative cooling and indirect evaporative cooling using the appropriate combinations (Table 1). Indoor comfort can be achieved passively in a building when the appropriate combination of passive design strategies as specified for the location is used.

CONCLUSION

With increased global warming and rapid urbanization, there is likelihood that extreme heat waves will be more frequent and intense in cities with accompanying comfort and health treats. The design of buildings should ultimately be climate-responsive to provide residents' satisfaction and improved comfort and health in cities. The detailed design of buildings using passive design strategies will reduce heat stress and produce more comfortable indoor conditions.

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FEEDMILLING BUSINESS IN IBADAN METROPOLIS, OYO STATE, NIGERIA

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Abstract

This study analyzed the feed milling business in Ibadan metropolis, Oyo state. Data set for the study were collected from 50 feed mills micro-enterprises. The research was carried out on costs and return and the socio-economic constraints under which the industry operates. Primary data were collected with the use of a properly structured questionnaire while secondary data were sourced from the records and books of the respective enterprise feed mills. Gross margin analysis and regression analysis showed the profitability level of feed milling business in Ibadan metropolis with the average gross margin of ₦3,304,018.4 from the survey sampled and an average profit of ₦3,073,216.40. However, the results revealed that the business consumes a high variable cost of production than fixed costs. Costs of raw materials constitute 91.04% of variable cost while salaries and wages followed with only 5.53%.

INTRODUCTION

Feed milling is basically an agribusiness whose major operational activity is the production of livestock feeds. The aims of the feed millers are to supply animals with feeds whose nutrients can be used by the animal when made available in a suitable form to its cells, organs and tissues. As a central business in the livestock industry it is responsible for the nutritional well being of the different livestock species, without which they will be out of business. For different types of animal, there are different methods of feed production, some are milled into powdery form while some are dried and given directly to the animal while some are pelleted to suit the animal characteristics and avoid vulnerability to disease infection.

Atteh (2002) revealed that the importance of feed in livestock production can be visualized from the facts that feed accounts for 55-70 % of the cost of producing chickens, 65-75% of the cost of producing pork, 45-65% of the cost of producing milk, 70-80% of the cost of feed lot finishing of beef animals, 40-60% of the cost of producing sheep and goats and about 70% of the cost of raising rabbits. Faulty feed and feeding have also been implicated in infant mortality, reduction in growth and product condemnation among livestock. Therefore good feed and feeding is normally used to augment breeding, health and management of livestock species. RIM (1992) revealed that poor productivity and high mortality of stock, which characterize the livestock industry is largely explained by the inadequacy of feeding the right quantity and quality of feeds to the various livestock species. Olumide *et al.* (2001) posited that compounded animal feed is usually made up of energy, filter materials, proteins, minerals and micro ingredients. Compounded feeds can be made from the unconventional sources, mainly cassava, cereals, grains, and other ingredients from agro-industrial by-products which abound, if these are properly processed to meet the criteria for their efficient utilization by the different livestock species. The rapid growth in livestock industry has led to a corresponding growth in the number of livestock feed mills. Olumide *et al.*, (2001) revealed that as of 1987, a total of 463 feed mills of various sizes had been established in Nigeria. Today it has been revealed that there are no specific government legislated regulations or laws that govern the feed milling industry in Nigeria. What exist presently are guidelines issued by the quality control units of the Ministries of Agriculture and Health. The Standard Organization of Nigeria has been charged with developing the standards and control of quality in the livestock feed sector. All feeds whether home mixed or commercial should meet the following pre-requisites:- must be palatable, the bulkiness of the feed should be related to the type and age of the animal, the feed must also furnish with adequate nutrients to enable the animal perform life process like growth, production and work and it must not contain poisonous/ toxic substances.

Table 1: Conventional and Alternative Sources of Ingredients for Livestock Feed in Nigeria

Nutrients	Conventional Ingredient	Alternative Ingredient
Energy	Maize	Sorghum, millets molasses, cassava chips, palm kernel meal, sweet potato, cassava tubers, cocoa beans etc
Filler materials	Wheat offal	Maize, offal, rice bran, rice husk, rice polishing, sorghum offal, etc
Protein	Fishmeal, Groundnut cake	Pigeon pea, Jack bean, Soya bean, Limabean, Sword bean Rubber seed meal, Blood meal, Meat meal, meat Bone meal, Feather meal, Fish meal, Fish slage, Leaf protein concentrate etc
Minerals	Bone meal, Oyster shell, Salt	Periwinkle shells, limestone, super phosphate, calcinised bone meal, meat and bone meal dicalcium phosphate.

Source: Atteh, 2002

FAO (2008) revealed that feed resources in Nigeria have decline due to stagnant or diminishing output of certain traditional crops. The increase in price of rice have increases the price of other grain like maize, millet, oats, barley, wheat, as well as sorghum and guinea corns. As a result of this, the feed millers and other livestock feed producers have been experiencing increase in cost of production which results to increase in feed price and this eventually affects achieving goals of profit maximization in feed milling industry.

The objective of this study is the economic analysis of the urban and peri-urban feed-milling business in the Ibadan metropolis of Oyo State. It was aimed at identifying and classifying the socio-economic characteristics of feed millers, determination of the net return to the feed milling business and the determination of the relationship between variable inputs and gross profit obtained by the feed millers. The significance of this study is based on the fact that in the past few decades, more emphasis has been placed on the ability of feed mill to produce adequate feed for the growing poultry population. A lot of research work has been carried out on factors affecting the productivity of feed mills at both micro- and macro- levels but this research would be addition to the existing literature. It will also discussed among other things that need to be done to improve on livestock feed production in the urban and peri-urban business sector of the agricultural economy. However, inadequate information on the level of instrument, input-output mix, costs and return and profitability associated with the industry has hindered a meaningful economic analysis of the enterprise.

METHODOLOGY

The population of Ibadan was estimated to be 3,847,500 in 2007 (Ayeni, 2007) and this makes Ibadan one of the largest urban centers in Africa South of the Sahara. The rainfall pattern is bimodal with peak in May and September or August. There is a distinct dry period between December and February. The annual rainfall (usually 1250-1500mm annually) pattern allows for the practice of rainfed agriculture in which poultry industry as a lucrative business thrives and there is a conducive atmosphere that provides market accessibility. Like other parts of Oyo State and Nigeria in general, the number of people engaged in the various agriculture activities in Ibadan region has continued to decline (Gbadegesin and Olusesi, 1994).

A recent development in the agricultural economy of the region is the emergence of "urban farmers" especially in the city. The urban farmers include civil servants, traders, and craftsmen who engage in various agricultural practices after their normal day's work and during the weekends. Ibadan is equally important as far as the production of livestock (such as sheep, goats, poultry and pig) and livestock feed production. Most of the animals are normally reared on free range in both the urban and rural parts of the region. Ibadan metropolis and environs are very important for poultry production. This enhances the need for establishing feed milling industry in the area.

The firms chosen for the analyses belong to the small and medium scale categories based on their production capacity per hour. The production capacity for small and medium scale feed industry varies from 1.0 to 10 tones per hour. Data used were mostly primary data, collected from the feed millers in the area with the aid of well structured questionnaire. Secondary data from textbooks, journals, conference papers, articles and other like literature were also used to supplement the primary data to achieve the stated objectives. The selection of firms was multi-stage, involving combination of random and purposive sampling. Out of all the Local Government Areas (LGAs) in Ibadan, only five were selected using simple random sampling and from these five LGAs, ten feed mills were purposively selected from each LGA (based on small and medium scale feed mills in both urban and peri urban) . The feed mills selected were those within the production capacity of 1.0 to 10 tones per hour. The total number of feed milling industries selected was 50 feed mills.

The data were analyzed using descriptive statistics (frequency tables and percentages) to analyze the socio-economic characteristics of the industry; gross margin analysis to analyze costs and return of the feed milling business and regression analysis.

Gross Margin

$GM = TR – TVC$……………………………………………………………………..(1)

Where GM = Gross margin

TR = Total revenue

TVC = Total variable cost

Multiple Regression Analysis

The multiple regression model is specified in its implicit form as

$Y = B_o + B_iX_i, + \ldots\ldots + B_nX_n + e_i$ ……………………………………………………………………………(2)

where

Y = Gross margin from feed mill

X_i = Cost of input i (i = 1, 2…n)

X_1 = Cost of raw materials

X_2 = Cost oof f labor

X_3 = Cost of fuel and transportation

X_4 = Cost of electricity

X_5 = Cost of Rent

X_6 = Miscellaneous Cost.

e_i = Error term.

RESULTS AND DISCUSSION

Table 2 shows the socio-economic characteristics of the owners of feed mills. Most (76%) of the feed mills are owned by private individuals (sole proprietorship) residing in the metropolis, while only 24% are owned by partnership. This reveals that the feed millers prefer sole-proprietorship because of the problem inherent in partnership. However, this may limit their capacity to raise capital for the expansion of their enterprises. Large percentage (94%) of financial investment in the feed mill business is sourced from personal savings, while only 26% some were personal finance and cooperative societies to which the owners of the firm belong. Skilled labor (26%) included people with agriculture or non agricultural-related skilled and obtained tertiary level of education while unskilled labor (74%) mainly consists of secondary or primary school leaver. Remuneration package for feed mill workers is not encouraging as the monthly take home pay for skilled worker ranges from ₦13, 000 - ₦30, 000 while for unskilled workers ranged from ₦5, 000 – ₦10, 000. Among the products offered by the feed mills, layers mash has the highest percentage (47.48%).

Table 2: Socio-economic characteristics of the respondents.

Parameter	Frequency	Relative frequency (%)
Types of ownerships		
Sole proprietorship	38	76
Partnership	12	24
Cooperatives	-	-
Private limited liability	-	-
Public limited liability	-	-
Source of finance		
Personal finance	37	94
Cooperative	-	-
Personal finance and partly cooperative	13	26
Salary range for skilled labor		
150,000-200,000	52	42.28
200,001-250,000	38	30.89
250,001-300,000	25	20.33
300,001 & above	08	6.50
Salary range for unskilled labor		
< 80,000	31	8.88
80,001-90,000	179	51.29
90,001-100,000	77	22.06
100,001-110,000	42	12.03
110,001-120,000	20	5.74
Percentage of feed type produced		
Chick mash	35.50	10.27
Layers mash	164.14	47.48
Grower mash	33.62	9.72
Broiler starter	41.60	12.03
Broiler finisher	70.86	20.50

Source: Field Survey, 2008

Table 3: Analysis of cost and return.

Analysis of costs and return		
Electricity	173,579.8	0.85
Rent	170,399	0.84
Fuel/transportation	320,463.4	1.57
Salaries and wages	1,125,920	5.53
Raw materials	18,529,409.62	91.04
Miscellaneous	33,669.4	0.17
Total	20,353,441.22	100

Source: Field Survey, 2008

RESULTS OF THE REGRESSION ANALYSIS

Double log was chosen because of the many explanatory significant variables and good fit of the regression line. The results showed that about 93% of the variations in the gross margin accruing to feed millers is explained by the explanatory variables while the remaining 7% is either attributable to some variables not included in the model or random error. In addition, the cost of raw materials, cost of labor and cost of fuel and transportation are the significant determinants of the level of gross margin from feed mill. The study shows that: as the cost of raw materials increases by 100%, the gross margin will increase by 183.1%, thus, cost of raw materials is a very important decider of gross margin. The cost of labor increases by 100%, the gross margin will increase by 58.8%. Also an attempt of increasing the cost of labor will also leads to an increase in gross margin. The cost of fuel and transportation increases by 100%, while the gross margin will decreases by 25.4%. This means that an increase in cost of fuel and transportation leads to a decrease in the gross margin.

Conclusively, gross margin obtained in the feed milling industry can only be increased by reducing the cost of labor and the cost of raw materials. Which means the cost of labour and the cost of raw materials are the only costs that bring out a negative effect in increasing the gross margin of the feed mill.

Table 4: Multiple regression analysis

Variable	Linear Regression	Exponential Regression	Double log Regression	Semi- Log Regression
Constant	2300.277 (0.015)	14.782 (18.82)*	-4.272 (-5.138)*	-33492946.179 (-6.766)*
Cost of Raw materials (X_1)	0.281 (7.932)*	0.0000000545 (2.787)*	1.831 (12.884)*	4628341.693 (0.547)
Cost of Labor (X_2)	1.381 (1.797)	-0.000000124 (-0.293)	0.588 (3.521)*	22173554.036 (0.223)
Cost of fuel and transportation (X_3)	-2.126 (-0.935)	-0.00000173 (-1.377)	-0.254 (-2.249)*	6501066.733 (2.965)*
Cost of electricity (X_4)	0.165 (0.066)	0.000000505 (0.364)	0.042 (0.490)	-1533557.186 (0.303)
Cost of rent (X_5)	0.747 (0.257)	-0.000000546 (-0.340)	0.030 (0.288)	6393496.475 (1.017)
Miscellaneous cost (X_6)	5.301 (0.259)	-0.00000667 (-0.590)	-0.082 (-0.693)	8886158.568 (1.268)
R^2	0.998	0.595	0.936	0.685
Adjusted R^2	0.998	0.541	0.928	0.643
F = value	4042.366	11.016**	55.056**	16.335**

Source: Field Survey: 2008

Figures in parenthesis are t-values.

*t-ratio is significant at 1% level, **F-ratio is significant at 1% level

CONCLUSION

Feed mill business has gained a wide acceptance in both the urban and peri-urban areas of Ibadan metropolis of Oyo State. They are wholly owned by private individuals who invest their personal money into the business or sourced funds from co-operative societies. The feed millers engaged in the production of different types of animal feeds but with much emphasis on poultry feeds and partly on fish feed. Though most feed millers in Ibadan metropolis do not really have a standardized compound formula for the various feed types, but in most cases, produce and bag according to the specifications of their customers. Our analysis showed that the average operating cost was N20, 353,441.22 with electricity, rent, fuel and transportation, salaries and wages, raw materials, miscellaneous cost items accounting for 0.85%, 0.84%, 1.57% 5.53%, 91.04% and 0.17% respectively of the total operating cost. Average gross profit was N3, 304,018.4 and average net profit was N3, 073, 216.40. The implication of which is that a feed mill business yields high returns. However, about 93% of the variation in the revenue (Y) accruing to feed millers is explained by the explanatory variables while the remaining 7% is either attributable to some variables not included in the model or random error. In addition, cost of raw materials, cost of labor and cost of fuel and transportation are the significant determinants of the level of revenue from feed mill.

The development of the feed mill industry in Ibadan needs to be aided by provision of infrastructural facilities such as road, transport, electricity etc. This calls for the efforts of State government, private individuals and private organization sector. The cost of raw materials is about 91% of the total cost of production. The high cost of feed has a multiplier effect on cost of livestock and their products. Feed milling is a profitable business because the Gross Revenue in each of the sample case was greater than the cost of production. Thus, in order to enhance better feed mill operations in the urban and peri-urban areas of Ibadan metropolis, efficiency of feed milling industries can be enhanced by the government if specific considerations are given in providing adequate infrastructure, leverage for the industry to borrow money from commercial banks under the Agricultural Credit Guarantee Scheme. The agricultural credit scheme should focus in feed mill enterprise by providing enough take-off capital for unemployed graduates who are interested in feed milling. Feed mill operators should be encouraged to patronize the services of professionals; nutritionist and researchers in research institutes for newly developed feed formulations and also for least cost feed formulation that will boost their productivity.

Policies that aid provision of infrastructural facilities such as good roads, and provision of subsidy on feed mill machine, will lower the cost of production. Government should enforce the establishment of quality control unit in feed milling industry in order to maintain uniform standard and to meet the nutritional requirement of farm animals including poultry. This will check the activities of feed millers who specialize in production of substandard feeds for the market.

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GENDER AND URBAN AGRICULTURE: THE CASE OF VEGETABLE MARKETING IN LAGOS STATE OF NIGERIA

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Abstract

This study examined the socioeconomic and gender characteristics of the urban vegetable marketers in Lagos State.Four markets renowned for vegetable marketing in Lagos State were purposively sampled for the study. Stratified random sampling technique was used to select 200 vegetable marketers from the study area. Pre tested structured questionnaires were used to collect data from the respondents through the use of interviews and farm business survey. Data collected were analyzed using descriptive statistics as well as marketing channel analysis.

Results from the analyses show that women who are mainly young people of between age range 31 to 40 years, mostly married with a family size of between 4 and 6 members are the main vegetable marketers in the study area. Men and women marketers had formal education of up to secondary school. In terms of the channels of distribution, there exists a four level channel of distribution for vegetable marketing in Lagos State. The channel pathway for Ugwu was more complex than that of tomato. The study concluded that capacity building in the form of value addition and processing will not only increase the margin obtainable by the marketers but enhance the potential of urban agriculture in meeting the twin goal of mainstreaming gender and reducing urban poverty.

INTRODUCTION

Urban agriculture in the developing countries has been growing in importance and scope in more recent times. It is estimated that 800 million people are engaged in urban agriculture worldwide, with the majority in Asian cities and of these 200 million are considered to be market producers, employing 150 million people full time (UNDP, 1996). In fact, it has gained importance in Nigeria as a viable intervention strategy for the urban poor. This is obvious because, with an urban growth rate of 5.5%, the urban population has increased tremendously in Nigeria. In fact it is estimated that about 46% of the 140 million Nigerians (approximating 64.4 million) lives in towns and cities where urban agriculture contributes in no small measure to their food security. Incidentally, while annual population growth is about 3.0%, food production is growing at an average rate of 3.5%. Hence although the growth of agriculture is slightly above the national population growth rate, it is certainly below the rate of urbanization.

Several studies have been carried out on urban agriculture in Nigeria and Africa (Rogerson, 1998, Agyemang and Smith, 1999, Armar-Klemesu and Maxwell, 2000, Lynch *et al*., 2001, Adeyemo and Kuhlmann, 2009, Okon and Enete, 2009, Ebong *et al*., 2009) putting into consideration the production and the productivity aspects, also, (Mboganie-Mwangi and Foeken, (1996), Simatele and Binns, 2008 and Etim et al., 2010) related urban agriculture with welfare indices, but to the best of the knowledge of the authors the aspect of gender consideration of marketing of agricultural produce in the urban centers has received little attention. This study, therefore, is aimed at generating gender disaggregated information on marketing of vegetable in Lagos State to complement existing studies in order to make recommendation for the formulation of appropriate policies on marketing of vegetable in urban area.

This study was conducted with the specific objectives of examining socio-economic characteristics of vegetable marketers in Lagos State, analyzing gender participation in the overall vegetable marketing trade, and assessing the distribution channel for vegetable in the study area. This is with a view to highlighting the potential role of vegetable marketing as an urban agricultural component to meet the challenges of gender mainstreaming and reduction of urban poverty.

MATERIALS AND METHODS

Although Lagos State is the smallest State in Nigeria, it is the second most populous State (after Kano State) and arguably the most economically important State of the country (www.lagosstate.gov.ng). The State contains Lagos, the nation's largest urban area, with an area of 356,861 hectares of which 75,755 hectares are wetlands, yet it has population, which is over five per cent of the national estimate and great potential for marketing of agricultural produce especially the perishables.

The main economic activities in the rural communities of the State are farming, fishing and agro allied businesses including processing and marketing. Artisanal fishing is prominent along the coastal areas of the State covering Ibeju, Lagos Island, Epe, Ikorodu and Badagry. Crop farming and livestock rearing are also common. Urban agriculture has become a common feature in all the local government areas in the State especially Livestock, Capture fishing, homestead and commercial fish farming, processing and vegetable farming.

For this study, a total of 200 persons identified as vegetable farmers, ugwu marketers, and tomato marketers were randomly selected and interviewed in the Oyinlola, Aboju, Alakija and Awori markets in Amuwo-odofin and Ojo Local Government Areas of Lagos state. These markets were purposively selected because they are known for vegetable marketing in the two local governments selected.

Primary data were collected with the use of pre tested structured questionnaire, which sought for the following information among others, socio-economic characteristics such as age, gender, family size, education level and information on marketing, such as source of supply, mode of transportation, problems associated with vegetable marketing, source of market information and pricing. The information collected were analyzed using descriptive statistics such as frequency tables, percentages, and charts. Frequency tables are very useful in knowing the trend related to a particular variable. The same technique was followed in analyzing results of this study. Percentage method was used to analyze farmers' responses related to gender issues, socio-economic characteristics, challenges faced, transportation and marketing channel.

RESULTS AND DISCUSSION

The result from the analysis of the data obtained on the socio economic characteristics of the respondents is presented in Table 1. The table summarizes selected socio-economic characteristics derived from the sampled respondents. The study reveals that most (77.5%) of the respondents interviewed are female. Obviously, there are more women in the distribution channel of vegetable than men in the study area. This is similar to the result obtained by Gerstl, (2001) that women dominate the vegetable marketing sector.

As regards age distribution of the respondents, whereas most (57.8%) of the male fall between the age category of 41 to 50 years, more (39.4%) women fell in the age category of 31 to 40 years. Altogether the result suggests that the people involved in marketing channel of vegetable in the study area are predominantly youths who are in their economically active age bracket. While 91.1% of the male are married, 60.6% women are married. In essence, married women and men dominate the marketing of Ugwu and Tomato in the study area. Whereas, men had a modal family size of between 7 and 9 members, women had a family size of between 4 and 6 members. The modal family size of between 4 and 6 members suggests the possible involvement of family members in the marketing ventures of the respondents. The higher family size obtained for males could be as a result of the polygamous family style in Nigeria.

Most (47.5%) of the respondents had formal education of up to Secondary education level and this is true of both male and female. This suggests that most people involved in marketing channel of vegetable in the two LGAs of Lagos State are educated which is contrary to perceived believe that farmers are not educated. This result may however be peculiar to urban vegetable marketers alone.

Most (48.5%) of the respondents got their stall erected through personal individual effort, while only about 3% got their stall erected through the support of association and this is peculiar to tomato wholesalers because of the scale of their operation. Interestingly, most men (46.7%) got their stall erected through the permission of the Lagos State Government while most female (56.8%) had their stalls through self efforts. This could be because of men's involvement in wholesales activities where permanent stalls are required for storage. These results obtained for socio-economic characteristics of the respondents are consistent with that obtained by Adeogun *et al*., 2007 on Urban Aquaculture in the same State.

Access to transport in vegetable marketing depends on the availability of appropriate vehicles and at the right time. The study revealed that means of transportation is mostly (34%) by car/bus, however, this means of transportation leads to a lot of loss during transit because the vehicles are not appropriate for vegetable transportation especially tomato. Most male (62.2% make use of pick-up van while female use car/bus. This result conforms to that of Ali-Akpajiak and Pyke, (2003), which estimated that the post-harvest food losses in Nigeria amount up to 20-25% of total output, of which a substantial portion must be attributable to transport failure.

Table 1: Socio-economic characteristics of the respondents

	Male	%	female	%	Pooled	Percentage
GENDER DISTRIBUTION						
	45	22.5	155	77.5	200	100
AGE DISTRIBUTION						
< 20	4	8.9	23	14.8	27	13.5
21 – 30	3	6.7	53	34.2	56	28.0
31 – 40	4	8.9	61	39.4	65	32.5
41 – 50	26	57.8	14	9	40	20.0
>51	8	17.8	4	2.6	12	6.0
Total	**45**	**100**	**155**	**100**	**200**	**100**
MARITAL STATUS						
Single	4	8.9	13	8.4	17	8.5
Married	41	91.1	94	60.6	135	67.5
Divorced	-	-	27	17.4	27	13.5
Widow	-	-	21	13.5	21	10.5
Total	**45**	**100**	**155**	**100**	**200**	**100**
FAMILY SIZE						
< 4	3	6.7	14	9	17	8.5
4 – 6	12	26.8	91	58.7	103	51.5
7 – 9	21	46.9	48	31	69	34.5
> 9	9	20.1	2	1.3	11	5.5
Total	**45**	**100**	**155**	**100**	**200**	**100**
LEVEL OF EDUCATION						
Primary school	7	15.6	54	34.8	61	30.5
Secondary School	21	46.7	74	47.7	95	47.5
Higher Institution	13	28.9	9	5.8	22	11.0
Vocational Education	4	8.9	18	11.8	22	11.0
Total	**45**	**100**	**155**	**100**	**200**	**100**
PERMISSION TO ERECT STALL						
Lagos State Government	21	46.7	60	38.7	81	40.5
Individual	9	20	88	56.8	97	48.5
Trade Association	6	13.3	1	0.6	7	3.5
No Stall	9	20	6	3.8	15	7.5
Total	**45**	**100**	**155**	**100**	**200**	**100**
MODE OF TRANSPORTATION						
Human portage	2	4.4	36	23.2	38	19
Motor Cycle	-	-	24	15.5	24	12
Trailer	12	26.7	2	1.3	14	7
Pick-up Van	28	62.2	28	18.1	56	28
Car/bus	3	6.7	65	41.9	68	34
Total	**45**	**100**	**155**	**100**	**200**	**100**

Source: Field Survey, 2009

Gender Participation in Marketing Activities

The result of the analysis of gender participation in marketing of Ugwu is presented in Table 2. The major role played by each stakeholder is stated in the table. Glaringly, farmers are producers while sedentary traders buy in bulk directly from the producers and almost immediately sell to whoever desires to buy and disappear from the scene; they do not have stalls for storage. Wholesalers also do bulking and direct sale to consumers, while permanent retailers do more of direct sale to final consumers, and the mobile retailers do roam about in their effort to sell directly to final users. In terms of gender analysis, there are more women as permanent retailers (69.1%) than sedentary trading (2.5%), whereas, men are equally distributed between sedentary trading (26.3%), wholesaling (26.3%) and permanent retailing (26.3%). In all, this result suggests that women are at the lower end of the marketing chain.

Table 2: Analysis of Gender Participation in marketing of UGWU

Stakeholders	Principal Role	Gender Pattern					
		Male		Female		Pooled	
		Freq	%	Freq	%	Freq	%
Farmers	Vegetable Production	2	10.5	6	7.4	8	8
Sedentary Traders	Bulking and Direct Sale	5	26.3	2	2.5	7	7
Wholesalers	Bulking and Distribution	5	26.3	13	16.0	18	18
Permanent Retailers	Direct Sale	5	26.3	56	69.1	61	61
Mobile Retailers	Roaming and Direct Sale	2	10.5	4	4.9	6	6
Total		**19**	**100**	**81**	**100**	**100**	**100**

Source: Field Survey, 2009

The result of the gender analysis for Tomato marketing is presented in table 3.

Gender distribution in tomato follows the similar trend as that of Ugwu, in the sense that most (78.4%) women are permanent retailers while men are mostly(53.8%) wholesalers. The distribution channels especially the retailing aspect are handled by women. However, because of the nature of the crop all the supply is from outside the state hence there is no producer neither sedentary trader. This result tallies with that obtained by (Gerstl, 2001) which asserts that women dominate the vegetable marketing sector, particularly the retailing aspect.

Women's general dominance in retail is partly attributed to the Nigerian tradition that holds retailing as a woman's job. Both men and women involved in marketing vegetables see the venture as a more profitable aspect of the value chain which produces immediate gains, unlike the production (farming) aspect which takes some months before the farmer receives income from his efforts. Though some men expressed the willingness to sell their own produce in the market, they are held back by the prevailing culture.

Table 3: Analysis of Gender Participation in marketing of Tomato

	Principal Role	Gender Pattern					
		Male		Female		Pooled	
		Freq	%	Freq	%	Freq	%
Farmers	Vegetable Production	-	-	-	-	-	-
Sedentary Traders	Bulking and Direct Sale	-	-	-	-	-	-
Wholesalers	Bulking and Distribution	14	53.6	9	12.2	23	23
Permanent Retailers	Direct Sale	10	38.5	58	78.4	68	68
Mobile Retailers	Roaming and Direct Sale	2	7.7	7	9.5	9	9
Total		**26**	**100**	**74**	**100**	**100**	**100**

Source: Field Survey, 2009

Vegetable Distribution Pathway

The channel for Ugwu is made up of four levels, viz: the sedentary traders, wholesalers, permanent retailers and mobile retailers.. In terms of the source, most (77%) of the Ugwu sold in Lagos State is from outside, while only about 23% is sourced from within. Of these figures, 13% is sold to permanent retailers, 37% to sedentary traders, 46% to wholesalers and the balance of 4% sold to mobile retailers from the source.

The sedentary traders sell most (54%) of their wares to wholesalers, 38% to permanent retailers and 8% to mobile retailers. Wholesalers on their own sell 74% and 17% of their wares to Permanent and Mobile retailers respectively. The permanent retailers sell 71% of their wares to the end users and 29% to mobile retailers, while mobile retailers on their own sell all of their wares to the end users.

In the case of marketing of tomatoes, the information gathered revealed that all the tomatoes marketed in the markets visited as at the period of the survey are from outside Lagos state. The distribution pathways of Tomato are similar to that of Ugwu except for the sources and the sedentary traders' level. All the tomatoes in the market are sourced from outside the state. About 87% of the supply from the source is sold to wholesalers. Only about 13% of the permanent retailers' supply comes directly from the source. For this case, the retailers form themselves into a group by pulling resources together and asking one or two representatives to get the tomato purchased for them from the source. Wholesalers sell 95% of their stock to permanent retailers while only 5% is sold to mobile retailers. Permanent retailers sell 75% and 25% of their stock to end users and mobile retailers respectively. All (100%) of the mobile retailers' stock is sold to the end users.

The power to prices and supplies depends on the ability of market associations to act as cartels. This often depends on their control of key market spaces in urban areas and the ability to

control who buys from rural areas. This has been found in many West African markets (Smith and Luttrel, 1994; Lyon, 2000a). However, there is likely to be considerable difference between markets and within markets depending on the commodity. Membership of association is compulsory within the markets, Out of the 200 respondents interviewed, 140 (70%) belong to vegetable marketers association. In some areas, trade association was effective which is evident in members having uniform measurement and prices for their commodities, this issue was found to be common among the wholesalers. This could account for the reason why membership of association is the main determinant of price for 37.5% of the respondents. Almost half (41.5%) the respondents interviewed complained of glut of vegetable during harvest and scarcity during the off season. Glut always lead to spoilage (wastage) and hence reduction the margin that should have accrued to both the farmers and the during off season is also a common challenge cited by about 12% of the respondents. The marketers revealed that it is always very difficult to get all these vegetables to sell during the off season, some of them revealed that as a coping strategy, they either switch over to another commodity during off season or diversify into other trade. The cumbersome nature of haggling as a marketing strategy is another challenge cited both by about 8.5% of the respondents. This is so because of lack of standard measurement with fixed price. Some of the marketers revealed that by the time the bargaining is going on another customer with better bargaining power can end up buying the vegetable. Maybe because most of the respondents were retailers who buy from the wholesalers stands within the markets, only 5.0% saw transportation as a challenge. The categories of respondents who saw transportation as major problem were mainly the wholesalers and farmers, especially for tomato. They complained about great loss they have been experiencing especially as a result of lack of appropriate means of transportation for tomatoes which increases wastage.

CONCLUSIONS

The conclusions that can be drawn from this study are that: Firstly, there are gender differentials in the marketing of vegetables in Lagos state. Men and women do play different and distinct roles in the marketing venture.

Secondly, whereas men vegetable marketers are older, married with larger family size, women are younger also married with fewer family size. Men are more of sedentary traders and wholesalers, while women are permanent and mobile retailers.

The challenge of seasonality is a major one that has to be frontally addressed in the trade. This is what breeds glut and wastage at the same time. Because of the highly perishable nature of the good, the period of glut results in a lot of wastage.

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RESIDENTS RESPONSES TO FARMING WITHIN RESIDENTIAL ENVIRONMENTS:
A CASE STUDY OF THE UNIVERSITY HOUSING ESTATE IN ILE-IFE

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Abstract

This paper examines the responses of residents to farming within the Obafemi Awolowo University staff housing estate. The rationale is that given the current situation where some residents continue to farm in seeming violation of regulations, it is useful to gain understanding of their attitudes to this phenomenon. A survey approach was adopted for data collection using the questionnaire, including structured and open-ended questions. Findings show that farming in one form or the other was practiced by 44 of the 70 respondents (62.9%). Farming activities were linked to house types, as the detached housing units provided some level of independence for residents to engage in farming. Most farming activities took place in the backyard of the house (68.2%). The main reasons given by respondents for farming were: as a form of recreation and to supplement household consumption in order to improve the household food security, rather than for commercial purposes. The study indicates a higher degree of non-awareness regarding the regulations guiding farming in the estate, suggesting a weak application of existing rules, and the lack of an active monitoring procedure as regards farming in the university land-use plan. More respondents were positively disposed towards farming in the estate: 57.1% of the respondents supported it; 27.1% strongly and 30% conditionally.

INTRODUCTION

Limited information is presently available on farming within the staff housing estate of Obafemi Awolowo University, Ile-Ife. Farming within the estate has become a common and perhaps, permanent phenomenon that requires closer investigation. It is not clear if the planning and design of the housing estate envisaged the possibility of residents engaging in farming activities. Moreover, management seems not to be taking into adequate account the existence of such farming activities.

The study was therefore conducted to collect and analyze available and relevant data on farming in the estate. These include the nature and types of farming, and residents' socio-economic characteristics. In particular, this paper examines the responses of residents – both those who farm and those who do not – to farming within the estate. The rationale is that, given the current situation where some residents continue to farm in seeming violation of regulations, it is useful to gain understanding of the attitudes of the residents. The aim is to examine these responses in the light of the attitude of the management to farming within the estate. In addition, professional attitudes in favour of strict zoning laws are examined.

BACKGROUND TO THE STUDY: THE OAU STAFF HOUSING ESTATE

The Obafemi Awolowo University staff housing estate presently consists of about four hundred and fifty (450) housing units (according to information obtained from the Housing Allocation Committee). The range of house types in the estate can be broadly categorized into five: chalets; semi-detached bungalows; detached bungalows (three- and four-bedroom types); two- and three-bedroom apartments in storey blocks; and detached storey houses. Majority of the houses were constructed with accompanying boys' quarters and also provide ample outdoor spaces that make them suitable for gardening and farming activities. Although, there is no evidence to suggest that these housing lots were originally intended for such activities by the designers, farming has become an increasingly visible and dynamic feature of the landscape and socio-economic reality of the staff housing estate.

From an urban design perspective, the staff housing estate has been viewed as a special form of public housing, one that is provided for a relatively autonomous public organization (Amole, 1986). The estate represents the living sector of the ‘Cite Universitaire’. This refers to the concept of the university campus as a small city, complete with carefully zoned working, living and support services areas; a distinct and identifiable urban community, physically separate from Ile-Ife town, but socially related to it (Amole, 2001). The strict adherence to functional zoning principles and hierarchical circulation networks characteristic of modern planning (Greed, 1996), is expressed not only on the overall level of the Campus planning, but also in the planning of the staff housing estate.

Less formal in design than the central ‘working’ core of the Campus, houses in the housing estate are located on very generous plots of land, demarcated with hedges of flowers and trees. These provide an attractive, naturally-landscaped environment, in the tradition of sub-urban planning. Many of the houses are modeled after the colonial Government Residential Area (GRA), complete with a Boys’ Quarters. However, the “clinical” treatment of the estate does not account for a tradition of living and working, buying and selling reminiscent of the typical Yoruba city (Amole, 2001). This perhaps explains why the issue of farming may appear contradictory to the character of the estate.

The attitude of university management is portrayed in “The Code for the University Environment” (2000): farming in the estate seems not to be well-recognized or acknowledged as a legitimate activity. This code treats farming on university land as one of a number of environmental issues which include maintenance of compounds, additions to structures, sign-posts, hunting, parking of vehicles, and noise. It refers to the keeping of “domestic animals” but does not address the possibility of this being a form of farming practice. The management appears not to have come to terms with the reality of farming in the estate. This attitude may be due to the prevailing perception of a rural-urban dichotomy: farming is regarded as a rural occupation meant for rural land use. Given such disposition, the likely tendency is that the planning of new housing units may limit the provision of private outdoor spaces and public open spaces, for fear of these being converted to farming use. Our perspective is that farming within the housing estate is a form of urban farming hence the need to examine the responses of residents.

RESEARCH METHOD

A survey approach was adopted for data collection using the questionnaire. Primary data were collected by means of eighty (80) self-administered questionnaire, distributed randomly amongst residents of the housing estate, and representing the main house types. A total of seventy (70) of these were returned and analyzed. The questionnaire consists of structured and open-ended questions: the first section focused on the respondent’s personal and socio-economic data; the second section on information related to farming activities within the estate; and the third section is a 5-point Likert scale designed to measure attitudes towards farming. The quantitative data were subjected to descriptive analysis using SPSS. Secondary data were derived from archival documents: the University physical Master Plan and the Code for the university environment. The study also involved a qualitative situation analysis of farming in the housing estate, relative to the existing regulations. The results are discussed in the light of current literatures which suggest the positive and negative aspects of urban farming (Egbuna, 2001; Harris, 2009; Hough, 2004; Madaleno, 2002; Mougeot, 2006; Redwood, 2009).

FINDINGS

Respondents' socio-economic characteristics

The unique nature of the staff housing estate is that most of the residents are university employees or their spouses, children or dependants. For the majority therefore, farming was a secondary activity to their primary means of livelihood as academic, administrative or technical staff of the university.

Out of the 70 respondents whose questionnaires were returned and analyzed, the results of the survey showed that the majority were between 41-59 years of age (68.6%), while those between 20-39 represented 21.4%. These two age-ranges broadly cover the employment life-span of the average university employee. Majority of the respondents were married (82.9%), and had obtained a minimum of post-graduate education (81.4%) as expected in a university community. The sample is divided between 45 males (64.3%) and 25 females (35.7%), a male to female ratio of about 2:1. This consisted of 41 academic staff (60.3%), 19 administrative staff (27.9%), and others (11.8%) being either technical staff, spouses who were not in the employment of the university or students (children or dependants) (See Table 1). The 41 academic staff included 8 Professors (11.4%), 7 Readers (10%), 12 Senior Lecturers (17.1%) and 6 other academic cadres (8.6%).

Respondents' farming-related characteristics

Farming in one form or the other was practiced by 44 of the 70 respondents (62.9%). Of these, 32 (72.7%) cultivated crops, 12 (27.3%) practised gardening and horticulture, 4 reared poultry, 2 had fisheries, and only 1 respondent reared goats. Among the few respondents involved in animal husbandry, poultry and goats were the most common, apart from household pets. There is no evidence to suggest the rearing of rabbits, pigs, cows or other animals. Most of those engaged in farming were between ages 40-59 (67.5%). Also, involvement in farming appears not to be at variance with respondents' socio-economic status, as 20 of the 31 higher cadre respondents (Professors, Readers or Senior Administrators), as well as seven (7) out of twelve (12) Senior Lecturers reported farming.

The predominant house types represented in the survey were: detached bungalows (45.7%) and semi-detached bungalows (25.7%). Detached storey houses and Blocks of Flats represented 11.4% each. The largest proportion of respondents engaged in farming were those who lived in the detached housing units: 6 of the 8 respondents in the detached storey houses (75%) and 21 of the 32 respondents in the detached bungalows (66%). Half of those in the semi-detached bungalows (9 out of 18) were engaged in farming. This indicates that the fully detached housing units provide some level of independence or territoriality for residents to engage in farming activities.

Table 1: Respondents' socio-economic characteristics & Farming-related responses

Demographic variables	Sub-categories	Frequency	Percentages
House type	Detached bungalows	32	45.7%
	Semi-detached bungalows	18	25.7%
	Detached storey houses	8	11.4%
	Storey Blocks of flats	8	11.4%
	Chalets	4	5.7%
Gender	Male	45	64.3%
	Female	25	35.7%
Age ranges	Below 20	2	2.9%
	20 – 39	15	21.4%
	40 – 59	48	68.6%
	60 and above	5	7.1%
Marital status	Married	58	82.9%
	Separated/widowed/single	12	17.1%
Education	Post-graduate	57	81.4%
	Post-secondary	13	18.6%
Employment	Academic staff	41	60.3%
	Administrative staff	19	27.9%
	Others	10	11.8%
Engagement in Farming	Yes	44	62.9%
	No	26	37.1%
Where Farming Was Done	Backyard of the house	30	68.2%
	Elsewhere within the compound	10	22.7%
	In a temporary built-up structure	2	4.5%
	Within the house	2	4.5%
Summary of Attitude to Farming Within the Estate	Strongly supported it	19	27.1%
	Supported it on condition(s)	21	30.0%
	Indifferent	27	38.6%
	Strongly opposed it	3	4.3%

Source: Authors' fieldwork (2010)

Most farming activities took place in the backyard of the house (68.2%), and about 23% elsewhere within the compound. The principal reason given for farming in the estate was as a hobby or recreation (36.4%). Another 23% of those engaged in farming did so because they had farming experience; 9 % were encouraged by other neighbors doing the same. A smaller proportion of the respondents engaged in farming to supplement family feeding (13.6%) and only one respondent farmed for additional income. It is evident that the main reasons given by respondents for farming in the estate were: as a form of recreation and to supplement household consumption in order to improve the household food security and nutrition situation, rather than for commercial purposes. The predominant problems of farming in the estate in decreasing order of importance were: pests, inadequate space for cultivation and storage, health and environmental hazards, restrictive controls by management, and theft of the produce.

RESIDENTS' ATTITUDINAL RESPONSES

Awareness of regulations regarding farming in the estate

More respondents (40.6%) were unaware of the rules and regulations guiding farming activities in the estate than those that were aware (34.3%). Those who were not sure, which also interprets to being unaware represented 24.3%. However 46.4% either agreed or strongly agreed to be aware that poultry was prohibited; while 41.4% agreed or strongly agree to be aware that livestock rearing was prohibited in the estate. The study therefore indicates some measure of confusion regarding the regulations guiding farming in the estate. It suggests a weak application of existing rules and regulations, and the lack of an active monitoring procedure as regards farming in the university land-use plan in general.

Attitude of Residents to farming in the Estate

In terms of the overall attitude to farming in the estate, more than half of the respondents (57.1%) supported it: 27.1% strongly and 30% *conditionally*. Some of the conditions included: the need for people to farm in designated areas; the absence of noise and odour; as long as 'it does not disturb neighbours' or 'constitute a nuisance to others'; if it is limited to only vegetables and/or gardening; that poultry and livestock be kept within the owner's boundary; if it is not animal husbandry; and that instances of bush burning be well-monitored. A respondent suggested that: "the university should allocate plots for interested farmers at the university farm. Gardens and lawns should not be converted to farm lands. Only pets should be allowed; no livestocks. Vegetables may be cultivated alongside the garden". However, only 4.3% of the respondents were strongly opposed to farming in the estate, while 38.6% were indifferent. Some of those who were indifferent were as well engaged in one form of farming activity or the other.

Two indices *PosAtt* and *NegAtt* representing "positive attitudes" and "negative attitudes" to farming in the estate were computed from summations of six relevant variables in the questionnaire Likert-scale. The index *PosAtt* sums up six inter-correlated items to which respondents were required to indicate their degree of agreement or disagreement on a 5-point Likert scale, namely:

1. Farming in the estate helps the family's food security.
2. Farming in the estate helps to sustain the environment.
3. Farming in the estate helps put the environment to productive use.
4. Farming in the estate adds aesthetic value to the environment.
5. Every resident has the right and freedom to farm within his or her residential environment.
6. Future planning of residential estates should provide for the farming needs of residents.

The index *NegAtt* was derived as a summation of the scores for the following six inter-correlated items:

1. Farming within the estate constitutes risks to health and well-being.
2. Farming within the estate constitutes a serious environmental hazard.
3. Farming within the estate is a nuisance activity.
4. Farming within the estate is a violation of regulations.
5. Farming within the estate should be totally prohibited.
6. More stringent measures should be taken to enforce regulations against farming in the estate.

The mean scores showed a higher value of 20.6 for *PosAtt* than 15.20 for *NegAtt*. This confirms that more respondents were positively disposed towards farming in the estate. As to the need to incorporate farming into future development of housing estate: 66.2% of respondents agreed that future planning of housing should provide for residents' farming needs, and 26.5% strongly so.

DISCUSSIONS

This paper has reported a concise analysis of the existing situation regarding urban farming within the university housing estate, its presence and participants, types of farming and their constraints and opportunities, including existing regulations. Particular attention is given to actual and perceived negative and positive attitudes of residents.

As it is, even though some form of restrictive instrument exists, most respondents claimed to be unaware of it. The seemingly passive attitude of management to implementing or enforcing the regulations might have reinforced this general lack of awareness, particularly among newer residents. This simply means that to all intent and purposes, farming is being carried out without active regulation or authorization. A specific and clear framework is needed to make farming in the estate sustainable, productive and mutually beneficial to the residents in particular and the university in general.

Community gardening is one form of socially-organized urban farming, which may be considered as an alternative planning approach for farming within a controlled environment as the university housing estate (Harris, 2009). In terms of the dimensions of urban farming – social, economic and ecological – the predominant role of farming in the housing estate is social: it is seen mainly as a micro-scale, subsistence-oriented strategy for home consumption. The recreational value of farming and home gardening has also been confirmed by the findings of this study. Some of the residents may be willing to expand their farming activities to a macro-scale, market-oriented dimension if the land and other resources, including policy instruments – legal, financial, educative and design/planning – are available to guide farming in the university residential estate in a more holistic manner (Mougeot, 2006).

Furthermore, policy instruments should differentiate between measures for various types of urban farming existing in an urban area, such as crop cultivation, horticulture, livestock keeping, and fisheries, based on their unique requirements and characteristics. Differentiation of the policy measures for the different types of farming (according to main products, level of technology and scale) is important since each type has specific characteristics in terms of the level and type of associated externalities (e.g. health and environmental impacts). Urban livestock tends to be restricted much more than vegetable growing, due to perceived health and environmental risks (Wilbers and de Zeeuw, 2006).

In the light of the findings of this study concerning the reality of farming in the staff housing estate, it may be more beneficial for the university management to incorporate rather than ignore the potential to include spaces for farming in the planning of estates in the future. Large backyards could be designed such as to be adapted as community gardens, providing space to cultivate. In place of the present generalized and seemingly out-dated list of rules and regulations, there is the need to develop a more comprehensive policy to guide, coordinate and regulate farming in the estate. The recognition of the importance of urban farming warrants the need to design more effective policies related to farming in the estate. Direct involvement of the residents – both the farming and non-farming residents – and other stakeholders of this policy in its formulation, will greatly enhance its legitimacy and acceptability. Such a policy would incorporate ordinances on urban farming, livestock keeping and fisheries, developed with a strong focus on preventing associated health risks through a system of permits and regulations.

This would involve a synergy of agricultural, architectural, environmental, health and related expertise. The aims would be to integrate farming in the general land use development plan of the estate; to develop and adopt specific norms and regulations regarding the different types of farming and possibly different house types and zones in the estate; to develop appropriate policy instruments (legal, economic, communicative and urban design) and apply same (e.g. regulations regarding use of fertilizers and pesticides); to periodically monitor and advice on farming practices, with a view to preventing pollution (of soils, air, water), ecological damage and public health problems; and to provide for landscape development, recreation and gardening in future housing designs and neighbourhood plans.

Updating the present status of the housing estate in terms of existing land uses through field surveys is expedient. This could be done as part of the overall updating of the University Master Plan.[1] This will form the basis for proper re-planning of the estate with a view to incorporating and moderating residents' farming activities. Portions of the estate may be designated for permanent agricultural land use, while multi-functional, temporary productive use takes place in non-built-up and vacant lands, apart from the home gardens. The desirability of setting aside land for community gardens as a way to meet public open space requirements means that planners must expand their definition of open space: not only playing fields but gardens. Unless spaces for home gardens and community gardens are incorporated, residents may not have the opportunities to grow their own food or improve on their food security.

There is need for continuing research into developing environmentally sound, hygienically safe and economically viable composting processes and facilities, if waste management is to cease being considered a serious deterrent to urban farming.

CONCLUSION

Farming within the university staff housing estate has become a common and perhaps, permanent phenomenon, even though this may not have been envisaged in its initial design and planning. This study collected and analyzed relevant data on farming in the estate. The paper examined the responses of residents – both those who farm and those who do not – to farming within the estate. Their responses of seem to differ from the attitude of the management to farming in the estate. The results were discussed in the light of current literature which suggests the positive and negative aspects of urban farming.

Research into urban farming cuts across disciplinary boundaries; this reflects the field's ample horizons and interdisciplinary nature. The various functions and unique properties of urban farming have contributed to the wide range of subjects in which academic research is scattered. Examples include urban agriculture, landscape architecture, community development, community health, urban planning, and environmental ethics. This present work offers an environmental and in particular, architectural and Urban Design input. It provides a unique opportunity to integrate agricultural and urban design concepts.

What is demanded is the development of creative approaches to thinking about human environments that are in tune with ecological thought. The argument is that an environmental view of the city is now an essential component of urban design, in tune with contemporary issues of energy and resource conservation and environmental awareness. The unrelenting march of urbanization is steadily replacing a once diverse natural landscape for a biologically sterile one. As part of the unplanned natural processes occurring in cities, farming in residential environments can provide an alternative basis for urban design concepts. This requires a re-examination of conventional negative assumptions arising from urban zoning and land-use. This paper may, in a sense, be viewed as a preliminary study which will hopefully trigger further detailed research encompassing a larger framework of case-studies.

<u>Note</u>: Updating of the University Master Plan is on-going at the moment.

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STREET-VENDED FOODS IN IBARAPA–EAST LOCAL GOVERNMENT AREA, NIGERIA

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Abstract

The study was conducted in Eruwa and Lanlate in Ibarapa - East Local Government Area of Oyo state, Nigeria. Based on the data collected on the number of registered food vendors with the Local Government Department of Health, 20 vendors were purposively selected on the basis of the nature of the foods vended. The number represented 40 percent of the registered vendors. Also, 60 unregistered food vendors were selected based on the nature of the foods vended and were randomly distributed throughout the two major towns of Eruwa and Lanlate. Simple descriptive statistical techniques such as frequency counts and percentages were used to describe and summarize the data collected .The results showed that 40% of the vendors had no formal education while majority fell within the age bracket 31-50 years (65%). The major source of finance was personal savings (87.5%). As touching water facilities, 43.75% of respondents indicated that portable water was not adequate. Also, 75% of the respondents did not have access to good toilet facilities while 93.75% did not have access to refrigerating facilities. However, despite the potential risks involved, the socio-economic significance of street vended foods in the area can hardly be underestimated, while their growth, relevance and contribution will continue with increasing urbanization and population growth. Therefore, enhancement of food safety is required via proper information, education and communication of risks associated with unsafe foods offered to consumers.

INTRODUCTION

Food security is defined as physical and economic access to sufficient, safe and nutritious food to meet dietary needs (FAO, 1996). Food security as a concept relates to a defined region be it a local government area, state, geo-political zone, nation, an urban or a rural area and the number of people that have enough and safe food to eat to meet their daily requirements are counted as a proportion of the total population (Akoroda,2010). Globally, the number of food insecure people in the 70 lowest-income countries rose from 849 million to 982 million between 2006 and 2007 and the majority of these people are in the African region (IFT, 2008). Consequently, the increasing lack of access to safe food has influenced quality of food intake, and negatively impacting the health and nutritional status of households.

FAO (1995) described street foods as ready – to – eat foods sold along streets, walkways and several other public places, such as lorry parks, school premises, construction sites and amusement centers (FAO, 1995) while WHO (1996) defined it as foods and beverages prepared and or sold by vendors in streets and other public places for immediate consumption or consumption at a later time without further processing or preparation. Street-vended foods had contributed significantly to assuring food security for low-income urban population and provided a livelihood for those involved in its production, particularly suppliers of raw produce, food processors and vendors most especially poor urban women. Thus, the socio-economic significance of street-vended foods can hardly be underestimated, while their growth, relevance and contributions will continue with increasing urbanization and population growth.

Consumption of contaminated or poisonous foods can cause illness, for which reason consumers face several risks. While food poisoning can be defined as an illness usually characterized with symptoms of acute diarrhea and or vomiting caused by the consumption of contaminated or poisonous food, it can occur as a result of bad kitchen practices, as well as vendors' failure to identify food safety hazards and or control them. Some possible sources of food safety hazards listed by Zaney (2006) are, dust, metal pieces from milling machines, charcoal, stones and sand particles, rice and corn husks, nails and hairs, unhygienic water, milling lubricants, faecal matter from unwashed hands, faecal droppings from rodents and birds.

Food safety and food security are inextricably linked. When food is in short supply, individuals are mainly concerned with satisfying hunger and are not compelled to consider food safety and quality. Therefore, for a community to have the full benefits of street vended foods with minimal risk of food-borne diseases, it requires the collaborative efforts of all the stakeholders- government, vendors, and consumers- at ensuring that the standard of safety for such foods is the best attainable in the context of prevailing local situations.

In the light of the above, this paper examined the following: socio-economic status of food vendors and consumers in Ibarapa – East Local Government Area of Oyo state, Nigeria: sanitary infrastructures available in the study area and factors that influence patronage of street vended foods by consumers.

METHODOLOGY

Ibarapa East local Government Area falls within latitude 7^0 15'N and 7^0 55'N and longitude $3^0$00'E and 3^0 30'E. The area is bounded in the north by Iseyin Local Government Area, to the east by Iddo Local Government, to the west by Ibarapa – North and Central while the area is bounded in the south by Ogun state. Based on the latitudinal location of the area, it is found within the tropical hinterland climatic belt, with annual rainfall between 1500mm and 2000mm, relative humidity is over 80% in the morning and falls between 50% and 70% in the afternoon. The mean annual temperature is 27^0C and annual temperature range is 8^oC. The major occupation in the area is farming which is mainly subsistence in nature (Oladapo, Ogundele and Akindele, 2008). Major towns in the area are Lanlate and Eruwa, the two communities that host the two tertiary institutions in the area-The Polytechnic, Ibadan (Adeseun Ogundoyin Campus, Eruwa) and Emmanuel Alayande College of Education, Oyo (Lanlate Campus). However, one of the fascinating aspects of urban social life in the study area is the widespread presence of street food vendors operating at strategic locations.

Based on the data collected on the number of registered food vendors with the Local Government Department of Health, 20 vendors were purposively selected using the nature of the foods vended. This number represented 40 percent of the registered vendors. Also, 60 unregistered food vendors were selected based on the nature of the foods vended and were randomly distributed throughout the two major towns of Eruwa and Lanlate. Simple descriptive statistical techniques such as frequency counts and percentages were used to describe and summarize the data collected.

RESULT AND DISCUSSION

Table 1 shows the socio – economic activities of both the vendors and the consumers. From the table, majority of the vendors had one form of formal education or the other (60%) and were between 31-70 years old (95%) and had no formal training (90%) in safe food handling of foods and proper hygiene. Also, 80% of the respondents employ 1 – 5 workers with family members assisting in the preparation and sale of products. As such, they were able to make daily savings after providing for their households the daily meals. Therefore, street food vending is more than an income generating activity and source of employment for poor urban women but a sustenance strategy (Tomlins, 2006; Zaney, 2006). Many (87.5%) of the respondents started the business with personal savings. The table also reveals that some populations, such as students and civil servants (62.5%) who work away from their homes/families are almost totally reliant on street foods. The predominance of adult male and children (85%) revealed that the people of the study area relied on street foods both as a coping strategy and as part of normal consumption.

Table 1: Socio-Economic Analysis of the Vendors and Consumers n=80

Item	Variables	Frequency	Percentage
Age, years	below 30	4	5.00
	31-50	52	65.00
	51-70	24	30.00
Educational level	No formal education	32	40.00
	Primary	36	45.00
	Secondary	8	10.00
	Post secondary	4	5.00
Sources of finance	Personal savings	70	87.50
	Cooperative	8	10.00
	Microfinance bank	2	2.50
Vending facility	Mobile carts	20	25.00
	Fixed stalls	48	60.00
	Food centre	12	15.00
Number of employees	1 – 5	64	80.00
	6 – 10	16	20.00
Distribution of customers by status	Artisans	30	37.50
	Civil servants	25	31.25
	School children	10	12.50
	Students (tertiary)	15	18.75
Distribution of customers by age	Adult male	38	47.50
	Adult female	12	15.00
	Children	30	37.50

Table 2: Available Sanitary Infrastructure n=80

Items	Variable	Frequency	Percentage
Portable water	Not available	23	28.75
	Slightly adequate	22	27.50
	Not adequate	35	43.75
Toilet facilities	Not available	60	75.00
	Not adequate	20	25.00
Electricity	Not available	5	6.25
	Slightly adequate	8	10.00
	Not adequate	67	83.75
Refrigeration	Not available	75	93.75
	Slightly adequate	5	6.25
Waste disposal facilities	Not available	8	10.00
	Slightly adequate	27	33.75
	Not adequate	45	56.25
Mode of waste water disposal	Slightly adequate	32	40.00
	Not adequate	48	60.00
Mode of solid waste disposal	Slightly adequate	10	12.50
	Not adequate	70	87.50

Table 2 shows the available sanitary infrastructures in the study area. From the table, it was discovered that sanitary infrastructural development was relatively limited as reflected in non – availability of toilet (75%), electricity not adequate ((83.75%) or not available (6.25%) thereby making refrigeration of foods almost impossible, and waste disposal facilities either not adequate or not available (66.25%). However, the most critical problem in street food vending in the study area is the inadequate supply of water of acceptable quality and in sufficient quantities for drinking, washing, cleaning and other operations. Indeed water is generally scarce in the area with non – availability of (28.75%) or restricted access to portable water (71.25%). Consequently, street vendors in the area wash their utensils, including those in which food has been served, in water which has been used previously, perhaps many times while consumers drank sachet water most times. Therefore, water supply needs close attention in street food operations in the area. This is to avoid contaminated water being added to foods or applied to utensils without a subsequent step (heating or chemical sanitizing) to eliminate or reduce the potential hazards to an acceptable level.

Based on the observation of food handling and preparation in the area, there is a need to properly address the problems associated with street foods, especially safety concerns. For instance, food stands are often crude structure, toilets facilities are either not adequate (25%) or not available (75%), as shown by table 2, and washing of hands, utensils and dishes is often done in buckets or large bowls. Disinfection is rarely carried out; insects, rodents and domestic animals are attracted to sites with no organized sewage disposal. Food is most of the times not adequately protected from flies and refrigeration is not often available due to erratic electricity supply.

An examination of the existing food legislation, regulation and enforcement in the area revealed the following:

- There are insufficient personnel and materials for monitoring and inspection of the activities of the food vendors
- Inspection and monitoring were carried out occasionally during the day but not at all in the evening
- Registration, training and medical examinations were not among selected management strategies
- There are difficulties in controlling the large number of street food vending operations because of their diversity, mobility and temporary nature
- There is poor knowledge of street vendors in basic food safety measures, and inadequate public awareness of hazards posed by unsafe street foods.

Thus, street vended foods may pose significant public health problems and the livelihood of those involved in the sector may be jeopardized due to reduced public confidence, if government does not ensure proper monitoring and supervision of the sector.

CONCLUSION

Since sale and consumption of street foods are on the increase within the study area, with such foods forming an indispensable part of the diets, then the need to improve their safety is very imperative. Strategic interventions and regulatory measures need to be kept in place so as to fully reap the benefits of such foods with minimal risks to food borne diseases. Thus, government intervention is required to ensure that the standard for such foods is the best attainable in the context of the prevailing local situation. However, the following specific actions may become very necessary:

- Government, in collaboration with private sector must ensure provision of basic sanitary infrastructure, since to support improved hygiene practices, local people require access to clean water, proper disposal of sewage, regular refuse collection and a means of keeping food cool.

- A well tailored training session must be organized by the sanitary inspectors on regular basis for vendors on safe food handling and preparation, hazard associated with unsafe food, good hygienic practices, nutrition, and business management, which are essential part of any strategy to improve the safety and quality of street vended foods.
- The formation of Street Food Vendor Associations or Cooperatives should be encouraged to provide a liaison point and help create a data base of all the vendors with the relevant authorities in view of facilitating control measures. This can also be used as a basis for giving financial support to the vendors as majority of them are poor and may require adequate funding to observe proper hygiene.
- The sanitary inspection unit of the Local Government should strengthen information, education and communication activities to raise awareness on healthy food choices and nutrition amongst the populace. For example, simple posters illustrating the dos and don'ts of street foods preparation and vending should be widely and prominently displayed in relevant places for the benefit of the vendors and consumers,
- To enable official recognition and control of street foods, it may be appropriate to develop government regulations specific to this food service sector at local level.
- Finally, it is necessary that designated authorities undertake Hazard Analysis and Critical Control Point (HACCP) studies to identify and integrate critical control measures into strategies for improving the safety of street foods. Thus, HACCP will provide guidance in selection of enforcement and education priorities rather than general sanitation and superficial improvement.

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URBAN HEALTH CHALLENGES OF INDUSTRIAL WASTE DISPOSAL IN IKEJA INDUSTRIAL ESTATE, LAGOS NIGERIA

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Abstract

The objective of the research are to examine the types and quantity of waste generated, the disposal management methods adopted by the industries in Ikeja Industrial Estate of Lagos Nigeria and also examine the urban health challenges facing residents around the Industrial Estate. 55 manufacturing establishments were randomly selected from eight categories of industries and 150 residents were selected through systematic random sampling for the study. The data generated were analysed using both descriptive and inferential statistics. The findings of the research showed that industrial wastes in the area are poorly managed and poses threatening health challenges to the environment and residents around the estate. Urgent attention and industrial environmental policy re-examination are recommended as a way out towards a sustainable development of healthy urban centres in the country.

INTRODUCTION

In most cities of developing countries in Africa, due to lack of good physical planning, factories are intermingled with residential houses and thus exposed the residents to vagaries of waste related health problems, even where industrial estates are developed residential quarters are part and parcel of such estates, thus making the permanent residents of such industrial Estate direct vulnerable group to diverse effects of industrial waste. Further more people living within few kilometers around such estate and those depending on streams and rivers into which industries discharges there effluents are as well exposed to vagaries of waste disposal problems.

The objectives of this paper are to examine the types and quantity of waste generated, the disposal management methods adopted by the industries in Ikeja Industrial Estate of Lagos Nigeria and also examine the urban health challenges facing residents around the Industrial Estate. Lagos State is the smallest state in Nigeria, yet it has the highest population. The rate of population growth is about 275,000 persons per annum with a population density of 2,594 persons per sq. kilometer. In the urban area of Metropolitan Lagos, the average density is 8,000 persons per square kilometer on average (up to 55,000 per sq. km. in the densest parts of the urban area). Ikeja Local Government Area is located at the central part of the Lagos State. The total population of Ikeja Local Government as at 2006 was put at 313,196 (2006 census). The area is divided into two major parts, the first is the residential, while the second is the industrial region. The industrial estate was established within the LGA in 1959 by the then Western Nigeria Housing Corporation (WNHC).

METHODOLOGY

Both primary and secondary data were used for this study. Primary data were collected through interview, personal observations and questionnaires administration. The two sets of questionnaires were administered: one is for the industrial managers in the Ikeja industrial estate. It was used to elicit information on the types of product they produce, level of wastes in terms of types, quantity, storage and method of waste disposal. The second set was for the residents around the Ikeja industrial estate to ascertain the effect of wastes to human health and the immediate environment.

The industrial questionnaire comprises 26 questions, which were grouped into three sections viz: company data, wastes generation and management, and waste minimization. While that of the residential area comprises of 26 questions which were grouped into two sections viz: socio-economic data, and effect of industrial wastes management.

Secondary data were collected from existing data on the wastes management status of Lagos State with specific emphasis on Ikeja Industrial Estate from the Wastes Management Units of the Lagos State Environmental Protection Agency (LASEPA & LAWMA), Lagos State Ministry of Health, Ministry of Commerce and Industry, Ministry of Planning and Statistics, Manufacturer Association of Nigeria (MAN), different wastes management sites and authority in Ikeja Local Government Area, and among other relevant organizations. Also, relevant information was sourced from related literature and previous works on wastes management from different sources. Direct field observations were conducted in the study rea to ascertain information from the documentary sources.

There are 110 registered manufacturing industries classified into eight categories of products in Ikeja industrial estate, according to the manufacturers association of Nigeria (MAN 2008). Random sampling was used to select 55 out of the 110 industrial establishments across the eight categories for the study (Table 1). Only 53 of the questionnaire were returned with adequate information for the analysis. Also, systematic random sampling was used to select 150 respondents from 23 streets around the industrial estate. The questionnaire administered on the respondents was to elicit information on the effect of the industrial wastes to the immediate environment and their exposure to health challenges as result of their living within and around the industrial estate. Data generated were analysed using simple descriptive and inferential statistics.

Table 1: Manufacturing Industries in Ikeja Industrial Estate

Manufacturing Industries	**Numbers**	**Number selected Selected Numbers**
Chemical and pharmaceutical	41	20
Basic metals, iron and steel, and fabricated metal	20	10
Pulp and paper product, publishing and printing	14	7
Food, beverage and tobacco	11	5
Textile, wearing, carpet and leather	10	5
Domestic and industrial plastic and rubber	7	4
Wood and furniture products	4	2
Non-metallic mineral	3	2
Total	**110**	**55**

RESULTS AND DISCUSSIONS

Pattern of Industrial waste generation

The structure of the industries by the type of products is an indication of the type and volume of waste such industries will generate. The results of the survey showed that 38 percent of the industrial establishment engaged in chemical and pharmaceutical products, while 19 percent engaged in basic metal, iron & sheet & fabricated metal. Also Pulping and paper product; Textile; Food, beverage constitutes 9 percent each. Domestic & industrial plastic products constitutes 8 percent while those that engage in wood production (including furniture); and non-metallic mineral product constituted only 4 percent each (see Table 2)

Table 2: Categories of the Industrial Establishment by Products

Category of products	Frequency	Percentage
Chemical & pharmaceutical	20	37.7
Basic metal, iron & sheet & fabricated metal	10	18.9
Pulp, paper product & published	5	9.4
Textile wearing apparel & leather	5	9.4
Food, beverage & tobacco	5	9.4
Domestic & industrial plastic, & rubber	4	7.5
Wood production including furniture	2	3.8
Non-metallic mineral product	2	3.8
Total	53	100.0

Source: Field survey 2009.

Three categories of waste are discernible within the industrial estate as solid, liquid and gas, however due to the focus of this study only solid and liquid waste generated by the industrial establishments were quantified in terms of tonnage of solid waste and cubic meter of volume of liquid waste. Measure of gas released and chemistry of the liquid waste are beyond the scope of this study.

Table 3 showed the distribution trend of wastes generated by the industrial establishment. The table shows that 75.5 percent of the industries generates below 2,000 tons, 13.2 percent generate between 2,000 – 4,000 tons while those generating between 4,001 – 6,000 tons and 8,001 – 10,000 tons constitute 1.9 percent each, meanwhile, 7.5 percent of the industries establishment generates above 10,000tons of solid wastes. Also, the table shows that 64 percent of the industries generated below 2,000m^3 of liquid wastes, 17 percent generate between 2,000 – 4,000m^3 ; while between 4,001 – 6,000m^3 and 8,001 – 10,000m^3 constituted 2 percent each. Those that generate between 6,001 – 8,000m^3 were 4 percent and 11percent of the industries establishment generated above 10,000m^3 of liquid wastes.

However, the table shows that out of the solid wastes generated, 30 (56.6%) of the industries reuse below 500tons; 11 (20.8%) reuse between 500 – 1,000tons; 7 (13.2%) reuse between 1,001 – 1,500tons; while those that reuse within the range of 1,501 – 2,000tons and above 2,500tons constitute 2 (3.8%) of the industrial establishment; and only 1 (1.9%) of the industry reuse between 2,001 – 2,500 tons of solid wastes.

Table 4 showed the waste management practices adopted by the industries. Out of the total solid wastes generated 56.6 percent are disposed off through land filling and open burning methods by the waste management authority. Land filling and open burning operation were contracted out to waste management companies which were collecting and taking waste to dump site where the open burning is done before the residue would be land filled. Waste dump site were also located within and around the residential areas. 41.5 percent of waste is recycled and only 1.9 percent are treatment within the industrial premises. Also, out of the total liquid waste generated, 37.7 percent is treated before discharge, 52.9 percent liquid waste is discharge into drainage channel without treatment and the remaining 9 percent is recycled. From Table 4, it could be stated that both solid and liquid waste generated were not disposed off properly. This was identified to portend serious environmental and health hazards to the residents around the industrial estate.

Table 3: Monthly Solid and Liquid Wastes Generation by Industries

Variables		Frequency	Percentage
Solid wastes generated per month (tons)	Below 2000	40	75.5
	2000 – 4000	7	13.2
	4001 – 6000	1	1.9
	8001 – 10000	1	1.9
	10000 above	4	7.5
	Total	**53**	**100.0**
Liquid wastes generated per month (m^3)	Below 2000	34	64.2
	2000 – 4000	9	17.0
	4001 – 6000	1	1.9
	6001 – 8000	2	3.8
	8001 – 10000	1	1.9
	10000 above	6	11.3
	Total	**53**	**100.0**

Source: Field survey 2009.

Table 4: Solid and Liquid Waste Management Practices

Solid waste management				**Liquid waste management**			
Landfill and open burning	**Treatment**	**Recycling**	**Total**	**Treatment Before discharge into drainage**	**No treatment Before discharge into drainage**	**Recycling**	**Total**
30 (56.6 %)	1 (1.9%)	22 (41.5%)	53 (100.0)	21 (37.7%)	28 (52.9%)	5 (9.4%)	53 (100.0%)

Source: Field survey 2009.

The motivating factors influencing the waste management practices adopted by industries in Ikeja Industrial Estate revealed that economic factor of reducing the cost of waste management which could increase their production cost and lower profit account for 55 percent, followed by 9 percent environmental factor and 36 percent account for a combination of both economic and environmental factors.

Urban Health Challenges of Industrial Waste

This section revealed the findings on the environmental and health challenges experienced by the residents within 1kilometre radius of the industrial estate. About 41 percent of the respondents identified constant unpleasant odour as the most discomfort experienced in their residential area and ascribed it to their closeness to the industrial estate; another 27 percent identified unhygienic environmental condition which makes the neighbourhood to be so dirty and reducing the aesthetic value of the area. This view was most common to areas where refuse dumps are close to residential area. 18 percent of the respondents also identified water pollution as one of the common environmental problems around the estate. This opinion was further reinforced by 43 percent of the respondents claimed that they shared drainage system with effluent discharge from some of the industries. The result further revealed that the observed environmental challenges portend serious health implications for the residents.

The pattern of source of domestic water supply to the residents revealed the quality water available. 59.6 of the respondents depends on either well or bore hole water for domestic use, 35 percent on public water source and 5 percent depend on water vendors of which they could not ascertain the main source from which the vendors collect water. However, out of the 84 respondents that depend on well or borehole water 55 percent claimed that their water tasted polluted, only 17. 8 claimed their well/borehole water is okay. This group also claimed that they do purify their water before use.

The study probed further to find out about the common health problem in the study area within one month of the survey, it was revealed that Typhoid fever, malaria, diarrhoea and cholera are water borne diseases that were found to be rampant among the residents. Diseases identified as others are; cough, tuberculoses, catarrh, etc. The result further revealed that 60 percent of the respondents ascribed their ailment to the problem of poor environmental situation in the industrial estate. Blocked drainage and refuse dumps is veritable zone of breeding of rodents and mosquitoes that are carrier of diseases. This implies that residents were exposed to health challenges as a result of poor management of both solid and liquid waste from the industrial estate.

SUMMARY AND CONCLUSION

This study on urban health challenges of industrial waste management has revealed degenerated situation of poor industrial waste management in Ikeja Industrial Estate in Nigeria. It showed that large quantities of both solid and liquid waste were being generated from all the industrial establishments in the study area and unethical method of waste disposal is currently the norm among the industries. For instance, 56.6 percent of solid waste was disposed through Land fill & open burning methods and 52.8% of liquid waste was not treated before being discharge into the drainage system. Uunpleasant odour in the area was traced to decomposition of the solid waste and as well waste from paint and pharmaceutical industries in the study area. Textile industry was more culpable of water pollution as they discharged coloured effluents into the drainage system without treatment. Steel industry and solid waste dump sites contributed to the deplorable aesthetical value of the environment within the study area.

Some methods of waste disposal adopted in the study area released air pollutants and greenhouse gases into the atmosphere. Methane released from landfill sites is a strong greenhouse gas and contributes to global warming. Fluids leached from decomposing waste can permeate through the underlying and surrounding geological strata, polluting groundwater which is used for drinking water supplies as well/borehole.

The conclusion is that the current waste disposal methods adopted are not environmental friendly and poses serious health challenges to the residents around the industrial estate as identified by the respondents. This portends that institutional framework for monitoring and management of industrial waste is weak.

RECOMMENDATIONS

Addressing the health challenges of industrial waste in Ikeja LGA and other similar locations will require a pro active measure in waste management processes from generation points to final disposal point. The ultimate aim of any solid waste disposal activity is to be sanitarily and aesthetically acceptable and economically convenient. Disposal should proceeded by engineering activities such as sorting, volume reduction and/or recycling. Since there different categories waste generated, handling of different categories may required different method thus, the following policy options are advocated for industrial waste management in the area:

Proper treatment of effluents from generation sources needs to be improved to reduce water pollution. Dump sites should be relocated far away from residential areas.

Where land fill is necessary, Containment landfills as advocated by Kirthy (2008) can also be adopted to limit the leaching of harmful chemical compounds into ground water. Incineration of pharmaceutical and medical waste put separately after sorting.

The recommendations can only be achieved through strengthening of institutional framework for waste management in our cities. This will include a holistic review of current industrial environmental policy; deployment of adequate resources (personnel and materials) for the enforcement of environmental laws; adoption of Public-Private Partnership (PPP) strategies in the management of industrial waste as it is done currently for domestic waste in Lagos. These are recommended as a way out towards a sustainable development of healthy urban centres in the country.

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YOUTH INVOLVEMENT IN PERI-URBAN AGRICULTURE IN OSUN STATE, NIGERIA

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Abstract

This study assessed the involvement of youth in peri-urban agriculture in Osun-state, Nigeria. Multistage sampling procedure was used to select 113 youths from 6 Local Government Areas in the State. Frequency count, percentages, mean scores and standard deviation were used to summarize the data collected. Results revealed that majority (93.0 %) of the respondents were unmarried, with mean age of 21.0 years and spent average of 8.0 years on formal education. Peri-urban agriculture enterprises in which the youths engaged were snailery (42.0 %), bee keeping (31%), grass cutter rearing (13.0%), rabbit rearing (6.0 %) and vegetable production (73.0%). Constraints inhibiting successful involvement in the identified peri-urban agricultural enterprises include: problem of inadequate extension service (30.0%), inadequate information about importance of peri-urban agriculture (27.0%) and problems of inadequate capital (26.4 %). Age, years of education, income, sex and marital status were found to have significant association with the youth's level of involvement in peri-urban agriculture.

INTRODUCTION

Peri-urban agriculture (PA) is an extensively practiced industry worldwide that has existed for a long time. It is an agricultural enterprise located within or on the fringes of a town, a city or a metropolis, which grows or raises, processes and distributes a diversity of food and non-food products, (re-) using largely human and material resources, products and services found in and around urban area, and in turn supplying human and material resources, products and services largely to that same urban area. PA includes small- and large-scale activities in horticulture, micro- livestock keeping, fodder and milk production, aquaculture, and forestry - where several activities may be carried out within one enterprise (Torimiro *et al*., 2007).

The practice has become an extremely visible economic activity in peri-urban areas of cities all over the world. It engages about 800 million people globally and utilizes available urban empty spaces. About 200 million of this estimate is considered to be market producers employing approximately 150 million people on a full-time basis (Benell, 2007). Thus, it contributes significantly to food security for approximately 50% of the world's population, who are city dwellers. This, and other benefits that accrue from peri-urban farming, such as increased availability of fresh crops, especially vegetables, and contributions to sustainable livelihoods, are often underestimated and undervalued (Erwat, 2001). However, in times of harsh economic situations and periods of food insecurity, peri-urban farming often assumes significant livelihood strategy for survival. This is especially true for vulnerable groups (e.g. Youth, women, retired people, and people without formal education) who relied more on livestock keeping due to their limited alternative choices of livelihood options (Gregory, 2005). Peri-urban farming has thus assumed global concern and become a topical issue of scientific discourse in recent years.

Motivation for peri-urban farming among the youth is largely due to lack of formal jobs and as a means of adding up to household income practices (Gregory, 2005). Thus, the practice has been a significant source of job creation for unemployed urban youth, improved livelihood and sustained the urban ecology (Fuller, 2003 and ILO, 2005). It is estimated that about a fifth to a third of families in some towns are engaged in peri-urban farming, with some, not having any other source of sustenance or income. In many towns, the majority of youths depend indirectly on agriculture for their livelihoods, through employment in rearing of micro-livestocks, food transport, retailing, and processing. Peri-urban agriculture also makes a contribution to the food security of the poor, particularly in urban slums. Even in large, congested towns, the peri-urban youths often have a home garden or raise small animals as part of a coping strategy. Survival strategies may involve maintaining links with a home community in rural areas, through a plot of land to return to for retirement or continued connections with family (Gregory 2005).

Against this background, this study was designed to generally assess youth involvement in peri-urban agriculture and its implication for sustainability of food security in Osun state, Nigeria. Specifically, it determined the personal and socio-economic characteristics of the youth that are involved in peri-urban agriculture; identified peri-urban agriculture enterprises they engaged in; and determined constraints inhibiting their successful involvement in peri-urban agriculture. Empirically, association between some selected personal and socio-economic characteristics of the youth and their involvement in peri-urban agriculture were established.

METHODOLOGY

The study was carried out in Osun State, Nigeria. The study area lies within longitude 2.75^0 and 6.75^0 Greenwich meridian and latitude 7^0 and 9^0 (Ministry of Information, Osun State, 2009). A multi-stage sampling procedure was used to select respondents sampled. Firstly, three agricultural zones were identified in the state, namely: Osogbo, Ife-Ijesha and Iwo zones, comprising thirteen (13), ten (10) and seven (7) Local Government Areas (LGAs), respectively. Secondly, about 20 per cent making three, two and one (LGA) were proportionately selected from each zone respectively. These are Osogbo, Odo-otin, Ila, Ife central, Obokun and Olaoluwa LGAs. The third stage involved selection 113 youth interviewed for the study using snow-ball sampling technique.

The dependent variable was number of peri-urban agricultural enterprises involved in by the youth in the study area. It was measured by their respective involvement in these activities. Youth were asked to respond to a set of five peri-urban agricultural enterprises commonly found in the urban areas of the country; ranging from Rabbit keeping, Snairy, Bee-keeping, Grass cutter rearing and Vegetable production in a Likert scale as follows: scarcely involved (1), moderately involved (2), highly involved (3). The total score for each of the respondents was calculated by summing up the respective values. The maximum score obtainable was 15 points while the minimum was 1 point. Descriptive statistics such as percentages and frequency counts were used to describe the data collected while inferential statistics such as correlation and chi-square were used to test the hypotheses.

RESULTS AND DISCUSSION

Respondents' personal and socio-economic characteristics

Results in Table 1 reveal that 67.3 percent of the respondents were male with mean age of 20. 9 years and average income of N6, 525.00k. The Table further show that schooling was the major occupation of the respondents (91.1%) with average of 7.98 years of formal education, while majority were Yoruba tribe (93.8%) and 77 percent of the respondents were male while the remaining 23 percent were female. This implies that there is still gender sensitivity in the involvement of youth in peri-urban agriculture, which may be a reflection of the different gender gap in education in Nigeria (Torimiro *et al.,* 2007). Concerning the marital status, majority (93%) indicated that they had not married. This conformed to authors' (CYIAP-

Network, 2006 and World Bank, 2006) definition, which took cognizance of the circumstances of poverty, unemployment and deprivations that prevalent in Nigeria.

Table 1: Distribution of respondents by personal and socio-economic characteristics (N = 113)

Variable	Frequency	Percentage (%)	Central Tendency
Age (years)			
< 15	4	3.5	
16 – 20	58	51.3	Mean = 20.9
21 – 25	31	27.4	Std. dev. = 4.7
> 25	20	17.7	
Sex			
Male	76	67.3	
Female	37	32.7	
Marital status			
Single	105	93.0	
Married	8	7.0	
Religion			
Christianity	88	77.8	
Islam	20	17.7	
Traditional	6	5.3	
Years spent on formal education			
< 5	21	18.5	
6 – 10	32	28.3	Mean = 7.98
11 – 15	49	43.3	Std. dev. = 5.62
> 15	11	9.7	
Major occupation*			
Farming	3	2.7	
Trading	9	6.9	
Schooling	103	91.1	
No response	8	7.1	
Income ('000) in ₦			
< 5	15	13.3	
6 – 10	14	12.4	
11 – 15	3	2.7	Mean = ₦ 6,525
> 5	2	1.8	Std. dev. = ₦ 4,345
No response	79	69.9	

*Multiple responses provided (Source: Field survey, 2010).

Data in Table 2 show that some respondents' were moderately and highly involved in the production of certain micro livestock's among which are Rabbit production, Snailery, Bee-keeping, Grass cutter rearing and Vegetable production (6.1%), (42.4%), (30.9%), (13.2%) and (72.5%), respectively. This implies that youth were aware of importance of peri-urban agriculture particularly in relation to enhancement of family income as indicated by Gregory (2005) and Gündel (2002).

Table 2: Distribution of respondents according to their respective involvement in peri-urban agricultural enterprises (N=113)

Enterprise/Involvement	*Scarcely Involved	Moderately Involved	Highly Involved
Rabbit production	106 (93.8)	2 (1.7)	5 (4.4)
Snailery	65 (57.5)	35 (30.9)	13 (11.5)
Grass cutter rearing	98 (86.7)	12 (10.6)	3 (2.6)
Beekeeping	78 (69.0)	25 (22.1)	10 (8.8)
Others (vegetable production)	31 (27.4)	35 (30.9)	47 (41.6)

*Percentages are in parentheses (Source: Field Survey, 2010).

Constraints to youth involvement in peri-urban agriculture

Data in Table 3 show that some of the respondents indicated that inadequate extension service (30.0%), inadequate information about importance of peri-urban agriculture (27.0%) and problems of inadequate capital (26.4 %) were among the constraints inhibiting their successful involvement in the identified peri-urban agricultural enterprises indicated. This implies that policies for improving peri-urban livelihoods must take into account the complexity of peri-urban–rural links and recognize that the fact that rural conditions affect peri-urban livelihoods, therefore, enhancement of rural-urban extension services must be given priority (Gregory, 2005).

Table 3: Distribution of respondents according to constraints to involvement of youth in peri-urban agriculture (PA) (N=113)

Constraints*	Frequency	Percentage
Inadequate information about importance of PA	31	27.4
Inadequate extension services	34	30.0
Inadequate hybrid breeding stock	33	29.2
Poor marketing	32	28.3
Bad road network	31	27.4
Inadequate capital	30	26.4
Fear of loan repayment	27	23.8
Inadequate storage facilities	29	24.6
Poor motivation	26	22.3
Neglect of youth in policy making concerning PA	27	23.8

*Multiple responses (Source: Field Survey, 2010)

Testing of hypotheses

In order to establish relationship between personal and socio-economic characteristic of respondents and their involvement in peri-urban agricultural enterprises, data were subjected to Chi-square test and Pearson's correlation analysis. Results in Table 4 show that at $p < 0.05$, marital status ($x^2 = 19.176$) and sex ($x^2 = 18.030$) were strongly associated with the youth involvement in peri-urban agriculture.

Table 4: Chi-square analysis showing the association between the youth involvement in peri-urban agriculture and some of their selected personal characteristics (N=113)

Variable	X^2	p- value	Decision
Sex	18.030	0.032	Significant
Marital status	19.176	0.013	Significant

X^2 is significant at $p \leq 0.05$ levels. (Source: Field Survey, 2010).

Table 5 reveal that at 0.05 level of significance, age (r = 0.432), education qualification of the respondents (r = 0.435), income (r = 0.239), were significant and positively correlated with the youth involvement in peri-urban agriculture. This implies that youth with higher education were more involved in peri-urban agriculture. The study further confirmed that age (51.2%), educational qualification (51.3%) and income (17.7%) had the highest contribution to the involvement of youth in peri-urban agriculture.

Table 5: Pearson correlation (r) analysis showing the relationship between selected personal and socio-economic characteristics of the youth and their involvement in peri-urban agriculture (N=113)

Variable	r	r^2	p- value
Age	0.432*	0.512	0.042
Years of education	0.435*	0.5127	0.034
Income	0.239*	0.1771	0.024

Source: Field survey, 2010.

Correlation is significant at $P < 0.05$ level

SUMMARY AND CONCLUSIONS

The study revealed that majority (93.0 %) of the respondents were unmarried, with mean age of 21.0 years and spent average of 8.0 years on formal education. Peri-urban agriculture enterprises in which the rural youths engaged were Snailery (42.0 %), Bee keeping (31%), Grass cutter rearing (13.0%), Rabbit rearing (6.0 %) and Vegetable production (73.0%). Constraints inhibiting successful involvement in the identified peri-urban agricultural enterprises include: inadequate extension service (30.0%), inadequate information about importance of peri-urban agriculture (27.0%) and problems of inadequate capital (26.4 %). In addition, age, years of education, income, sex and marital status were found to have significant association with the youth's level of involvement in peri-urban agriculture. In order to exploit the potentials of peri-urban agriculture to the fullest towards sustainability of national food security, adequate extension services and training opportunities should be provided to rural youths, to facilitate their involvement in peri-urban agriculture.

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REVERSING THE DESERTIFICATION OF PARTS OF NORTHERN NIGERIA:
LESSONS OF EXPERIENCE FROM ISRAEL, TURKEY AND EGYPT

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Abstract

Nigeria has tried to combat the desertification challenge by coming up with desert-rollback strategies and committing more and more funds to the issue over the years. Yet Nigeria remains a net importer of food and food products. The question then is: what have other countries done that Nigeria has not come up with? How can Nigeria correct errors of the past in this direction ? Israel, for instance, is a country in the heart of the desert - it is self-sufficient in agriculture for home consumption and even for export. In like manner, Egypt and Turkey, also in the desert, have done well conquering their environment to produce enough food for their citizenry. The present paper draws lessons of experience from the three countries of Israel, Turkey and Egypt. Based on their success stories in conquering, by and large, their ecological environment, relevant policy statements are drawn for post-50years-old Nigeria.

INTRODUCTION

Desertification is becoming a major source of worry for Nigeria's agriculture, particularly in the Northern parts where eleven of the nineteen states are reported to be seriously under threat. Extending southwards at the rate of 0.6 kilometres per annum, desertification is thus threatening over 35 million people in the North. Much of the grass which serves to feed livestock is rapidly disappearing. This has led to the overgrazing of the available ones. Indeed, between 1978 and 1995, deforestation over-ran 350,000 hectares of land annually. Within the same period, sand dune increased from 80,000 ha in 1978 to 480,000 ha in 1995 in the northern parts of Nigeria (Abalu and D'Silva, 1980). Indeed, deserts now cover 41 percent of the world's surface and desertification menaces about 250 million people on five continents with some 1.2 billion people in the world's 110 poorest states under threat. The main causes are believed to be over-harvesting, cattle-breeding and overgrazing, deforestation and climate change (Warren and Agnew, 1988; Arntzen, 1990).

In this paper, the study area in Nigeria covered includes the so-called eleven frontline desert-prone states namely: Kebbi, Sokoto, Zamfara, Katsina, Kaduna, Kano, Bauchi, Jigawa, Yobe, Borno and Gombe. They cut across the Guinea Savannah, Sudan Savannah and Sahel Savannah ecological zones. Against conceptual background of drought and desertification in these ecological zones, the present paper places emphasis on the success stories of Israel, Turkey and Egypt in rolling back the desert, and draws lessons of experience for future ecological Nigeria.

DROUGHT AND DESERTIFICATION

Drought is a normal, recurring feature of the climate in most parts of the world. It is among the earliest documented climatic events as could be seen in biblical story of Joseph and his brethrens moving to Egypt in search of food. It has been suggested that, broadly, drought could be mitigated in a number of ways. These, as noted by Adar, Gev and Issar (1995) include:

1) Cloud seeding - an artificial technique to induce rainfall.
2) Desalination of sea water for irrigation or consumption.
3) Drought monitoring - Continuous observation of rainfall levels and comparisons with current usage levels can help prevent man-made drought. For instance, analysis of water usage in Yemen has revealed that their underground water level is put at grave risk by over-use to fertilize their farms.

Drought is an extended period of months or years when a region notes a deficiency in its water supply. A situation qualifies as drought when a region consistently receives precipitation (over a period of months or years) below its known recorded average. Such situations dislocate the local settings by affecting their pattern of livelihood. According to the UN Environmental Programme (UNEP) which had declared 2006 a year of focus on 'deserts and desertification', land degradation especially drought causes crop losses of around 42 billion dollars a year. Not only does it disrupt cropping programmes, drought reduces breeding stock and it could impact negatively on human health. It has been implicated in the mass migration and other humanitarian crises reported in most countries and continents. In general, the eventual effect of drought is famine.

Israel

It is important at the outset to consider Israel's climatic conditions. Some 95% of the country is semi-arid, arid or hyper-arid with only 5% of the lands receiving sufficient rainfall to fall into a dry sub-humid category. Thus, Israel is almost entirely comprised drylands. The greatest risk of desertification exists in the semi-arid zones in the center of the country, with soil degradation also occurring in the arid parts of the Negev surrounding the greater Beer Sheva region (Gabbay, 1998; Azmon, 1999).

The most salient new Israeli efforts associated with combating desertification can be divided into four general categories, and several sub-categories. These, according to Agassi, Benyamini, Morin, Marish and Henkin (1996) include:

A. New Comprehensive Planning Initiatives for Israeli Drylands

- Approval of National Masterplan 35 as a new long-term strategic plan that controls urban growth and balances development against conservation;
- Government adoption of the "Daroma" (Southbound) development plan to expedite settlement of the Negev region.

B. Upgraded Sustainable Water Management in the Drylands

- Upgrading of effluent recycling for agriculture;
- Construction and operation of new desalination facilities;
- Implementation of water conservation policies to prevent overexploitation
- Commencement of watershed management projects -- Nahal Beer Sheva, Nahal Besor.

C. Continued Afforestation in the Arid and Semi-Arid Regions

- Implementation of Masterplan 22 for Forests and Afforestation;
- Transfer of legal control of forests to the Jewish National Fund (JNF);

- Adoption of a national policy of sustainable forestry to ensure biodiversity, the ecological integrity of Israel's woodlands and the public's involvement in planning and access to forests as recreational resources.

D. Policies to Promote Sustainable Agriculture in Vulnerable Regions

- Implementation of national soil erosion control policies;
- Ongoing promotion of national grazing strategy and associated regulation.

Israel realized that the greatest risk in the transformation of traditional dryland-rangeland to modern cropland, and in the transformation of rain-fed to irrigated dry land, is soil salinization. Transportation of water to areas of shortage alone will not generate sustainable dry land agriculture, unless irrigation methods and technologies are developed and implemented which reduce water loss by evaporation, and prevent the accumulation of salts on the surface and in the root zone of the crops. Israel pioneered drip-irrigation technologies and practices, and as a result has produced record crops in dry lands by developing "protected agriculture" technologies. These desert greenhouses are instrumental in reducing evaporation and preventing soil salinization (National Research Council, 1999).

Furthermore, although within its territory, there are many sand dunes and sandy soils; Israel has not suffered from the overlaying of fertile croplands by moving sands, and from other desertification effects caused by moving dunes. Moreover, Israel discovered that in dry lands, sandy soils have an advantage over non-sandy soils, due to the water-holding capacity of the sand. Thus, paradoxically, the sandy soils of Israel are not looked upon as a curse, but as a blessing and they are sought after by the farmers. At the same time, Israel has developed means for maintaining the stability of its sand-dunes and helps advance research on sand-dune plants and on the microbial soil crusts of such sands and other desert soils' (Eitan, Rafael 1997).

Israel has also developed forestry and forest rehabilitation methods for dry lands. As a result, in 50 years, it increased the forested area from less than 1 percent to nearly 10 percent of its territory. By utilizing methods and practices of run-off harvesting, Israel succeeded in afforestation of regions with 200 mm of rain a year, with trees that normally occur only where rainfall is more than 350 mm. Israel is currently developing afforestation practices for semi-arid and even arid regions, and aims at achieving savannah-like landscapes there. The Israeli afforestation effort is combating soil erosion and thus prevents desertification. At the same time, it promotes the natural dry land biodiversity, and functions as a sink for atmospheric carbon, thus mitigating the greenhouse effect and global warming.While developing large areas of its dry lands as agricultural areas and others as afforestation areas, Israel has also allocated much land for conserving its rich biodiversity. More than 3,000 species of wild plants grow in Israel, and many of these are of economic potential, such as relatives and progenitors of cultivated domestic plants used for reconstructing the eroding genetic basis of many food plants. These important plant species of Israel are protected in about 150 nature reserves, which cover about 15 percent of the size of the State, mostly in its dry lands. These protected areas are of economic significance and play a role in combating desertification, in that they provide ecosystem services for agricultural areas by their contribution to the recharging of aquifers, later used to irrigate dry land agriculture. These nature reserves are also used for recreation and tourist activities, thus providing alternative livelihoods for the inhabitants of the dry lands livelihoods that do not exert pressure on the sensitive soil resources of the dry lands.

Thus, by investing in prevention of desertification rather than in combating already prevailing desertification, by stressing science and technology, but at the same time respecting indigenous knowledge, by adopting the bottom-up approach in training and technology transfer, Israel has done a great deal in combating the issue of desertification in its territory.

Turkey

Turkey has an important location - it is like a bridge between East and West, both culturally and geographically. Turkey is at the crossroads linking Asia, Europe and Africa, with 97 per cent of its total area (779,452 km^2) situated in Asia. With an average elevation of 1,132 m and only 10 per cent of the country less than 250 m above sea level, Turkey is exposed to drought hazard effects rather frequently (Drought Network News, 1996).

The geological structure, topography, climate, wildlife, and plant cover are diverse and the country can be divided into four coastal units (the Black, Marmara, Aegean, and Mediterranean Seas) and three mountainous areas. Nearly 63 per cent of the land has slopes steeper than 15 per cent in average, even in the coastal areas (UNEP, 1992). The climate of Turkey, which is mainly characterized by the Mediterranean macro climate, results from the seasonal alternation of frontal depressions with polar air masses and subtropical high pressures with subsiding maritime tropical and continental tropical air masses. Climate affects erosion by rainfall, temperature and wind. The most important of them is rainfall.

Intensive drought periods occurred in Turkey in 1804, 1876, 1915, 1930s and between 1970 and 1974. Also 1988 and 1989 were the hardest drought years for South-eastern Anatolia Region where the flow of Euphrates River decreased to 50 m^3/sec. Turkey's response to these calamities, were partly driven by Non-Governmental Organizations (NGOs). Two main NGO reactions occurred. The first came through the Turkish Society for Protection of Birds which reacted strongly to the damage of fragile habitats. It has established a visitor centre with the aim of raising awareness of the general public over the water needs of the bird sanctuary, and has been able to induce DSI to provide some additional water to the sanctuary from the canal system in the order of 700 l/sec.

The second major NGO activity has been the establishment of the "Save the Gediz" campaign. This is a public interest group trying to raise awareness over issues of water quality and water shortages. It holds public events and lobbies various departments to deal with the restoration of satisfactory water conditions. It has had strong links with the Gediz Soil Conservation Society.

The eleven (11) Water User Associations in the Gediz basin have, from 1999 onwards, formed themselves into a federation of the Water Users' Associations (WUAs) so that they meet as a body to address issues of water shortages and water allocation between different WUAs served by a common main canal. This represents a significant departure from the original concept of individual WUAs (Svendsen and Murray-Rust, 2000). Other responses from NGO include the formation of Basin-Level Consultative Body, Association for the Protection and Management of Bird Paradise, Basin Level Water Management Body.

Apart from the role of NGOs, an instructive pattern observed in Turkey's, is the involvement of municipalities and governorates in environmental issues. Municipalities and Governorates are individually trying to establish environmental management plans, following their empowerment by the acceptance of the local Administration Act in the parliament. They set up and monitor early warning systems. They worked to ensure the determination and mapping of risky areas, ensuring implementation of action plans as they affected land use, legal status on land etc.

Overall, "Turkey's National Action Programme on Combating Desertification (ANKARA: 2006)" highlights the methods, tools and criteria targeted at preventing desertification and reducing its effects. Moreover, national institutions still have traditional roles to play. For instance, there are still very functional Ministries of Agriculture and Rural Affairs, Environment and Forestry, Energy and Natural Resources. All these are involved on issues of environment. Then, there is a place for the educational institutions. The Universities of Cukurova, Istanbul, Ankara, Ege and Dokuz are all involved in researches for the combat of drought and desertification.

Egypt

Desertification affects roughly a fifth of the world's population, causing nearly $42 billion (LE 224 billion) in lost earnings and produce and in prevention costs each year. Egypt is among the countries worst affected by the phenomenon. According to Egypt's Central Agency for Public Mobilization and Statistics, there are only 533 square meters of agricultural land per capita in Egypt, compared to 2,235,896 square meters per capita in Texas, USA. Egypt has a total area of about one million km^2, under arid and hyper-arid climatic conditions, of which only a small portion (3% of total area) is agriculturally productive of which a sizeable percentage in the North Delta alone have already been lost due to rising groundwater levels, unsound drainage practices and encroaching sand dunes.

The country is endowed with four main agro-ecological zones having specific attributes of resource base, climatic features, terrain and geomorphic characteristics, land use patterns and socio-economic implications. Therefore, it is found appropriate to formulate programmes comprised of subcomponents geared to address the specific attributes in each of the agro-ecological zones distinguished as follow:

1. The **Nile Valley and Delta**: encompassing the fertile alluvial land of Middle and Upper Egypt, the Nile Delta region and the reclaimed desert areas in the fringes of the Nile Valley.
2. **North Coastal zone**: including the coastal area stretching eastward from North-Western coast to North coastal area of Sinai.
3. The **Inland Sinai and the Eastern Desert** with their elevated southern areas.
4. The **Western Desert**: encompassing oases and southern remote areas, including East Uweinat, Tushka and Darb El-Arbian areas.

The Egypt Profile Series of the Johannesburg Summit of 2002 chronicles the key aspects of the Egyptian experience in the fight against desertification:

First, Egypt's efforts to combat desertification is hinged on its organisation around and championed by its Ministry of Agriculture. A National Coordinating Committee (NCC) was established in response to the adoption of United Nations Convention to Combat Desertification (UNCCD) requirements. The NCC is currently headed by the deputy Prime Minister, Ministry of Agriculture and with membership of representatives from relevant Ministries such as Water Resources and Irrigation, Local Development, Planning and Foreign Affairs. Membership also includes representatives from the Parliament, scientific community, private sector and NGOs.

At the centre of its drought control project, Egypt ensured the following policies:

- Increasing the efficiency of using the available water resources;
- Conserving the fertile land resources, reclaiming the degraded land to restore its production and placing more land in the production system; and
- Supporting agricultural research.

Egypt went on to establish The National Action Plan (NAP) for Combating Desertification which was saddled with:

- Identification of stakeholders and increasing awareness; and
- Initiating a system of communication for data exchange between stakeholders and integrate the current projects being implemented with the mainstream objectives and action of the NAP.

Egypt has a strong scientific establishment in the universities and research institutions (such as Agricultural Research Centre). These support the research needs of the agricultural development of Egypt. Three illustrative examples could be given to demonstrate this important contribution:

- Soil testing was adopted as a basis for effective and rational fertilizer recommendations;
- Integrated pest management was introduced to increase yield and minimize pollution;
- Remote sensing was utilized to assess land capability, monitor sand dune movements and determine the extent of urban encroachment on cultivated lands.
- Expansion of the use of drip irrigation and water conservation technologies in new reclaimed lands.

Egypt itself has made gains in restoring degraded agricultural lands by passing laws that ban the use of top soil as raw material for red bricks, restrict the urban development on arable land and regulate irrigation systems. Already, the amount of cultivated land in Egypt has risen from 5 million feddans to 8 million feddans. It is estimated that 11 million feddans will be productive by 2017. On its website, the Ministry of Agriculture and Land Reclamation says the target is to reclaim 150,000 feddans per year.

Science and technology are also being put to work in Egypt to tackle the problem of desertification. In 2004, Egypt set up the National Gene Bank with facilities to preserve and store genetic material from the flora and fauna of the country as a safeguard against the future effects of greater desertification. Investment in people especially by enhancing awareness in women and children living in rural areas has also been recognized as essential.

Another focus of anti-desertification research are ‘wonder plants’ that may provide natural means to keep Egypt’s farmland productive. The Moringa tree holds a lot of hope for those fighting desertification. Sometimes called the ‘Life Tree,’ because of its high vitamin and mineral content, it is native to India, the Arabian Desert and the Mediterranean basin. Researchers have found that 28 grams of its leaves contain as much calcium as four cups of milk, potassium equaling three times that of a banana, and ten times the Vitamin A found in a carrot. It also contains iron and protein, and the oil from the Moringa’s seeds is said to be more beneficial than olive oil. Its value goes above and beyond nutrition, as some African groups use the tree as a traditional medicine to naturally treat impotence in men. Its ground leaves purify the water, while its leaves and pods help to cure anemia, cancer as well as nerve, brain and cardiac diseases. The Moringa Tree is already being used in other arid parts of Africa to fight malnutrition, since it is able to survive harsh conditions on only 100 - 300 millimeters of water per day (Egypt’s Desert Research Center, 2006)

LESSONS OF EXPERIENCE FOR NIGERIA

Drought is certainly not new in Nigeria. Annual tree planting has been the hallmark of the northern states since the seventies. The same could be said of dam construction and establishment of river basin authorities. One objective was common to all of these projects/activities: water management to ensure conducive soil environment essential for food production. But the continued advancement of the Sahara desert does not suggest these efforts achieved the desired result. There continues to be mass movement of nomads and herds down south in search of the proverbial greener pasture. Also, there appears to be a dwindling fortune to farmers’ efforts as crop yields continue to be on the decline. The overall analysis of the presented information and data leads to the following lessons learnt and applicable to the Nigerian situation

i. The formulation of several legislations pertinent to combating desertification, mechanisms for enforcement need to be established.

ii. In all the countries studied, national actions to combat desertification form a major component of national actions to ensure sustainable development of land resources. Such actions aim at : (a) Preventive measures that sustain land productivity,(b) Remediation of degraded lands and rehabilitation of desertified (lost) lands,(c) Development of new lands through programmes of reclaiming desert territories and provision of new water resources, and programmes of non-agricultural use of land.

CONCLUSIONS

African nations are among the worst hurt by desertification and the loss of arable lands. It would be meaningful to formulate action programmes which comprise sub-components dealing with the specific attributes of various agro-ecological zones. The programmes would involve participatory approach of concerned stakeholders in the various phases of planning, formulation of actions, implementation and follow up, thus maintaining and securing the sustainability of actions to combat desertification.Importantly, the required contributions and roles of concerned governmental institutions, local authorities, NGOs, women youth and other stakeholders as identified should be coordinated and planned with particular emphasis on enhancing the participatory role of all based on identified priorities.

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SUSTAINABILITY OF URBAN AGRICULTURE IN IBADAN, NIGERIA: GENDER ANALYSIS OF LIVELIHOODS

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Abstract

This study was conducted in Ibadan, the largest city in Nigeria. Primary data on activities of vegetable producers were collected using cluster sampling technique. Thirty seven male and sixty three female were selected proportionate to size; from three production clusters. Descriptive statistics, gross margin analysis and Ordinary Least Square (OLS) regression model were used to analyze the data. The urban vegetable producers are young and economically active. The mean years of schooling is 9 for male producers and 7 for female producers which shows that majority of the farmers are not highly educated. Irrigated vegetable production is the main livelihood activity of the female farmers while it is a supplementary activity for the men. Gender does not discriminate access to land, credit, extension services and method of irrigation. Female managed farm profit was higher than for male managed farm. Access to credit, membership of farmers' association and farm size has positive and significant influence on the income from UA. Also, returns to female-managed farms are higher than to male-managed farms. Improved access to credit, extension services and land is recommended for all farmers irrespective of gender to improve productivity and income.

INTRODUCTION

Nigeria is the largest country in Africa, and the largest concentration of black people in the world — with a land area of close to 1 million square kilometers, and a population of well over 125 million. (Nwaka, 2005). The rate of urban population growth is thought to be 5.5% annually, roughly twice the national population growth rate of 2.9%. Thus providing food for this growing population has been a priority of the government. Kushwaha et al (2007), found that more vegetables are consumed in the urban areas than in the rural areas of Nigeria. Thus, urban agriculture contributes to enhancing food security and healthy nutrition of both the urban producers and other categories of the urban population. The growth of urban agriculture is now considered a vital element in urban food security.

Production practices in urban agriculture include: home gardening, cultivation of undeveloped plots, available spaces by the roadside and use of government lands. Some of these year-round home gardens serve as nurseries for rain-fed off-plot fields. A field may have vegetables in the dry season and grain crops in the rainy season. This allows for the use of space in a complementary way. (Tinker1998). Adeniyi (1999) stated that Urban Agriculture practice in Nigeria includes growing of food crops and rearing of livestock and fish for food. However, farmers still use traditional implements such as hoes, cutlasses, spades, bush knives, rakes and axes (Gbadegesin, 1991). Only an insignificant proportion of urban farmers use modern implements.

There has been an increased interest in the study of urban agriculture (UA) (Adeoti and Egwudike, 2003; Omonona et.al., 2007). However, none of these studies gave due attention to its gender dimension. An exception is Anosike and Fasona, 2004. They stated that in Nigeria, the dominance of either male or female cannot be generalized; it depends on location and the type of UA enterprise. For example, in Lagos, urban agriculture is dominated by men while in Ibadan there is a mix of both gender.

They also found out that women do not have a say in decision making. Most women depend on the assistance of hired labour and family members (children), which makes the production expensive and unprofitable (same for men), and in addition affects the quantity of time the children can spend at school. Limited access to resources (land, funds, irrigation, and machinery) puts an extra burden on the women farmers, which in combination with direct and indirect pollution, theft and insecurity, makes farming a tedious and difficult task to venture into for women. With few exceptions, the volume of the production output is also higher among men than women. Gender disparities in urban agriculture in Lagos are such that more women hold relatively small, less fertile land that is less conducive for efficient farming practices. In Lagos, a caretaker usually allocates about two plots of land to four to six farmers, especially among the migrant farmers, for a rent of between three hundred(3US$) and one thousand(9US$) Naira per month, depending on the size of the land. Many women are unable to cope with such payments, due to their poor production output and sales, and they have no proper access to the better land.

METHODOLOGY

The study was conducted in Ibadan, the largest city in Nigeria and sub- Sahara Africa. It has a total land area of 3,123 km^2 consisting of 11 Local Government Areas (LGAs). These include the banks of streams as well as isolated wetland areas that dot the city, which is enclosed by valleys and swamps. Family land and leasehold accounts for the dominant part of land tenure systems of urban vegetable production. Farm sizes, as well as, the number of farm holdings by individual farmers are a factor of land tenure. Farm sizes average below one hectare (RUAF, 2007). Although the city has a high potential for urban agriculture, especially crop production with “Ogunpa” stream running through the city, a larger proportion of the land is not used at all for either agriculture or for any form of land use (RUAF, 2007). Vegetables produced in Ibadan include Chinese spinach, okra, aubergine, cucumber, tomatoes, pepper, etc. These vegetables are produced in commercial quantity for sale in several local markets operating on a daily basis in the city.

Primary data were collected with the aid of a comprehensive questionnaire. Data on socioeconomic and demographic characteristics, household assets utilization, production activities, labour, capital, physical inputs and output were obtained. A cluster sampling technique was adopted for selecting the required sample of urban vegetable producers. This involves the selection of three Local Government Areas (LGAs) in the metropolis with the dominance of different gender in the urban farming activities namely: Lagelu and Ibadan Northwest and Egbeda LGAs. Odogbo and Mokola barracks were selected for Lagelu and Ibadan Northwest LGAs respectively. All the urban farmers in Odogbo barrack are female while all are male in Mokola barrack. In Egbeda LG, a mix, proportionate to size of male and female farmers growing vegetables were also interviewed. A total of one hundred (100) producers were selected from the three clusters made up of thirty seven male and sixty three female. The data were analyzed using descriptive statistics, gross margin analysis and Ordinary Least Square (OLS) regression model. The income made from urban agriculture is hypothesized to be influenced by factors such as the household socio-economic characteristics and asset endowment, farm characteristics and institutional factors.

The OLS regression is given as:

$$LnY_i = ß_0 + ß_1X_1 + ß_2X_2 + \ldots + ß_iX_i + \varepsilon_i$$

Y_i = farm gross margin from UA vegetable production of the ith farm

X_i = farmer’s age in years, marital status, gender, household size, access to credit, membership of farmers’ association, farm size in hectares of the ith farm.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Producers

The mean age for male producers is 31years while it is 40 years for female farmers. This shows that a larger proportion of urban vegetable producers are young and economically active. The mean years of schooling is 9 for male producers and 7 for female producers. Only one of the male producers spent over 12 years in school. The result shows that majority of the farmers are not highly educated. There is a large difference between the marital status of male and female producers. About 76% of male producers are single while only 6% of the female producers are single. This result reveals that UA producers are mostly unmarried men and married women. A larger percentage of female producers have household sizes within 5 and 8 while those of male producers are less. The mean years of experience for male producers is 7years and for female is 5years. The result shows that men engaged in urban farming earlier than women, in spite of men's relatively younger age.

Almost all the male producers and half of the female producers do not belong to the farmers' cooperative society. A probable reason for this is that all the male producers are young men, with 65 % being students and they practice UA as a secondary livelihood activity. Therefore, they do not get involved in activities outside their direct production while more female give attention to producers' cooperative society so as to enhance their production.

HOUSEHOLD LIVELIHOOD ACTIVITIES

The livelihood activities engaged in by the various farm households reveals that majority of the producers cultivate during both rainy and dry seasons. They represent 91.9 percent and 76.2 percent of male and female producers respectively. While none of the female urban producers is a student, about 64.9 percent of the male farmers are students. This group of student-producers are found in only one location (Mokola barrack); and they support their educational pursuit with urban farming. The result shows that UA is undertaken as a primary or secondary livelihood activity by people but they still have other sources of livelihood.

As shown in Table 1, there is accessibility to land by both gender and the same tenure pattern is common to all. The highest percentage of female farmers borrowed their land while male farmers encroach on land. The use of buckets for irrigation is common among men and women representing 89.2% and 95.2% respectively. Others use watering cans. None of the farmers use modern water lifting devices like motorized pumps.

Table 1: Land Tenure Patterns of Producers

Land Tenure	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Purchase	10	27.1	11	17.5
Rented	6	16.2	12	19.0
Encroachment	17	45.9	11	17.5
Borrowed	4	10.8	29	46.0
Total	37	100	63	100

Access to Credit and Extension Visits

Private savings is the major source of capital for both male and female managed farms. This is followed by friends and relatives and lastly by Esusu/ROSCAS. None of the producers obtained credit from formal sources. None of the farmers claim to have been visited by extension agents. This shows that urban vegetable production is yet to be recognized as an important contributor to household economy by agricultural workers as they do for rainfed agriculture.

Household and Farm Assets endowment and control by UA producers

Household assets that can be used for UA include those on land, telephone, rain tank, bicycle and car; however, only telephones and rain tanks are used. Essentially, these assets are used to access information, water storage and processing. Overall, the level of household acquisition by male producers is lower than for their female counterparts. Also, while the number of those who use household assets for UA are few, male producers fare worse. This reflects a lower level of household asset acquisition among male producers. This mirrors the fact that most of the male producers are young and are students with limited household assets.

Decision taking with respect to these assets differs between gender. All the male farmers have full control over their farm land and assets. About 64% and 67% of the female farm managers have full control over their farmland and rain tanks respectively. Spouses of female farmers are found to have greater control over car. Joint decisions are also common in such households. The indicates that female managers have less bargaining power and are less active in decision making than male managers.

The basic implements used for cultivation are hoes, cutlasses, buckets and rake. These are owned by a larger proportion of farmers irrespective of their gender. Only two farmers representing 5.4% of male managed farms own sprayers. Generally, urban farmers do not own capital intensive implements and this limits the scale of their operation and prospect for commercialization.

CROPPING PATTERN AMONG UA PRODUCERS

The cropping pattern is such that female producers plant a wider variety of crops than men. Major crops cultivated by female farmers are Amaranthus sps., Celosia, Chorchorus, pumpkin, garden egg and okra. Male producers plant Amaranthus, Celosia, Chorchorus, and maize. The average size of male-managed farms is 0.56 ha while that of female-managed farm is 0.62ha but not significantly different.

Table 2 shows that the level of resource-use per hectare of female-managed farms is higher than those of male-managed farms. This reflects that the level of investment made by female producers is higher than that of male producers. This is likely so since it is their main activity. However, there is no significant difference in standard labour days used on both farms.

Table 2: Mean Values of Resource-Use Levels Per Hectare of UA Producers

Resources	Male managed	Female managed	Level of significance
Seeds(Kg)			
Corchorus	14.2	24.7	0.9(0.40)
Celosia	1.1	7.4	3.1(0.01)
Amaranthus	3.9	19.3	3.5(0.01)
Chemicals(l)	1.5	10.6	3.5(0.01)
Fertilizer(kg)	49.6	112.6	1.9(0.06)
Labor(std)	66.7	75.0	0.6(0.54)

The gross margin analysis shows incomes from female-managed farms are higher than from male-managed farms. The difference on per farm basis is 25.4% while it is 17.4% on per hectare basis. The difference on per hectare basis is significant at 1% (t= 6.693).About 29%

difference in gross margin is reported for UA in Accra with female managed farms having higher gross margin(IWMI,2008).It shows that female managed farms have higher profit.

Table 3: Cost and revenue of UA producers in US $

Unit of analysis	Male Managed Farm			Female Managed Farm		
	Variable Cost	Revenue	Gross Margin	Variable Cost	Revenue	Gross margin
Per farm	55.2	540.7	485.6	90.4	741.3	650.9
Per hectare	98.6	965.5	867.1	145.8	1195.6	1049.8

CONTRIBUTION OF UA INCOME TO HOUSEHOLD INCOME

The diagnostic statistics of the result of the OLS model shows that the model has a good fit. The result indicates that returns to female-managed farms are higher than to male-managed farms. Access to credit, membership of farmers' association and farm size have positive influence on gross margin from UA. Thus, policies that would enhance access to credit and membership of farmers' association will boost UA output. Also, farm size expansion results in increased output. This indicates that if land constrained UA producers have access to more land, they will increase their output. However, size expansion with improved technology will be more productive.

Table 4: Determinants of Income from Urban Agriculture

Variables	Coefficient	T statistics	Level of significance
Constant	0.01***	2.92	0.00
Age	-0.07***	-4.78	0.63
Marital status	-0.07	-0.33	0.74
Gender	-0.39**	-2.27	0.03
Household size	-0.06	-0.50	0.62
Years of formal educ. of manager	-0.16	-0.14	0.90
Access to credit	0.24**	2.25	0.03
Mem. of Assoc.	1.96*	1.75	0.08
Farm size	0.41***	4.23	0.00

Dependent variable: Gross Margin; R^2 = 0.75; F= 3.79***

CONCLUSION

Vegetable production is a means of livelihood which has engaged young and economically active men and women although there are more women involved. Although, female managed farms have higher profits, the results show greater control of assets by men. Sustainability of this livelihood activity calls for improved access to credit and membership of farmers association for all. Females who have less years of schooling and less involved in decision making should be targeted; so they can benefit from Government interventions. Extension programmes should be extended to urban farmers as none of them has access to extension services. A land policy reform that makes land available to willing farmers around the major streams will improve UA livelihood and vegetable production in particular.

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PROSPECTS OF TECHNOLOGY UTILIZATION AMONG DRY SEASON VEGETABLE PRODUCERS IN OSOGBO METROPOLIS OF OSUN STATE, NIGERIA

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Abstract

The study sought to verify this assertion with respect to dry-season vegetable production in Osogbo Metropolis of Osun State, Nigeria. Data analysis was based on 132 producers randomly sampled from 8 production sites with the town. This reveals that majorly (68.2%) were low adopters. The average technologies adopted was 5 with an adoptions performance score of 40%. The income of the farmers was ₦ 47,000 per annual with a standard deviation of ₦13.400. The inferential statistics analysis (Z test) reveals that high technology adopters recorded significant higher output ($Z=3.68$, $P < 0.05$) and more farm income ($Z = 3.37$, $P < 0.05$) than low adopters. Significant relationship were found between gender, age, marital status, source of farm labour, educational level, farm size, income and utilization of improved technologies by dry season vegetable producers. This study therefore recommends better extension attention to these categories of producers to enhance their performance.

INTRODUCTION

In Nigeria, leaf vegetables are customarily regarded as a condiment essentially used in order to improve the eye appeal and flavor of foods and are consumed in such small amounts for any nutritional impact. The rate of vegetable production varies from state to state, due to some influences of vegetable consumption pattern. These include distribution facilities, buying power (market), religious beliefs, social customs and knowledge of nutrition.(Dento et al 1998).The significant importance of vegetables lies in the role they play in raising the nutritional level by adding proteins, vitamins, fat and minerals to that mainly starchy diet of the people. They are also a provider of employment of labour and food for the teeming population, a source of foreign exchange and generator of income for farmers.

In urban areas the village pattern of life is replaced by a more sophisticated way of life, and many member of the community could not produce their own vegetables because of lack of suitable land for cultivation. In this case, the urban dwellers depend on the supplies from the market garden and from neigbouring communities. According to Oladoja et al (2006) market gardens around cities such as Jos, kano, Kaduna, Zaria, Sokoto , Enugu and Lagos produce large quantities of vegetables of different types all the year. These are commercial centres of vegetable production from where they are distributed to other areas of the country. The production level of the crop has been less than satisfactory.

This observation calls for urgent steps to be taken to boost vegetable productivity. One of such efforts is geared towards developing high yielding disease resistance varieties to satisfy domestic demand of vegetable (House et aI, 1997). Apart from its potential in facilitating production increases, adoption of improved technologies also has implication in enhancing farmers' income and alleviating poverty since the crop is mainly produced by resource poor farmers.Dento et al(1998)

Questions of interest in this study, which also constitute the study objectives, are to ascertain:

1. the extent to which farmers have embraced vegetable related technologies.
2. determine the output and economic benefits of dry-season vegetable production in the study area
3. determine the effect of technology adoption on producers farm performance with respect to output and economic returns.

Hypotheses of the study

Two null hypotheses were evaluated in the study. These are:

1. There is no significant difference in output of low and high adopters of selected vegetable recommended practices.
2. There is no significant difference in economic returns of low and high -adopters of selected vegetable recommended practices.

METHODOLOGY

The study was conducted in Osogbo the Osun State Capital located in the southwestern Nigeria. The scope of the study covers all categories of dry season vegetable producers in and around the metropolis. A total of eight (8) locations where dry season vegetables has been produced for the past 5 years were identified for the survey; and all the growers in the various locations between the month of January and April 2009 were involved in the study. In all, information was elicited from a total of 132 respondents through the use of validated and pretested structured interview schedule.

Descriptive statistics such as frequency count, percentage, mean and standard deviation were used while z-test was used to test the hypotheses set for the study.

Model description (z-test)

This test compares the significance of the difference of two independent large sample (n >30) means (Aluede, 1997). The formula is given as:

Where:

x_1 = mean of sample 1

x_2 = mean of sample 2

$\sigma \overline{x_1} - \overline{x_2}$ = Is an estimate of the standard error of the difference for independent samples computed using the formula:

$$\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}$$

N_I, N_2 = sample size for samples 1 and 2 respectively

(J" 2 :: variance which is computed using the formula:

L X\2 - (L: XJ2 / *N*

N -1

Decision Rule*:* Decision to accept or reject the null hypothesis was done at the 5% level and based on the values of computed Z (zeal) and critical Z (zen)' Thus:

Accept H_o (reject H_1): zeal < Zen Accept H_1 (reject H_o): zeal> Zen

Measurement of variables

<u>Adoption</u>: Respondents were required to tick 'Yes' or 'No' against the listed or identified technologies associated with vegetable production that have been disseminated in the study area .

<u>Adoption categories</u>: The average adoption score was used in dichotomizing the respondents into 2 groups: those whose adoption score fall below the average were categorized as low adopters and if otherwise, high adopters. The adoption score of a respondent measures the number of recommended practices he/she has adopted. The average adoption score was computed by dividing total number of technologies adopted by sample size of respondents.

<u>Adoption performance</u>: The adoption performance is a proportion (percentage), measured by computing or dividing the average adoption score by the total identified technologies. <u>Income</u>: Total money realized from sales of different types of vegetable produced.

<u>Returns (profit)</u>: Net farm income i.e. total sales less expenditure.

<u>Output</u>: output was measured in kilogrammes. Local measures were converted to kilogramme.

RESULTS AND DISCUSSION

Data in Table 1 revealed that 59.1 percent of their respondents were female while 40.9 percent were male. This indicates that there are more female in the business in the study area than male. The mean age was 32.years. Many of the respondents are above thirty years while 28.8 percent are between 21 – 30 years and 23.5 percent are below 20 years of age.

Majority (65.6%) are married while 24.8 percent are single. Many (50.6%) had primary education while 21.2 percent had post secondary education. Majority of the respondents in this category are National Directorate of Employment (N.D.E.) participants found in Omu/Kelebe site. As for the source of labour, majority (64.4%) claimed that they use both hired and family labour. Only 8.3 percent use hired labour alone while 27.3 percent use family labour only. Majority (77.3%) of the respondents used less than 1 hectare for their production activities while 20.5 percent use 1 – 2 hectares and 2.3 percent use more than 2 hectares.

On their experience in commercial vegetable production, 65.9 percent had more than 5 years of experience while 25.8 percent had less than five years only 8.3 percent had more than 10 years of experience in vegetable production. On the visit by extension agent, majority (80.3%) claimed that they have not seen the extension agent for the state ADP for the past one year while 15.9 percent claimed that see them once in a month during the production season while only 8 percent had seen them weekly. Dealers/input suppliers are the major source of information on seeds and other input accounting for 74.2 percent other sources are Government centres, open market and Farmers Organizations.

Table 2 shows the list of vegetables that are commonly grown in the study area. All the respondents produce *Corchorus olitorus* (Ewedu) and *Amarathus spp* (*A. hybridus and A. viridus*). About 90.9 percent grow tomatoes while 81.1 percent produce okra. Other crops produced are *Celosia orgenita* (Soko), lettuce, *Telferia occidentalis*, cucumber, melon, water melon and garden egg.

Table 1: Distribution of respondents by socio-economic characteristics

Distribution of respondents	*Frequency*	*Percentage*
Gender		
Male	**54**	**40.9**
Female	78	59.1
Total	132	100.0
Age (years)		
Less than 20	31	23.5
21 – 30	38	28.8
31 and above	63	47.7
Total		
Marital status		
Single	46	34.8
Married	86	65.2
Total		
Educational level		
Primary	67	50.6
Secondary	16	12.1
Post Secondary	28	21.2
No formal Education	21	15.9
Total		
Source of labour		
Family labour	36	27.3
Hired labour	11	8.3
Both	85	64.4
Total		
Frequency of visitation by extension agents		
Weekly	0	8
Forthnightly	5	3.8
Monthly	21	15.9
No visit	106	80.3
Total		
Land area (Hectare)		
Below 1	102	77.3
1 - 2	27	20.5
2.1 – 3.0	3	2.3
Sources of information/seed		
Government Service Centres	44	33.3
Farmers Organization Office	27	20.5
Open market	54	40.9
Dealer/Input suppliers	98	74.2
Total		
Experience in Vegetable Production		
Less the 5yrs	34	25.8
5-10yrs	87	65.9
Above 10yrs	11	8.3
Multiple sources used		

Source: Field survey, 2009.

Table 2: Distribution of respondents based on types of vegetable grown

Crops	Frequency	Percentage
Vegetables (leafy vegetables)		
Corchorus olitorus (Ewedu)	132	100
Celosia orgenita (Soko)	64	48.5
Amarathus spp (Tete)	132	100
Lectuce	27	20.5
Telferia occidentalis (Ugwu)	58	43.9
Fruit vegetables		
Tomatoes	120	90.9
Pepper	84	63.6
Water melon	43	32.6
Melon	24	18.2
Okra	107	81.1
Garden egg	82	62.1
Others	52	39.4

Multiple responses provided.

Source: Field survey 2009

Table 3 shows the available technologies associated with commercial vegetable production and far5ers level of adoption. Seven of the 10 identified practices were highly adopted. These were proper weeding using chemical (85.6%), improved method of land preparation (96.2%), thinning (65.9%), use of inorganic fertilizer (100%), use of insecticides (44.2%), use of watering can to wet the vegetable (62.1%) and use of appropriate pest control chemical (69.7%). The technologies that are properly adopted are use of organic manure (9.1%), use of irrigation facilities to supply water, sourcing for improved seeds for planting, use of recommended fungicides and others. This indicates that the adoption of the recommended technologies is still very low in the study area. Studies by Oladoje *et al* (2006) asserted the use of improved technologies for vegetable production is very essential if substantial profit is to be made.

Table 3: Adoption of improved technologies by producers

	Frequency	Percentage
a. Use of chemical for weed control	113	85.6
b. Improve method land preparation	127	96.2
c. Uses recommended spacing	64	48.5
d. Thinning	87	65.9
e. Use of inorganic fertilizers	132	100
f. Crop rotation	67	50.8
g. Use of Irrigation pump supply water	37	28
h. Improved seed varieties	98	28
i. Use of recommended insecticides	28	74.2
j. Use of recommended fungicides	12	21.2
k. Use of watering cane to supply water	82	9.1
l. Use of organic manure	47	62.1
m. Use of appropriately chemical for seed dressing	56	42.4
n. Drilling of leaf vegetable seed	44	33.3
o. Approximately of pests control	92	69.7

Multiple responses were given source

Source: Field survey. 2009

The adoption of selected vegetable related technologies by farmers ranged from a minimum of 2 to a maximum of 12 with the mean adoption being 7. Their adoption performance score was thus 40%, which is less than average. This result shows that there is need for farmers' adoption of the recommended practices to be improved upon. Based on the average adoption score which was 4, respondents were classified as low or high adopters.

The result reveals that most vegetable producers in the study area were low adopters (68.2%) with only 31.8%. This finding further confirms the low technological status of the respondents. The agricultural performance of the respondents vis-à-vis farm output and net income agricultural performance of the respondents vis - a - vis farm output and net income earnings.

The average output was 887.99kg with a minimum and maximum of 260kg and 5000kg respectively. When total production expenses (₦16.241. 72) is subtracted from the income (₦71.039.39) an average net profit of ₦54.797.67 per annum was obtained, which translates to about ₦4,577.5 per month. Although. The result indicates that respondents realized profit from growing vegetable. Their small profit margins per month suggest they have other revenue sources. The annual net profit ranged from ₦8,675 to ₦304,375. The test of mean difference for two (2) levels. Computed z value was 3.63. This samples (z test analysis) was employed result is in agreement with Ajani et al (2001) to test the hypotheses of the study i.e. observation of the positive to determine the impact of technology adoption and utilization on farmers' productivity. The performance measured as output and the hypothesis was therefore rejected. The average output which means there is a significant of low and high adopters was 619.7kg difference in output of vegetable and 1,487kg respectively. The difference between low and high adopters of (about 867kg) was significant at the 5% improved technologies.

Table 4: Output and returns of producers (per annum)

Items	Minimum	Maximum	Sum	Mean	Std. Deviation
Output (kg)	260.00	5000.00	117215.00	887.99	976.73
Total cost	3125.00	95625.00	2143907.50	16241.72	20331.66
Income	20800.00	400000.00	9377200.00	71039.39	78138.08
Front	8675.00	304375.00	7233292.50	54797.67	58954.57

Source: Field survey. 2009

A similar finding was obtained for net farm returns. The value for high adopters (₦88,457.5) was significantly different from that of low adopters (₦39.825.1) at the 5% level. Computed z value was 3.37. This result is consistent with the assertion of Mortimore, *et al* (2000) and Ajani and Olayemi (2001) regarding the positive contribution of technology utilization to improved farm earnings. The result of the study also corroborates the finding of Anyanwu et al (2001) in which technology adoption, facilitated through contact with agricultural extension workers. contributes positively to economic returns of farmers. The null hypothesis is therefore rejected in favour of the alternative hypothesis which states that a significant difference exists in returns of low and high adopters of improved technologies. To ascertain if the difference in their performance was not due to differences in production scale (farm holdings) the difference in their holdings was subjected to z test analysis. The results show that the difference in production unit between low (63ah) and high adopters (52arc) was not significant. The computed z statistic (0.89) is less than the critical z (1.64). Thus we conclude that the difference in their agricultural performance was not influenced by their scale of vegetable production.

Table 5: Difference in agricultural performance of low and high adopters (z test)

		Mean		
Performance variables	Low adopter (n=90)	High adopters (n=42)	mean difference	Computed z value
Output 9kg)	619.74	1487.13	-867.39	3.63*
Return -s (profit in naira	39825.1123	88457.5	-48632.387	3.37*
Farm size (ha)	1.63	1.51	0.12	0.89

Source: Field survey, 2009

The result in table 6 reveal the relationship between socio-economic characteristics of respondent and their utilization of improve technologies in vegetable production. From the table, gender, age, marital status, Farm size, Income, had significant influence on vegetable grower's use of improved technologies utilized in vegetable production especially during the dry season.

Table 6: Relationship between respondents' socio-economic characteristics and utilization of improved technologies

Variables	X^2_{cal}	Df	X^2_{tab}	Decision
Age	125.19	76	97.34	S
Gender	57.19	4	9.49	S
Source of labour	56.57	8	15.51	S
Education level	59.30	8	15.51	S
Marital Status	54.20	4	9.49	S
Family size	72.19	26	38.89	S
Income	100.11	60	79.08	S
Farm size	63.36	28	41.34	S
Information sources				

Source: Computed from field survey 2009.

CONCLUSION AND RECOMMENDATIONS

From the above findings, it could be concluded that dry season vegetable production is a viable business and has a lot of potentials in empowering the producers economically. Although the level of technology utilization by the producer is still very low; Therefore, it is essential that effort be made to persuade farmers to incorporate recommended farm practices into their farming system.

The study therefore recommends an intensification of extension workers visit to farmers to facilitate their acceptance of these technologies.

In addition, extension personnel shou1d focus on those technologies that were poorly embraced by farmers such as improved varieties, insecticide/fungicides and irrigation family should be made to realize that the potential prospect of techno1ogy utilization is attainable only when they embrace the recommended practices as a package.

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URBAN AGRICULTURE AS A DRIVER OF LANDUSE/LANDCOVER CHANGE IN THE LOWER OGUN RIVER BASIN, NIGERIA

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Abstract

This study investigated the growth of urban agriculture in the urban periphery of Lagos between 1984 and 2007 and its implication on the environment using the geospatial analysis techniques. Two sets of topographical map obtained from the Federal Survey, a Land Sat TM image of 1984 and a SPOT image of 2007 were used for the study. These topographical maps and satellite images were digitally processed using ILWIS 3.2 software and exported to ArcGis 9.2 for further processing and analysis. The processed images were subsequently classified using the maximum likelihood classification algorithm, resulting in the identification of seven land use classes, which are, farmland, forested wetland, light forest, non-forested wetland, shrub, urban and water body. Furthermore, change detection analysis was carried out using the cross module of the ILWIS software. Five composite soil samples each to the depth 0-20 cm were randomly collected and analyzed for their physicochemical properties using standard methods to determine the impact of urban agriculture on soil quality in the selected forested and non-forested wetlands. The result of the change detection analysis indicated that between 1984 and 2007, 60.90% of the land cover in the area had been converted to other land uses while 39.10% remained unchanged. Also, light forest, water body and forested wetland are decreasing at the average rates of 2.39, 1.88 and 0.32% per annum respectively. On the other hand, farmland, shrub, non-forested wetland and urban/built up are expanding at the rates of 6.31, 4.94, 0.29 and 0.26% respectively. The study concluded that to ensure sustainable urban agricultural practices that will protect soil ecosystem against soil degradation, proper monitoring of urban soils is desirable to help mitigate its adverse consequences on soil quality.

INTRODUCTION

Urban agriculture is a cultural phenomenon that is fast becoming a permanent feature of modern cities the world over, even though in the past it has been viewed erroneously as incompatible with urban development. However, research on the subject suggests that urban agriculture must be understood as a permanent and dynamic part of the urban socio-economic and ecological systems using typical urban resources, competing for land and water with other urban functions, influenced by urban policies and plans, and contributing to urban social and economic development. Adewole and Uchegbu (2010) concluded that the most important distinguishing character of urban agriculture is not so much its location, but the fact that it is an integral part of the urban economic, social and ecological system. Indeed, urban agriculture can contribute substantially to the millennium development goals, particularly in reducing urban poverty and hunger and ensuring environmental sustainability.

Little is known about the spatial distribution of urban agriculture in the cities. Although Geographic Information System (GIS) have been widely used for urban planning purposes for decades (Mengistu and Salami, 2007) but open spaces management was hardly ever included. GIS is an ideal tool to visualize the spatial distribution of urban agriculture in the cities, as well as changes in the space it occupies. With the integration of aerial photograph and satellite imagery from different years, land use changes can be documented and analyzed.

The lower Ogun river basin, because of its proximity to the urban periphery of Lagos is presently experiencing increasing urbanization rate. Increasing population pressure, increasing and urgent demand for food, high cost of land and urban agricultural activities are having serious environmental impacts on the basin (Omonona and Ologbon, 2007). The consequence of this has been land degradation, flooding and threatened food security. The study seeks to investigate the impacts of land use change through urban agriculture on the lower Ogun river basin using GIS technology.

Study Area

The study area is the Lower Ogun River Basin Wetlands and located partly in Ifo South Local Government Area of Ogun State and Kosofe Local Government area of Lagos State, Nigeria and lies between latitude 06º 35´ and 06° 45´N and longitude 003°17´ and 003°25´E. It is approximately 161.4 km^2. The study area is located within the sub-equatorial zone, which is characterized by rainfall throughout the year with two maxima (May to July and September to October). The highest air temperature occurs in April/May and the lowest occurs in December through February. The study area lies within the rainforest belt (dry lowland rainforest).

The vegetation of the region is that of coastal swamp and marsh forest, part of which had given way to the construction of houses, markets and other infrastructures. The river channels are characterized by vegetation of the wet southern segment of the rainforest belt. Generally, the relief of the area may be described as belonging to the belt of coastal plains with thick limestone layers at its base (Bolaji, 2006). The land rises from the sandy beaches along the Atlantic Ocean to a belt of fresh water swamps with an intricate network of lagoons and creeks. The coastal belt is about 10 km wide and is generally less than 20 m in height.

MATERIALS AND METHOD

Data sources

The main data used for this research included a Landsat TM satellite image of December 1984 and SPOT image of 2007. Two sets of topographical maps on a scale of 1:50000, Lagos NE sheet 279 and Lagos SE sheets 279, published in 1964 were obtained from the Federal Survey, Lagos and used as base map for ground-truth information required for classification and accuracy estimation of the classified TM and SPOT images. The ground- truth information required for the classification and accuracy assessment of the Landsat images was collected through a field survey which was carried out between October 2009 and February 2010.

Digital Image Processing

Pre-processing operations in form of linear contrast stretch and spatial filtering were performed on the Landsat images which were also geo-rectified to Universal Transverse Mercator coordinate system. Subsets of the satellite images and topographical maps were geo-referenced using georeferenced tie points and affine transformation method. The supervised Maximum Likelihood Classification method was used for all the images. Training areas corresponding to each classification item (land use class) were chosen from among the training samples collected from the field and the topographical map of the study area. Thereafter, seven land use/landcover classes were identified on the two images for change detection analysis, which include: urban, light forest, forested wetland, non-forested wetland, farmland, and shrub and water body.

Soil Sampling and Analysis

Two study sites were selected on the classified images for soil quality analysis. That is, forested wetland which was relatively less disturbed and non-forested wetland which was under cultivation. Five composite soil samples, replicated thrice, each to the depth 0-20 cm to give a total of 30 soil samples were randomly collected using soil auger and analyzed for their physicochemical properties to determine the impact of urban agriculture on soil quality in the selected forested and non-forested wetlands. The coordinate of each soil samples were also taken using GPS.

The soil samples were air-dried for seven days, crushed and sieved through 2 mm sieve. The hydrometer method as proposed by (Bouyoucos, 1951) was used for particle size analysis. Soil pH was determined potentiomatrically in H_2O at a ratio of 1:1 (soil to water) (Mclean, 1982).The Kjeldahl method was used to determine Total nitrogen (Bremner and Mulvaney, 1982). The determination of soil organic carbon was based on the Walkley-Black chromic acid wet oxidation method (Nelson and Sommers, 1982). While available phosphorus was determined using Bray P1 method (Olsen and Sommers, 1982). Exchangeable cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+) were determined using 1 M NH_4OAc (Ammonium acetate) buffered at pH 7.0 as extractant (Thomas, 1982). The K^+ and Na^+ concentrations in soil extracts were read on Gallenkamp Flame photometer while Ca^{2+} and Mg^{2+} concentrations in soil extracts were read using Perkin-Elmer Model 403 atomic absorption spectrophotometer. Descriptive statistics was used to detect the changes that have taken place in the study area from 1984 to 2000. Test of significance for differences in means of soil physico-chemical properties under forested and non-forested wetland was done using Least Square Difference (LSD) method.

RESULTS AND DISCUSSION

Changes in landuse/landcover in 1984 and 2007

Table 1 showed the entire study area covering 161.4 km^2. In 1984, light forest constituted the most extensive landuse/landcover occupying 53.5 km^2 (33.2%) and urban or built up area was 26.9 km^2 (16.7%). The non-forested wetland, forested wetland, shrub, water body and farmland occupied {km^2, (%)} 23.8 (14.5), 21.7 (13.5), 17.2 (10.7), 11.8 (7.3) and 6.5 (4.0) respectively of the study area.

However, by 2007 shrub expanded quite rapidly, increasing to 36.8 km^2 (22.80%) of the study area. Meanwhile, farmland, non-forested wetland and built-up areas increased to {km^2, (%)} 16.0 (9.91) 25.5 (15.78) and 28.5 (17.64) respectively. During the same period, light forest, forested wetland and water body decreased to {km^2, (%)} 23.7 (14.68), 20.2 (12.49) and 10.8 (6.69) respectively.

Table 1: Extent and Rate of Change in Land use/Land Cover from 1984 to 2007

Land use/Land cover Classes	1984		2007		Change from 1984 to 2007		Rate of Change	
	km^2	%	km^2	%	km^2	%	km^2	%
Farmland	6.5	4.0	16.0	9.91	+9.5	+146.4	+0.41	+6.31
Forested Wetland	21.7	13.5	20.2	12.49	-1.5	-7.1	-0.07	-0.32
Light Forest	53.5	33.2	23.7	14.68	-29.5	-55.1	-1.28	-2.39
Non Forested Wetland	23.8	14.5	25.5	15.78	+1.7	+7.1	+0.07	+0.29
Shrub	17..2	10.7	36.8	22.80	+19.6	+114.0	+0.85	+4.94
Urban	26. 9	16.7	28.5	17.64	+1.6	+6.0	+0.07	+0.26
Water Body	11.8	7.3	10.8	6.69	-5.1	-43.3	-0.22	-1.88
TOTAL	161.4	100	161.4	100	-	-	-	-

With these, most of the light forest have disappeared and converted to other land uses such as farm land and urban built-up. More non-forested wetland appeared in 2007 compared with that of 1984 as a result of conversion of the forested wetland to urban farming. Table 1 showed the proportion that remained unchanged, lost and gained in 2007 from the land uses compared.

Table 2: Proportions of LULC units gained and/or lost between 1984 and 2007

Land Use Classes	Proportion of LULC in 1984 and unchanged in 2007		Proportion of LULC in1984 lost to other LULC by 2007		Proportion of LULC in 1984 gained from other LULC type by 2007		LULC in 2007 (unchanged+ gained)		Difference of (1984-2007) LULC gained-lost	
	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
Farmlands	3.8	58.5	2.7	41.54	12.20	76.30	16.0	100	9.5	59.38
Forested Wetland	3.8	17.5	17.9	82.50	16.40	81.20	20.2	100	-1.5	-7.43
Light Forest	6.8	12.71	46.7	87.29	16.90	71.31	23.7	100	-29.8	--125.74
Non-Forested Wetland	6.0	25.21	17.8	74.79	19.50	76.47	25.5	100	1.7	6.67
Shrub	10.1	58.72	7.10	41.29	26.70	72.55	36.8	100	19.6	53.26
Urban	23.9	88.85	3.00	11.15	4.60	16.14	28.5	100	1.6	5.61
Water Body	8.8	74.58	3.00	25.42	2.00	18.52	10.8	100	-1.0	-9.26
Total Area	**63.2**	**39.10**	**98.3**	**60.90**	**98.3**	**60.90**	**161.40**	**100.00**	**-**	**-**

From Table 2, 88.85, 58.72, 25.21, 17.5, 74.58, 58.5 and 12.71% of urban, shrub, non-forested wetland, forested wetland, water body, farm land and light forest respectively remained unchanged between 1984 and 2007. Also, 87.29, 82.50, 74.79, 41.54, 41.29, 25.42 and 11.15% of light forest, forested wetland, non-forested wetland, farmland, shrub, water body and urban respectively have been converted to other uses within the same period.

Physico-chemical properties of soils of the study area

Assessing land-use-induced changes in soil properties is essential for addressing the issue of agro ecosystem transformation and sustainable land productivity (Mbagwu, 2008). The selection of suitable indicators with well established ecological functions and high sensitivity to disturbances is of paramount importance.

Tables 3 and 4 showed the properties of soils of forested and non-forested wetlands. Soils of the forested areas are mainly clay while the non-forested areas are clay loam and sandy clay loam. The mean soil pH (1:1 soil-H_2O) ranged from 5.0 to 6.5, indicating slightly acidic soil condition. In the forested areas, total nitrogen (TN; 0.98 to 2.63 g kg^{-1}), organic carbon (OC; 12.50 to 37.40 g kg^{-1}) and available phosphorus (24.05 to 44.80 mg kg^{-1}) values were obtained. Also, the cation exchangeable capacity (CEC) in the forested areas ranged from

9.55 to 12.37 cmol kg^{-1}. However, in the non-forested areas, TN, OC, available phosphorus and CEC values were low. Within each of the study area, soil properties varied significantly from one sample location to another.

The soil test results revealed the micro- variability of the soil, with significant ($p < 0.01$) differences in the properties compared. These results are in agreement with those reported from Nigeria by Adepetu *et al*. (1979) under continuous soil manipulation as a result of human activities. The soil physical properties such as soil texture known to be relatively 'stable' over-time (Mbagwu, 2008) changed from clay in the forested wetland to sandy clay loam in nearby non-forested wetland where anthropogenic activities are on-going.

Table 3: Mean values of physico-chemical properties of soils of non-forested wetland.

Sample location	pH	Sand	Silt	Clay	P	OC	TN	Mg	Ca	K	Na	Exchangeable acidity	Textural Class
1	5.10c	320	300	380	21.66d	20.30a	1.93a	1.23d	5.50d	0.17b	0.50b	2.00b	CL
2	5.40b	440	250	310	29.57b	15.60d	1.30c	1.22d	6.52a	0.23ab	0.48b	1.80b	CL
3	5.30b	360	210	430	23.15c	19.90b	1.67b	2.23b	5.33d	0.27a	0.48b	1.22b	C
4	5.00c	400	240	360	31.36a	13.70e	1.07d	2.03c	5.95c	0.20b	0.46b	1.40a	CL
5	5.90a	500	200	300	29.42b	16.80c	1.38c	3.25a	6.28b	0.33a	0.59a	1.30b	SCL

Note: Means with the same alphabet(s) are not significantly different at $p < 0.01$
Legend: CL= Clay loam
C = Clay
SCL= Sandy clay loam

Table 4: Mean values of physico-chemical properties of soils of forested wetland.

Sample location	pH	Sand	Silt	Clay	P	OC	TN	Mg	Ca	K	Na	Exchangeable acidity	Textural class
1	5.40c	120	270	610	44.80a	22.50c	1.72b	2.22a	8.70a	0.93a	0.52b	1.00bc	HC
2	6.20b	100	370	530	33.25b	37.40a	2.63a	1.83b	8.20b	0.67a	0.59a	1.10b	C
3	5.30c	120	380	500	31.63c	18.70e	1.57c	0.81c	8.30b	0.65a	0.59a	1.30a	C
4	6.50a	40	400	560	33.15b	19.50d	0.98e	1.83b	7.45c	0.56ab	0.57a	1.40a	C
5	5.20c	100	320	580	24.05d	24.20b	1.24d	1.83b	6.90d	0.30b	0.52b	0.90c	C

Note: Means with the same alphabet(s) are not significantly different at $p < 0.01$
Legend: HC= Heavy clay
C = Clay

The Effects of Urban Agriculture on Soil Quality

Olayinka (2009) viewed soil quality as the capacity of a soil to function within its ecosystem boundaries and interact positively with the environment external to that ecosystem. Soil quality has emerged as a unifying concept to address the larger issue of sustainability of ecosystem in general and agriculture in particular (Mbagwu, 2008). Tables 3 and 4 showed the impact of urban agriculture on the soil quality in the study area. Conversion of native forests to cultivation is usually accompanied by a decline in soil organic carbon, soil nutrients and deterioration of soil structure (Salami and Aladenola, 2003). The rapid urbanization as obtained from the nature of land use change over time using ILWIS and ARCGIS software confirmed the negative impact on the physical and chemical properties of soil in the study area. Mengistu and Salami (2007) obtained similar change detection using remote sensing and GIS in some parts of southwestern Nigeria.

CONCLUSION

Urban agriculture and its twin brother, urbanization remain the major causes of soil degradation. In view of the growing importance of urban agriculture more research is needed to establish sustainable urban agricultural practices and management. Knowledge of modern and innovative bioremediation of degraded land should be disseminated to urban farmers so as to ensure the sustainability of urban agriculture and to mitigate its adverse consequences. The present work also forms a contemporary baseline study for policy makers and stakeholders in environmental management. Available technologies such as remote sensing, GIS and routine soil testing are useful tools in addressing these challenges.

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EFFECT OF INDUSTRIAL EFFLUENTS ON WATER QUALITY OF RIVER ATUWARA IN OTA, NIGERIA

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Abstract

The impacts of industrial wastewaters discharged into River Atuwara were estimated from the physical and chemical characteristics of the samples using standard methods. The quality of the effluent before and after dilution in the receiving water and impact on the use of the water for irrigation was studied using QUAL2K software for hydrodynamic analysis of streams and rivers. From the inputted data into the QUAL2K software, the average (and range) of the stream depth, velocity of flow and flow rates on the reaches studied were respectively 0.915 m (0.49 -2.59 m), 0.336 m/s (0.21 - 0.4 m/s) and 14.66 m^3/s (3.48 – 59.36 m^3/s). Majority of the water quality parameters exceeded the maximum concentration permissible: BOD: ≥ 31 mgL^{-1}; COD: ≥181 mgL^{-1}; Alkalinity: ≥ 138.4 mgL^{-1}; TSS: ≥ 826 mgL^{-1}; TDS: ≥ 501 mgL^{-1}; Chloride ≥ 9.95 mgL^{-1}; Nitrates ≥11.3 mgL^{-1} and Phosphates: ≥ 2.92 mgL^{-1}. High concentration of heavy metals such as Cadmium (≥0.017 ppm), Pb(≥0.29 ppm), Zn (≥0.001 ppm), Fe (≥7.04 ppm) and Mn (≥ 0.127 ppm) portends environmental hazard to riparian users. Although the water in the river could be used for irrigation to encourage urban agriculture as practiced along the river, the gross pollution of the river underscores the need for pre-treatment of the industrial effluents before discharge into the receiving water body.

INTRODUCTION

The quality and adequacy of water available to a people or nation is an essential measure of the quality of the people. Water quality is closely linked to water use and to the state of economic development. The vulnerability of surface water and ground water to degradation depends on a combination of natural landscape features, such as geology, topography and soil type and anthropogenic activities.

Water quality has been heavily impacted worldwide by industrial and agricultural chemicals (Terry, 1996). Pollution is caused by washing into surface water of sewage and fertilizers, which contain nutrients such as nitrate and phosphates which when present in excess stimulate the growth of aquatic plants and algae that consequently clog watercourses and use up dissolved oxygen as they decompose (Adenuga *et al*, 2003).

Industries discharge into the environment a variety of pollutants in their wastewater. Such pollutants include heavy metals, organic toxins, oil nutrients and solids. It is a generally accepted fact that the developed countries suffer from problems of chemical discharge into the water sources mainly groundwater while developing countries face problems of agricultural runoff in surface water sources (West, 2006).

The physical and chemical characteristics of the receiving waters are important factors influencing the impacts of industrial effluents on aquatic environments. These characteristics include water hardness, temperature, acidity or alkalinity, background concentrations of nutrients and metals, and the physical nature of the receiving water body (e.g., whether it is a stream, lake, or estuary; whether it contains fresh water or salty water).

Engineers rely on the volume and (dry weather) flow of a receiving water body to assess its ability to dilute or assimilate effluent discharges and hence, the extent of impact of the discharge from a given point source (Adewumi and Ogbiye, 2009). In small watercourses, intertidal areas, or receiving waters that are subject to periodically low seasonal flows, the water volume may be insufficient to dilute the effluent to non-toxic levels (OMOE 1990). In addition, a high assimilative capacity may have little effect on the long-term impact of persistent chemicals that tend to accumulate in sediments or the tissues of aquatic organisms over long periods of time (Adelegan, 2002; Ritu and Prateek, 2004).

THE STUDY AREA: ATUWARA RIVER, ORIGIN AND COURSE IN OGUN STATE NIGERIA

The Ado-Odo/Otta Local Government Area with an area of 1,460 km² and a population of 526,565 (Nigeria Population Commission, 2006) is one of the 19 Local Government Areas and the third largest Local Government Area in Ogun State. Ota (or Otta) at 6°41′00″N 3°41′00″E / 6.68°N 3.68°E has the third largest concentration of industries in Nigeria . It has a large urban – urban drift due to its proximity to Lagos State for people looking for cheaper accommodation.

Atuwara, a major tributary to Ogun River in Ogun - Oshun River Basin, traverses several villages thereby providing the needed water and economic activities to the surrounding villages. The portion of the basin covered by this research has an estimated area of about 4,420 hectares (Fig 1).

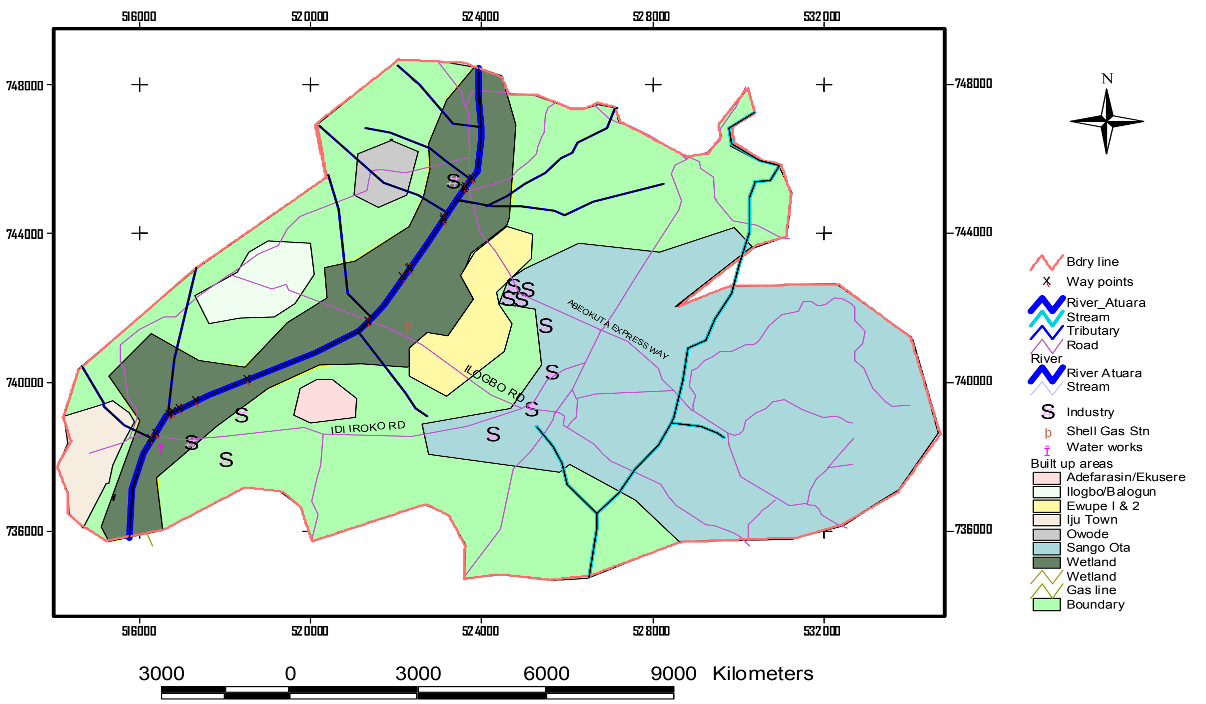

Fig 1: General Layout of Ota, Ogun State, Nigeria

A survey of Ado-Odo/Otta Municipal District lists about 100 large and small scale industries of which 35 industries and industrial units discharge their untreated or partially treated effluents directly or indirectly into the river. The impact of the industries on river Atuwara is the focus of this baseline study.

METHODOLOGY

A set of structured questionnaires were used to characterize the installed capacity, output, and capabilities and efficiencies of the treatment facility in each of 35 identified industries in Ado-Odo/Ota Industrial zone, with a sample size of at least 10 respondents from each of the selected industry. Secondary data from the Manufacturers Association of Nigeria (MAN) were also examined to extract the six sectors of effluent- producing industries studied during the course of this research (MAN, 2005).

Site Characterization Studies

In order to obtain background information and determine the extent of contamination to the water body for the pilot studies, reconnaissance survey of the study area was done. The water characteristics of the receiving water and those of the sampled industries were determined. The exact locations for sample collection on the receiving water were determined using the Garmin GPS Map 76 Global Positioning System (GPS). The effluent sample and the water sample at the respective locations were collected. The pH, Dissolved Oxygen (DO) turbidity, temperature and salinity for the water samples were determined according to standard methods (APHA, 1998).

The samples were taken within two hours after collection to the Covenant University Chemistry Research Laboratory where they were stored in the refrigerator at a temperature of 4^oC prior to analysis for preservation. The study examined the water quality scenarios that occurred between 14/10/2008 and 11/05/2009 and opted for the month of March 2009 which was the pick of the dry season and a low flow period in the River Atuwara to characterize the water body. In addition, as Atuwara River watershed receives discharges and stream flow data, water surface elevations and DO concentrations observed were compared with values of the Nigerian Standard for Drinking Water Quality (NSDWQ) by Standards Organization of Nigeria (SON, 2007) and Federal Environmental Protection Agency (FEPA) limits (FEPA, 1988, 1991 and 1992).

Laboratory Test Studies and Pilot – Scale Studies

Determination of electrical conductivity, BOD, NO_3^- PO_3^{3-}, suspended solids, dissolved solids and total solids were made according to standard methods (APHA, 1998). Electrical conductivity was carried out using a conductivity meter at the room temperature of 25 ^oC. The Fiske and Subbarow method as used by Ogunfowokan *et al* (2005) was adopted for the colorimetric determination of available phosphate. The BOD analysis of the samples was carried out using the Winkler's modified iodometric method as described in standard methods (APHA, 1998; Ademoroti, 1985). The DO content of each sample was determined before and after incubation. Trace metals analysis using the nitric-perchloric-hydrofluoric, acid digestion method by Carrondo, *et al* (1979) was adopted. The data were logged into the QUAL2K program to characterize the receiving stream's hydrodynamic properties.

RESULTS AND DISCUSSION

The field survey showed that the drainage area of the Atuwara River watershed is approximately 147.333 square kilometres ($147x10^3$ hectares) with up to 50% forested, 10% agricultural, 25% water and/or wetland, 7% residential and 8% commercial. The investigated section of Atuwara watershed covered 10.808 kilometers covering seven reaches and 17 sampling points taken in 2008 and 2009 dry and rainy seasons. The study showed that River Atuwara is actively used including its use for wetland farming that can boost urban agriculture. Most farmers are into vegetable farming along the river bank.

The results of the hydrodynamic, physical and chemical parameters of the water samples and of the physical and chemical parameters of the effluents are as shown in Tables 1 -3. The highest relative value for BOD (56 mg/l) occurred at stations STD and STG at the peak of the wet season and at the point of entry of the effluent discharged from a brewery effluent at Ewupe and a food processing effluents at Igboloye. Differences between the observed values of DO were significant and with a good fit at all the study locations. A brewery discharge at Ewupe was found to be the chief source of pollution in reach 1; it discharged 11.99 metric tonnes BOD/day, which is 58% of the total load (Table 1). Collective load of all the drains in reaches 4 and 5 were compared to the other reaches. They contributed 19% and 7.4% of the total load respectively. While the nutrients in the wastewater will boost organic farming, the other pollutants are a major concern for its use.

Table 1: Average Water Quality Input Data* for Atuwara Rivers using QUAL2K software

		Trace Organic Pollutants						Inorganic Water Pollutants						Heavy Metals					
SAMPLE CODE	Relative Distance To STA-Atuara Upstream (km)	BOD_5	pH	Cond. (mS/cm-l)	DO	T.Hard.	Temp °C	T.Alkal.	TSS	TDS	COD	PO_4^{-}	Cl^-	NO_3.i	Cad.	Pb.	Zn.	Fe.	Mn.
FEPA STD.		30	6.5-8.5	**1000**	**4**	150	**20-33**		**30**	**500**	**80**	5	250	50	0.003	**0.01**	3	**0.3**	0.2
STA	0.00	21	6.7	7.3	7.03	6.2	26.6	47.6	14.5	136	73.8	1.17	4.04	3.6	0.006	0.29	<0.001	1.17	<0.002
STB	0.19	18	6.9	18.3	7.79	7.34	26.9	50.4	16.1	170	154	2.76	6	8.5	0.008	0.25	<0.001	1.46	<0.002
STC	0.24	23	6.85	4.1	7.24	7.62	26.8	49.2	17.6	161	121	1.55	5.57	8.5	0.005	0.24	<0.001	1.24	<0.002
STD	1.21	31	6.55	4.7	7.33	7.67	27.2	50.8	31.6	374	117	1.28	5.15	7.1	0.009	0.19	<0.001	7.03	<0.002
STE	1.26	19	6.5	48.1	2.18	7.2	33.8	55.2	32.8	410	91	0.81	7.43	6.5	0.006	0.23	<0.001	7.04	<0.002
STF	2.78	6	6.9	40.1	7.88	7.51	26.9	52.4	20.8	501	56	0.6	9.19	2.6	0.01	0.25	<0.001	1.47	<0.002
STG	2.83	30	6.85	2	6.66	7.78	26.9	63	19.8	128	65	2.49	5.51	4.4	0.009	0.29	<0.001	1.32	<0.002
STH	3.08	10	6.85	4.7	4.99	2.36	27	62	37.6	104	71	0.9	4.66	3.6	0.008	0.2	<0.001	1.56	<0.002
STJ	4.67	12	6.85	0.33	7.3	7.54	26.9	48	20.4	308	53	2.33	5.27	0.04	0.006	0.18	<0.001	1.54	<0.002
STK	7.94	9	6.95	2.01	7.78	8.89	26.9	61.2	56.4	256	181	0.32	6.31	2.4	0.017	0.13	<0.001	1.81	<0.002
STL	8.36	13	6.65	0.17	1.03	3.78	27.1	138.4	59	323	92	2.92	3.68	11.3	0.011	0.2	<0.001	6.36	0.038
STM	9.28	6	6.95	6.9	6.51	6.19	27	70.8	72.6	193	116	2.49	4.66	1.8	0.016	0.28	<0.001	1.77	0.037
STN	9.71	11	6.65	36.1	2.61	15.42	27.1	110.8	69	189	76	1.52	9.26	2.5	0.011	0.24	<0.001	2.37	0.071
STP	9.88	12	6.55	0.9	0.85	13.53	27	113.2	82	211	102	1.37	9.95	4.8	0.01	0.26	<0.001	3.48	0.127
STQ	9.88	10	6.7	25.5	4.2	12.2	27.1	112.6	89.8	242	51	1.08	7.73	3.7	0.004	0.01	<0.001	1.85	0.12
STR	10.71	17	6.85	1.8	5.32	11.75	27.1	111.2	826	204	42	2.18	6.25	5.2	<0.002	0.01	<0.001	1.365	0.041
STS	10.81	15	6.95	2.95	5.46	10.41	26.9	58.8	39.2	102	58	2.11	7.84	4.2	<0.002	0.01	<0.001	1.33	0.041

*Units in mg/l except when otherwise stated in the table.

The water quality of the river sections from Ewupe to Adefarasin before the main tributary was found to correspond to Class E as explained in Table 2 suggesting that the water could not be used for purposes of drinking, fisheries, bathing and swimming but only for irrigation, industrial cooling and controlled waste disposal. Due to the huge pollution load from both the Distillery firm and Sewage discharges even from desludging vehicles, the DO concentration dropped down again to the anoxic state.

The BOD concentration of the stream at the headwater peaked at 32 mg/l in the month of May 2009 and was least in February 2009 at 10 mg/l. Subsequent loading at Igboloye from Distillery firm drain resulted in an increase in BOD level to about 56 mg/l (Table 3). At the downstream of the Brewery discharge, Combined (Nigeria –German, Fermex Mayer Nigeria Plc) and other pharmaceutical drains culminated to the lowest BOD level found to be 3 mg/l at Ewupe downstream. BOD levels increased several folds from 12 mg/l to 56 mg/l whereas DO decreased to zero from 8.40 mg/l in the river (Table 3, Figs 2-3).

From the inputted data into the QUAL2K software in Table 4 the average (and range) of the stream depth, velocity of flow and flow rates on the reaches studied were respectively 0.915 m (0.49 -2.59 m), 0.336 m/s (0.21 -0.4 m/s) and 14.66 m^3/s (3.48 – 59.36 m^3/s). Somewhere the main tributaries discharged into the river; this research found these discharges to be the main source of replenishment to buffering the capacity of River Atuwara. The low velocity of flow encourages sedimentation of solids and may encourage development of benthic culture that further lowers the DO concentration.

This aeration recovery capacity is encouraging for the river's use for urban agriculture and wetland farming. However the high concentrations of toxic substances and possibly pathogens from sewage discharged into the stream will put farm workers at risk of infection with water-borne diseases. Where the produce is vegetable or fruits, there is further risk of food borne infection. Therefore, it is very essential that the industrial effluents be treated before discharge into River Atuwara.

Given the areas traversed by the river and its traditional use, there is the need for the Monitoring agencies to enforce the treatment of effluents to make the water useable. The public health aspect of the water use is also important consideration, where the heavy metals are concerned. Since the metals can bioaccumulate in tissues of plants and aquatic life, there is the need for pre-treatment to meet effluent discharge standard set by FEPA and other regulatory bodies.

Table 2: The surface water quality classification by DO and BOD

Characteristic	Class				
	A	B	C	D	E
DO (mg /l)	>6	>5	>4	>4	<4
BOD (mg /l)	<2	<3	<4	<6	>6

Source: CPCB (Central Pollution Control Board of India, 1980 -81)

Legend:

A: Drinking watercourses without conventional treatment but after disinfection
B: Bathing Swimming and Recreation
C: Drinking water source after conventional treatment
D: Propagation of wild life, fisheries etc.
E: Irrigation, industrial cooling and controlled waste disposal

Table 3: Summary of Statistical analysis of the Data of Atuwara River in Table 1

S/NO	PARAMETERS	MEAN	STANDARD DEVIATION	RANGE
1	BOD_5	15.50	7.71	6 to 31
2	pH	6.76	0.15	6.5 to 6.95
3	Conductivity	12.69	15.94	0.17 to 48.1
4	DO	5.42	2.49	0.85 to 7.88
5	Total hardness	8.31	3.41	2.36 to 15.42
6	Temperature	27.39	1.71	26.6 to 33.8
7	Total alkalinity	74.80	30.82	47.6 to 138.4
8	TSS	91.62	197.48	14.45 to 826
9	TDS	244.38	111.47	104 to 501
10	COD	91.36	38.87	42 to 181
11	Phosphate	1.61	0.81	0.32 to 2.92
12	Chloride	6.29	1.91	3.68 to 9.95
13	Nitrates	4.78	2.94	0.04 to 11.3
14	Cadmium	0.009	0.004	0.004 to 0.017
15	Lead	0.203	0.09	0.01 to 0.29
16	Zinc	0.00	0.00	0 to 0
17	Iron	2.68	2.13	1.17 to 7.04
18	Manganese	0.027	0.04	0.037 to 0.127

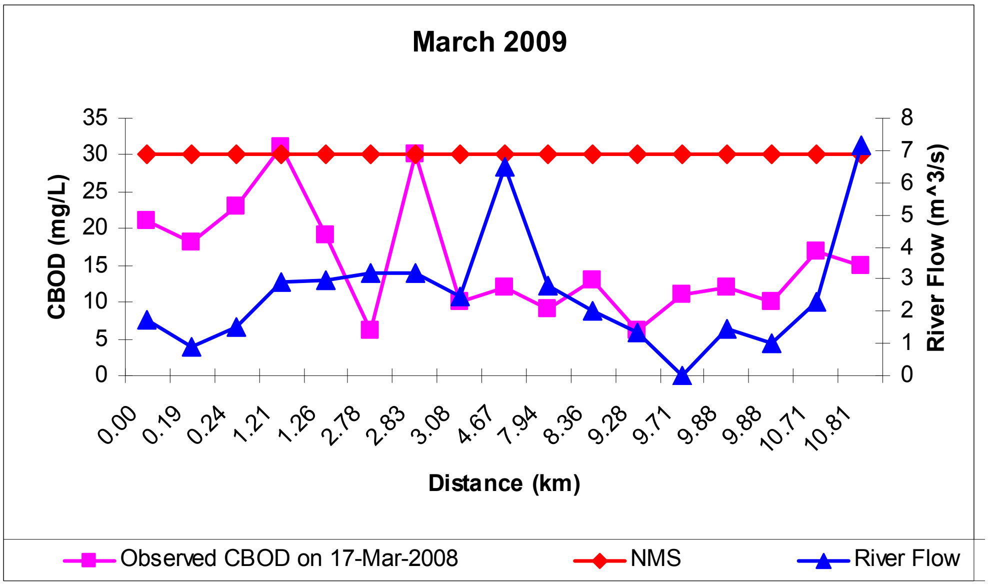

Fig 2: The plot of critical river flow versus CBOD for River Atuwara in March 2009

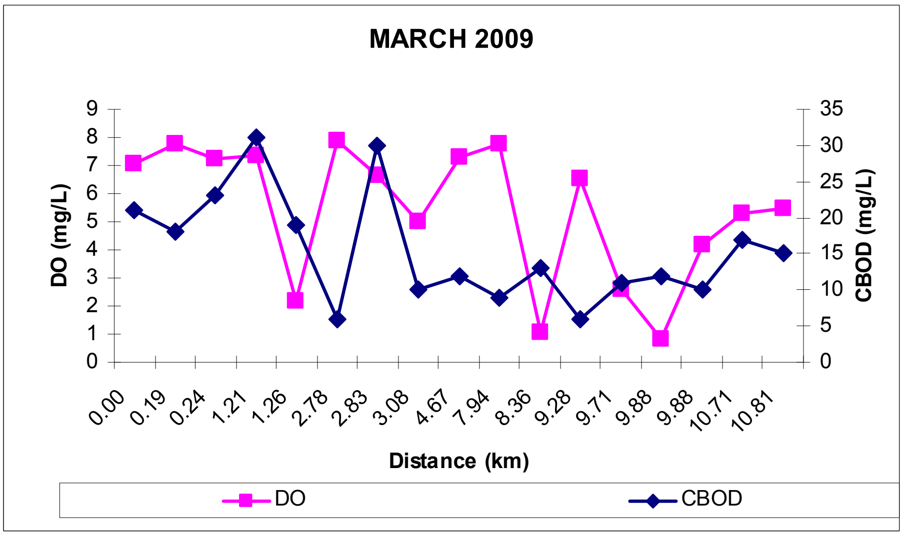

Fig 3: The CBOD Prediction model for River Atuwara based on the critical data in March 2009

The statistical analyses of the data in Table 3 showed that majority of the parameters are within the safety level. However the hydrogeometric characteristics of river Atuwara showed excellent recovery capacity because of the dilution power of river Atuwara which receives discharge from Afara meje stream and other tributaries (Table 4).

Table 4: Hydro – Geometric Parameters of the Receiving Atuwara River in March 2009

Way Point Station	Station Description	Width (m)	Depth(m)			Temperature (^OC)		Velocity (m/ s)	Flow (m^3/s)
			Left	Mid Stream	Right	Air	Water		
STA	Water Corporation	13.80	2.59	1.37	1.34	29.1	26.6	0.29	59.36
STB	200 m- Downstream	8.00	1.13	1.25	0.55	30.3	26.9	0.29	14.10
STC	50 m- Downstream	6.90	0.55	0.82	0.64	29.2	26.8	0.22	6.93
STD	IDL Discharge	8.70	0.55	0.82	1.01	29.8	27.2	0.21	11.23
STE	IDL Raw Effluent	-	-	-	-	-	-		
STF	50 m IDL Upstream	5.70	0.64	0.70	0.95	29.1	26.9	0.30	6.94
STG	50 m M & B Down Stream	4.78	0.92	1.40	0.95	29.2	26.9	0.38	9.91
STH	M&B Effluent	6.50	0.88	1.71	0.76	29.4	27.0	0.38	14.05
STJ	100 m M & B Upstream	13.40	0.76	1.04	1.56	29.3	26.9	0.43	28.97
STK	250 m Downstream to Ewupe	8.10	0.64	1.25	0.58	29.4	26.9	0.37	11.06
STL	Ewupe Effluent	8.00	0.65	1.59	1.04	29.8	27.1	0.36	16.82
STM	50 m Upstream of Ewupe	8.30	0.64	1.68	0.73	29.6	27.0	0.37	15.55
STN	Sona Effluent Discharge	8.80	0.58	1.40	0.55	29.7	27.1	0.4	12.47
STP	50 m Sona Upstream	9.50	0.49	1.13	0.54	29.7	27.0	0.33	10.42
STQ	50 m Downstream to Abattoir	6.00	0.65	0.82	0.56	29.8	27.1	0.35	6.30
STR	Abattoir Discharge	4.10	0.58	0.65	0.55	29.8	27.1	0.36	3.48
STS	250 m Upstream of Abattoir	9.20	0.49	0.64	0.55	29.6	26.9	0.34	7.03

The pH ranged from 5.95 to 8.8. Temperatures were in the range between 25.5 and 32.6^oC which was within the national limit (SON, 2007). The TDS, TSS, TS, Cl, COD, were specifically very high. The pH, in most samples from IDL indicated that they are slightly acidic (values range from 5.2 – 6.7) despite the dilution effect of the river.

CONCLUSION

The QUAL2K model used in this project showed that there was effective dilution of River Atuwara for its use as a receiving stream. The river can also support urban agriculture through its use for irrigation of wetlands along its course. Downstream riparian users of the River must be adequately protected from exposure to both pathogenic and other toxic chemicals in the stream. There is also need to enforce corporate social responsibility by the industries located along the river through provision of safe water supply possibly through groundwater source. Government must ensure that existing Environmental Control Laws and Regulations are respected by industries in the study area in the overall interest of the people living along and within the watershed studied.

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EFFECT OF CLIMATE CHANGE ON FOOD OUTPUT AND PRICES IN NIGERIA

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Abstract

Escalating food prices have been blamed on climate change among other factors. This paper examines the nexus between changing climatic elements, food output and food prices in Nigeria. The paper utilized climatic, agricultural output and price data obtained from the North-western part of Nigeria and compared these with data from the South-west. Secondary data from national institutions were also gathered and analyzed. The results revealed that climate change is gradually turning the rich but sensitive agricultural lands into non-productive zones in the northern sections of the country. In addition, Nigeria's inconsistent rainfall pattern in recent years has also led to drought and at other times flood leading to crop failure in both cases. This is partly responsible for the recent high prices of food products in the country. The paper concluded that policy efforts should be directed at developing irrigation facilities to ensure crops are produced the year round. The government should partner with international development agencies, the private sector and community based organizations to reduce the emission of greenhouse gasses in the country.

INTRODUCTION

Agriculture is the most important economic enterprise in Nigeria since the agricultural sector alone employs 60 % of the national labour force and accounts for 90 % of the non-oil export earnings (United Nations Systems {UNS}, 2001). It also contributes nearly 40% of the national GDP. In addition to the farm production sector, millions are also involved in food processing and distribution as well as input supply. Although Nigeria bridges her national food supply with imports, the agricultural sector provides the major proportion of the total food needs of the country. To underscore the importance of this sector, policy measures aimed at ensuring food sufficiency, creating employment as well as reducing poverty are mainly centered on the agricultural sector where Nigeria has vast potentials. This is evident in the number of institutions and programmes created to foster agricultural development in Nigeria which among others include the National Fadama Development Programmes (Fadama 1, 2 and 3); Agricultural Development Programmes (ADPs) and the River Basin Development Authorities (RBDAs); the National Livestock Development Programme (NLDP); the Aquaculture Development Project; and, the technical and resource support of UN agencies, especially UNDP and FAO. Agriculture is thus the backbone of the Nigerian economy and her capacity to be food secure like all nations on earth depends on the sector.

In response to national policy efforts, the agricultural environment has grown to include large and medium scale farms although the bulk of the operators are still small scale farmers who constitute nearly 60 % of the farmers in the country (Nigerian National Committee on Irrigation and Drainage {NINCID}, 2006). These farmers employ minimal capital resources which make them heavily dependent on natural systems that are highly sensitive to climatic changes although, the small holder farming techniques themselves negatively impact these natural systems. The farming environment is thus under stress from the farmers' production efforts that are environmentally unfriendly, green house gas emissions from the energy sector and the effect of global warming. These factors have worked together to compound Nigeria's challenge of climate variability and change within the global context. The central position of agriculture to the Nigerian economy ensures that any deleterious effect of climate change could be devastating as it will be passed to society and the economy (IISD and EARG, 1994).

CONCEPTUAL FRAMEWORK

Climate variability directly affects agricultural production, as agriculture is inherently sensitive to climatic conditions and is one of the most vulnerable sectors to the risks and impacts of global climate change (Parry *et al*., 1999). Climate variability and change are consequently a major threat to food security in many regions of the developing world especially those regions like Nigeria, which are largely dependent on rainfed and labour-intensive agricultural production (IPCC, 2001a). On a global scale, climate variability and change may have an overall negligible effect on total food production (Parry and Rosenwieg, 1994), however, the regional impact is likely to be substantial and variable, with some regions benefiting from an altered climate and other regions adversely affected. Generally, food production is likely to decline in most resource poor and technologically backward regions like sub-Saharan Africa where the agricultural population till marginal lands with low resource inputs. On the other hand, agriculture in developed countries may actually benefit where technology is available and if appropriate adaptive adjustments are employed. In fact in higher latitudes, farming could benefit from longer growing seasons and thus record higher yields.

Studies by the IPCC suggest that areas of the sub-Sahara are likely to emerge as the most vulnerable to climate change by the year 2100 with likely agricultural losses of between 2 and 7% of GDP. Western and Central Africa are expected to have losses ranging from 2 to 4% while Northern and Southern Africa are expected to have losses of 0.4 to 1.3% (Mendelsohn *et. al*., 2000). A Nigerian study applied the EPIC crop model to give projections of crop yield during the 21st century. The study modeled worst case climate change scenarios for maize, sorghum, rice, millet and cassava (Adejuwon, 2006). The indications from the projections are that, in general, there will be increases in crop yield across all low land ecological zones as the climate changes during the early parts of the 21st century. However, towards the end of the century, the rate of increase will tend to slow down. This could result in lower yields in the last quarter than in the third quarter of the century. The decreases in yield could be explained in terms of the very high temperatures which lie beyond the range of tolerance for the current crop varieties and cultivars. Changes are also expected in the onset of the rainy season and the variability of dry spells.

Although a number of studies on the impact of climate on food production has been conducted, there is limited understanding of how climate variability currently impacts food systems and associated livelihoods (Ziervogel and Calder, 2003). However, agriculture as an activity that depends on the natural systems tend to exhibit a linear relationship with major climatic elements most importantly, rainfall, temperature and sunshine (Adejuwon *et al*. 2006). Hence, seasonal drought, length of growing season, and the distribution of rainfall within a growing season become critical. This study is an attempt to examine the relationship between rainfall and staple food crop output in two geopolitical zones – Southwest and Northwest with a view to determining the necessary policy response to the effect of climate on food production in these regions.

MATERIALS AND METHODS

The study covered two of the six geopolitical zones of Nigeria. These zones which were purposively selected were the Southwest (Lagos, Oyo, Ogun, Osun, Ondo and Ekiti states) and Northwest (Sokoto, Jigawa, Kaduna, Kebbi, Katsina, Kano and Zamfara states) geopolitical zones.

The study used mainly secondary data on agricultural output and rainfall distribution in the two regions. Rainfall data for Sokoto was used as surrogate for the North Western region while that of Ibadan was used for the South Western zone. Rainfall data obtained from Nigeria Meteorological Agency on Ibadan spanned 1906 to 2008 while that of Sokoto spanned 1916 to 2008. Mean rainfall distribution pattern were derived with graphs. Disaggregated food crop output data were also obtained from the National Bureau of Statistics (NBS) from 1995 to 2006 for the South West and North West. Market prices of the various food crops used in the analysis were also obtained from NBS from 1995 to 2006. The rainfall-crop output-price relationships for the two zones were shown graphically. Correlation technique was also used to establish the relationship between rainfall and crop output.

RESULTS AND DISCUSSION

The Temperature and Rainfall Dynamics

In Nigeria, meteorological data have shown that in the last four decades from independence, rainfall and temperature variation and change have occurred.

Trends in Rainfall Distribution in the Northwes and Southwest Geopolitical Zones

Studies by Adesina *et al.*,(2006) and Adejuwon *et al.*, (2006) have shown that in the Guinea and Sudan savannah lands, rainfall has been increasing over time from an average of less than 700 mm per annum between 1981 and 1987 to between 700 mm to 2,000 mm between 1988 and 1998. This observed increase was however not corroborated by the rainfall data for the region presented in Figure 1 for the northwest zone. Figure 1 revealed that over the last century, rainfall distribution in the zone had being very variable. The zone witnessed more rain between 1916 and 1963. Ever since, the mean annual rainfall has been declining. In years with increased rainfall, the zone has not been able to attain the pre 1963 rainfall volume. The observed variation could be the effect of increased rainfall in specific areas like Plateau and Benue whose rainfall pattern are largely influenced by their location on the windward side of the Jos Plateau. The northwest region does not benefit from such influence of relief. In addition, the observed increase was possibly examined within the context of lower rainfall between 1981 and 1988. When viewed with the phenomenal development and anthropogenic activities that the zone has witnessed in the last 50 years, especially in the development of cities, the impact of rainfall decrease on the environment could be very devastating on the rich agricultural lands surrounding the major cities with attendant effect on food output and supply to the cities as well as the economic well-being of small holder farmers. The shortage of rainfall has led to the gradual conversion of savannah ecological zones to arid landscape as noted by Obioha (2009). Nigeria has lost part of its landmass to the desert, which is advancing southward at the rate of 0.6 kilometers annually (FEPA, 1992).

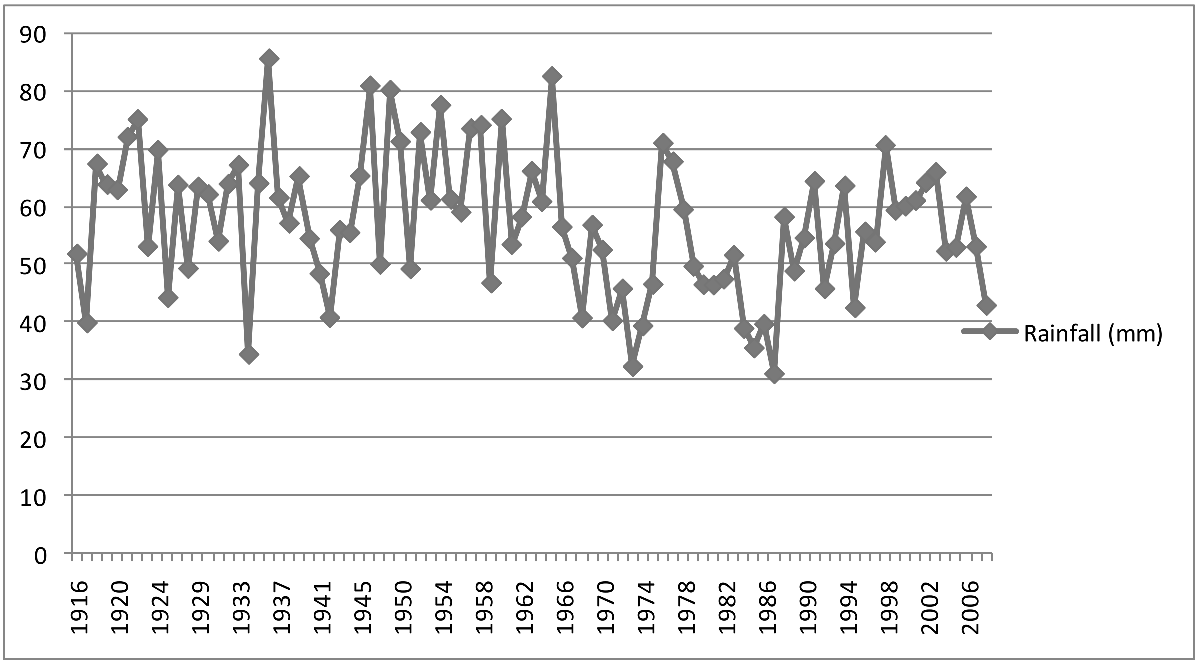

Figure 1: Mean annual rainfall distribution for Northwestern Nigeria: 1916 to 2008

The variability in rainfall in the southwestern Nigeria from 1906 to 2008 is presented in Figure 2. While the mean annual rainfall distribution also showed oscillations over time, the variability has not been as marked as rainfall variability in the northwestern zone. In fact, since 1993, the volume of rainfall has shown an increase. The rainfall distribution has also been spread throughout the months as data revealed that rain falls in nine months. The rainfall received was usually sufficient to grow crops of various kinds in the region. In the agricultural sector however, it is not the volume of rainfall received alone that is crucial to crop production. As Adesina (2006) observed, critical elements of climate change that can adversely affect food production are commonly short lived environmental processes such as heavy downpour within short periods, dry spells within the growing season, delay in the onset of rain, changes in temperature to below or above the values that are accepted as normal for specific periods in a year. In the southwest zone, there has been a clear variation in the timing of rainfall onset as known by small holder farmers. This fact was established by Fakorede (2001) who observed that in recent years, the onset of the effective rainy season seems to have been delayed without a corresponding delay in the time of recession of the rains at the end of the year. This leads to a shorter cropping season and failure of food crops with devastating consequences on food supply and prices especially to the cities.

Another critical factor affecting the mean annual rainfall experienced in the zone is the capacity of the soil to retain moisture. The rate of urbanization as well as deforestation has obviously affected the retentive capacity of the soil adversely as substantial part of the rain are lost via surface runoff which in turn accelerates erosion and degradation.

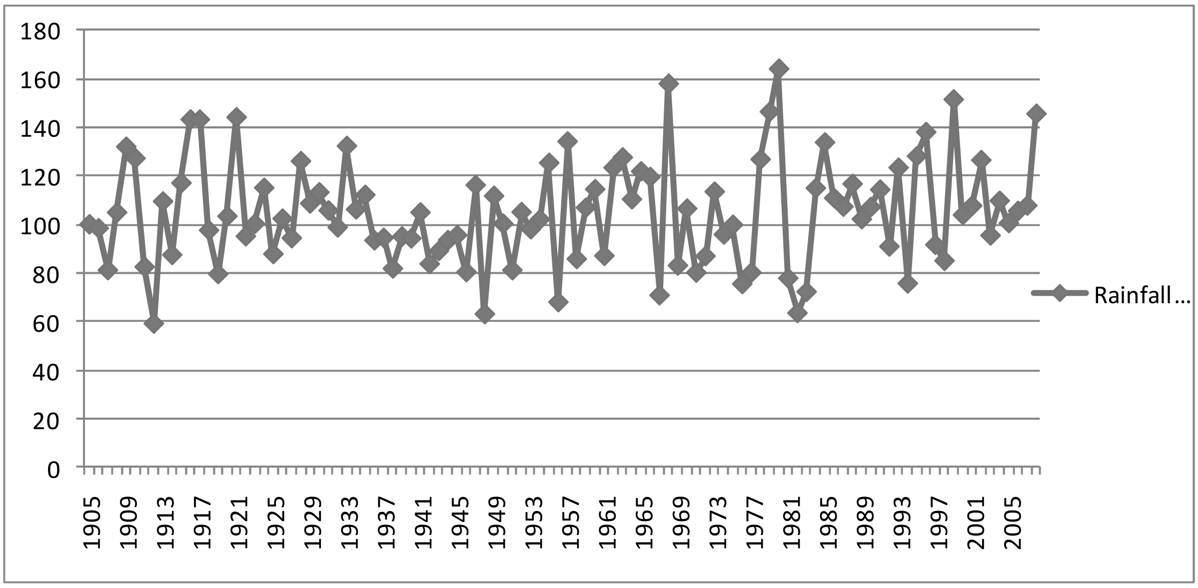

Figure 2: Mean annual rainfall distribution for Southwestern Nigeria: 1905 to 2008

Dynamics in Temperature variation in the Southwest and Northwest zones

According to Gbuyiro and Aisiokuebo (2003), an average of 0.4^{o}C rise in mean annual temperature was recorded for Nigeria in the last two decades of the 20th century. This perfectly tallied with the IPCC, World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) submission that the earth's temperature has increased during the twentieth century by about 0.6 ± 0.2° C (Obioha, 2008). As observed by Adeniyi *et al.* (2009), using temperature data for ten stations in Nigeria, temperatures tend to increase with the revolution of the earth. The study revealed a clear temperature distribution between the northwest and southwest with temperatures being much higher in Sokoto than Ibadan. The major effect of these high temperatures is the consequent impact on evaporation and soil moisture content. The unavailability of rain water to recharge what has been lost in the process of evapotranspiration makes farming impossible except where irrigation facilities are available or, in the fadama where the ground water table is close enough to the surface to permit farming.

Nexus Between Climate, Food Crop Production and Food Prices

Figure 3 shows the relationship between rainfall distribution and crop production between 1995 and 2006 in the northwest zone. Around 1995 when rainfall was increasing, food crop production was actually decreasing. After this date when rainfall was decreasing, output was also increasing. This trend was noticed during the twelve year period for which disaggregated data was available. A correlation analysis of the relationship between rainfall and crop output showed a coefficient r = -0.481 indicating a significant negative relationship between rainfall and crop output. This clearly presents a false relationship between rainfall and crop production. This is because as all things being equal, food crop output should increase with rainfall especially in a region where rainfall is a limiting factor to agricultural production. The negative relationship between increased rainfall and crop output could be as a result of "excessive" rain leading to flooding and destruction of food crops on the field hence, a reduction in crop output.

The relationship is a clear pointer to the devastation that can result from climate change. The soils in the savannah region are sandy and their capacity to hold moisture is limited. When rain falls, the pore spaces in the soil are easily filled. When the heavy but concentrated rains fall later when the soils are already saturated, flooding takes place. In addition, the major dams located in the zone hold water only to the limit of their capacity and when over filled, they are opened to stem the dams being washed off. These cause severe flooding and hence damage to farm crops in the field. This in turn reduces output and hence, the negative relationship between rainfall and crop output. Adewusi *et. al*. (2009, 2010) in a recent survey carried out in Kebbi and Katsina States found out that heavy flooding in 2009 and 2010 damaged the crops in the field in most parts of the States adversely affecting the supply of food and food prices in the major cities in the region. However, when there is decrease in rainfall, the large dams located in the zone become handy for irrigation and food output increases with a positive impact on food supply to the cities in the northwest region. The possibility of irrigation tends to dwarf the importance of rainfall to the production of food crops in the Northwestern zone when rain fall fails.

Since man has little control over climatic variability, adaptation to climatic variations is key to reducing its impact on food production in the country. The irrigation facilities in the zone are therefore important in ameliorating the effects of water shortages on crop production. However, the impact of occasional heavy downpours on dams as witnessed this year in Jigawa State on small holder farming communities and cities along large rivers could be very devastating where efficient and effective management and maintenance are not carried out. Failed dams will destroy both lives and farmlands. A proper linkage between dam mangers, Ministries of Water Resources and Nigeria Meteorological Agency (NIMET) is thus very critical especially among a largely illiterate farming household who will not be able to access NIMET information.

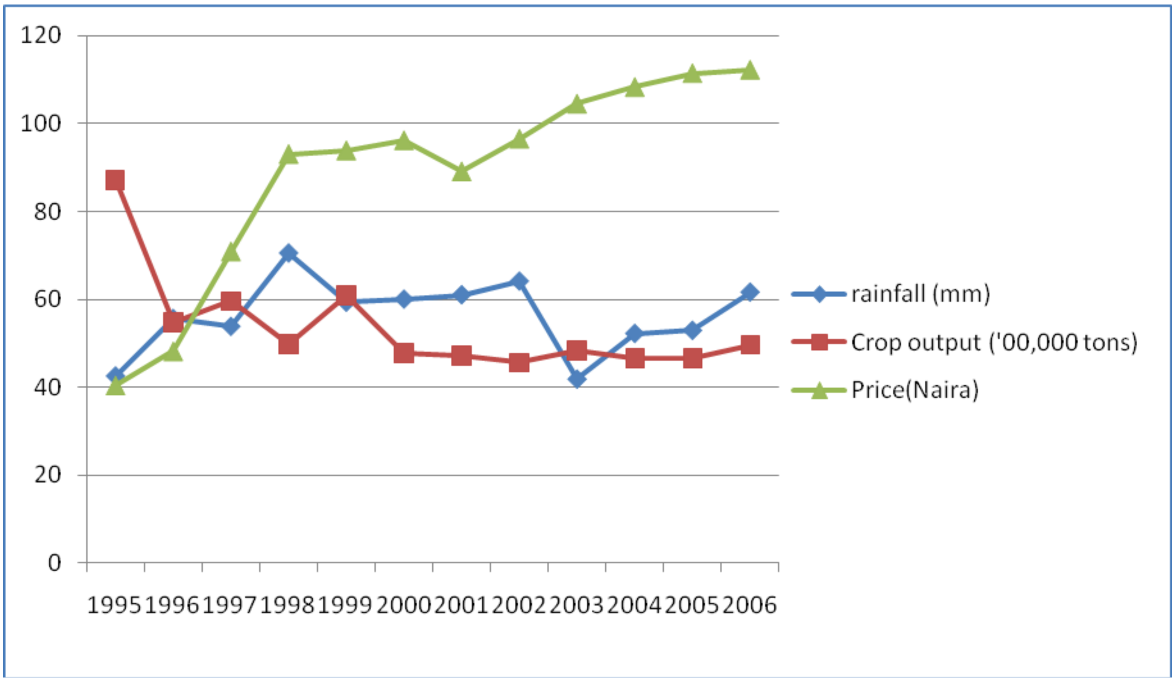

Figure 3: Relationship between rainfall distribution staple crop production and prices in Northwestern Nigeria

Figure 3 also shows price relationship between food crops output and rainfall distribution between 1995 and 2006. Food prices have continued to increase since 1995 in the northwest zone especially in the cities with a slight decrease in 2000/2001 farming season. The behavior of prices has little relationship with rainfall distribution. It seems that as food output has not increased appreciably over time, the gap between prices and output continues to widen resulting in high food prices. In addition, increasing population, rapid development of settlements in the region like Kano, Sokoto and Katsina into large millionaire cities, demand for better nutrition and increased standard of living have exerted an upward influence on the demand for food crops which has led to increased food prices.

The situation is different in the southwest zone where figure 5 reveals that food crop output tend to have a linear relationship with rainfall, increasing as rainfall increases and vice versa. The correlation analysis of the relationship between rainfall and crop output in the southwest zone showed a coefficient $r = 0.253$ indicating a weak but positive relationship between rainfall and crop production. Clearly, any form of climate change that reduces rainfall for a prolonged period of time in the southwest zone could be disastrous to farming and food security in the major cities in the zone. In the zone, dry season farming in the fadama lands have not been popular until recently. Incidentally, the zone is not blessed with dams that can be used for irrigation like the northwest zone although it produces more food crops.

Figure 4 also shows that relationship between price and output in the southwest is linearly related. Up till 2009, food output was much higher in the zone hence, prices were relatively low. Between 1999 and 2003 however, food prices had been on the increase and the gap between output and prices widened. During this period, there was a remarkable linear relationship between output and prices. After 2003, food prices and output have been oscillating but prices have also linearly varied with output. It is clear that in the southwest zone, the distribution of rainfall impacted strongly on both output and prices.

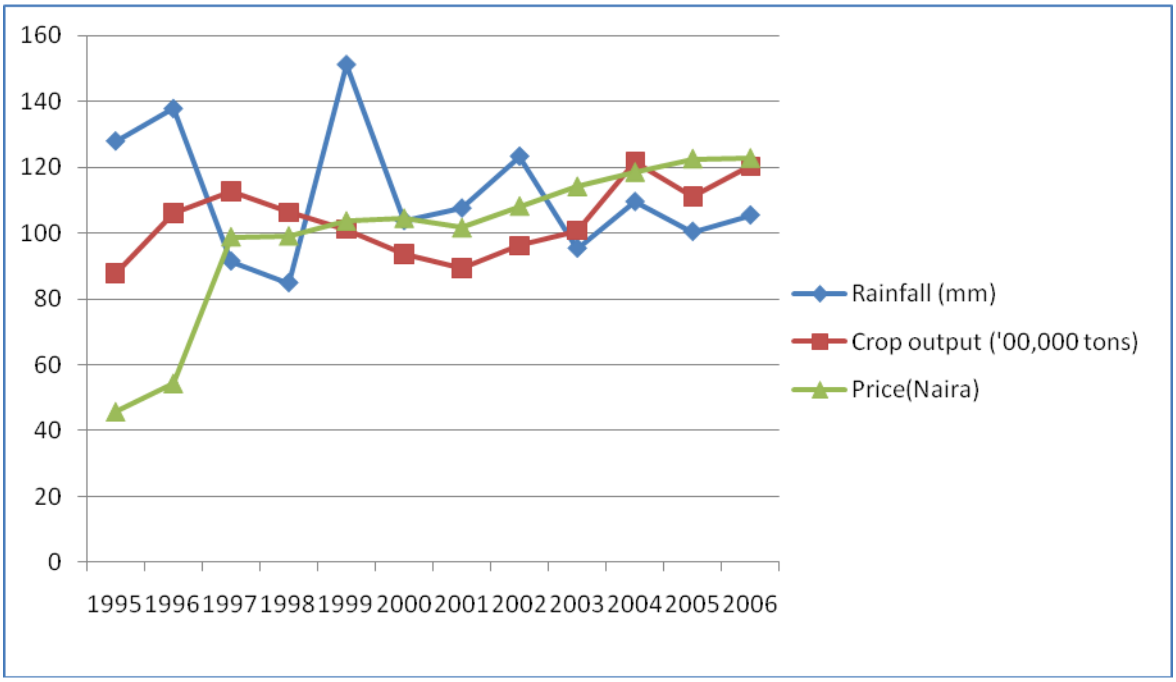

Figure 4: Relationship between rainfall distribution staple crop production and prices in Southwestern Nigeria

CONCLUSION

Agricultural activities are very critical to food production in Nigeria. The sector is however plagued by a number of factors some of which are endogenous to the sector (farmer's experience, perceptions, time devoted to farming, response to market situations and location of the farm) while others are controlled by exogenous (climatic, biophysical environment, policy, and economic conditions). While the solutions to the endogenous factors rest on the farmers, the solutions to the exogenous factors clearly lie beyond their abilities. One such exogenous factor is that of climate change as well as the necessary policy response from government. Generally, rainfall has been decreasing in the northwest, however, availability of dams for irrigation as well as the widely used fadama system has succeeded in ensuring that food production continued to increase. The reverse is the case in the southwest zone where there are little or no dam facilities.

In the northwest, food prices are not influenced by rainfall distribution nor output but by other factors like increasing population, increased living standards, rapid urbanization and desire for better nutrition which has exerted an upward effect on demand and hence prices. In the southwest, the nexus between rainfall, crop output and food prices showed a strong linear relationship. Consequently, while the policy drive in the northwest should be to sustain and increase irrigation as well as efficiently manage the dams, conscious efforts should be put in place to provide dams that will enable the southwest zone to benefit from the use of irrigation facilities and reduce the dependence on rainfall for farm production.

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DISPOSAL MANAGEMENT OF PACKAGED WATER MATERIALS

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Abstract

This paper examined the hazards associated with the indiscriminate disposal method of packaged water materials, reviewed ways of disposal in other countries of the world, and examined the suitability and adoptability of the disposal methods in the country. Primary data gathered from observation and personal interviews as well as secondary data were used for this study. The study found that some of the hazards associated with the indiscriminate disposal include loss of soil fertility, spread of diseases, environmental defacing among others. Some of the methods adopted for plastics and nylons disposal management in many industrialised countries, include recycling by melting, breaking down the polymers to yield chemicals used for synthesising drugs or textiles or additive for petrol and in many organic reactions. In Nigeria, the study found that factories with equipments for recycling polythene waste are scarce. While using plastic waste for alternative fuel is a preferred option; the viability was discussed. The study concluded that the disposal management of packaged water materials demands both private and public sector participation and also important for health, safety and the sustainability of the environment.

INTRODUCTION

The Earth has 1,386,000,000 km^3 of water but only 2.5 percent of that is fresh water (Online Business, 2010). Meanwhile, water is essential for the growth and maintenance of our bodies and is an important component in the diet. The British Dietetic Association guidelines state that an average adult should consume 2.5 litres of water daily of which 1.8 litres (or 5 x 330 ml cans; 7 x 250 ml glasses) must be in fluid form, the remainder being obtained from foods. This consumption rate is for the replacement of about 2.5 litres of water eliminated by adults per day through urine, perspiration and respiration (BDA, 2011). In the case of children, to maintain their correct water level of 60-70% body weight, they need to consume up to 2 litres of fluid every day. This intake needs to be increased during periods of hot weather or during and after periods of physical activity in order to avoid dehydration. According to Online Business (2010), dehydration is caused by consuming too little fluid and can cause symptoms such as headaches, tiredness and loss of concentration. In children, this varies greatly according to the outside temperature, age and activity level of the child, as well as other factors. Children do not instinctively drink enough to replenish the fluids lost during prolonged activity or play periods and evidence has shown that they consequently become dehydrated.

In Nigeria, the water business started off with the borehole water sold to neighbours on the streets to meet the demand for portable water. Then came the sachet and bottled table water to become a proper market segment. Significant is the pure water sub-sector which in 2003 accounts for about 10 to 15 per cent of the total manufacturing output from the SMEs, which in turn, accounts for over 40 per cent of the gross domestic product (GDP) – (NAFDAC, 2003). Also, in the Cape Coast municipality of Ghana, more than 29 brands of sachet water are produced by SME's between 1999 and 2004. Thus, owning to water scarcity in the African region, the manufacture and consumption of sachet and bottled water as a means of obtaining relatively safe drinking water have been proliferating. While this has boosted the SME's water subsector, it has management and environmental implication. This paper focused on packaged water materials and its environmental implication in African region, specifically in West Africa – Nigeria. It also evaluated recent efforts towards the environmental management of the polyethene waste arising from the manufacture and consumption of sachet and bottled water across the globe and implication for policy.

LITERATURE REVIEW

Many scientist, scholars and entrepreneurs have done a lot of work on recycling of plastics as a viable option for the disposal management of packaged water materials. This is because it is considered as an important goal in many industrialised countries, where polymers make up around 7% of domestic waste (Guterman, 1998). Plastic recycling programs were common in the United States and elsewhere since 1995 (Wikipedia, 2010). Thermoplastics can be re-melted and reused, and thermosetting plastics can be ground up and used as filler, though the purity of the material tends to degrade with each reuse cycle. Furthermore, it has been found that simply re-melting and shaping them results in a low-quality product (Wikipedia, 2010). Also, existing methods for breaking up large polymers typically yield a mishmash of hydrocarbons. Such mixtures can be used as fuel, but they contain too many different compounds to be of much use to chemists.

Hence chemists have come up with a way to break down the polymers to yield chemicals that can be used as a solvent, or to synthesise drugs or textiles. A catalyst containing gallium and silicate, called H-Ga-silicate, can break down polyethylene, otherwise known as polythene, into aromatic compounds such as benzene, toluene and isomers of xylene (Guterman, 1998). Benzene is an important solvent, and is used as an additive for petrol and in many organic reactions. Toluene is a useful solvent, and the xylenes are important in the manufacture of polyester synthetic fibres. This reaction may work on a mixture of polymers, however, sorting out different kinds of polymer remains a stumbling block to the recovery process.

In general, the selection of technological options to recycle/reuse plastic wastes depends upon the quality and quantity of waste. For the rest of this section, the work done by Central Pollution Control Board (CPCB) of Delhi, India in 2009 shall be reviewed. In their research, they found it pertinent to make a distinction between different recovery options before reviewing the methodologies of recovery system. The word 'recovery' was used to cover all forms of plastic disposal management options. The different recovery options are: Primary Recycling (Conversion of waste plastic into products having performance level comparable to that of original products made from virgin plastics); Secondary Recycling (Conversion of waste plastics into products having less demanding performance requirements than the original material); Tertiary Recycling (The process of producing chemicals/ fuels/ similar products from waste plastics); and Quaternary Recycling (The process of recovering energy from waste plastics by incineration). However, International Standards like ISO refers Plastics Recycling as a Recovery Process. The recovery has been divided into two categories namely Material Recovery and Energy Recovery. The process flow chart for recovery process is depicted in Fig 1.

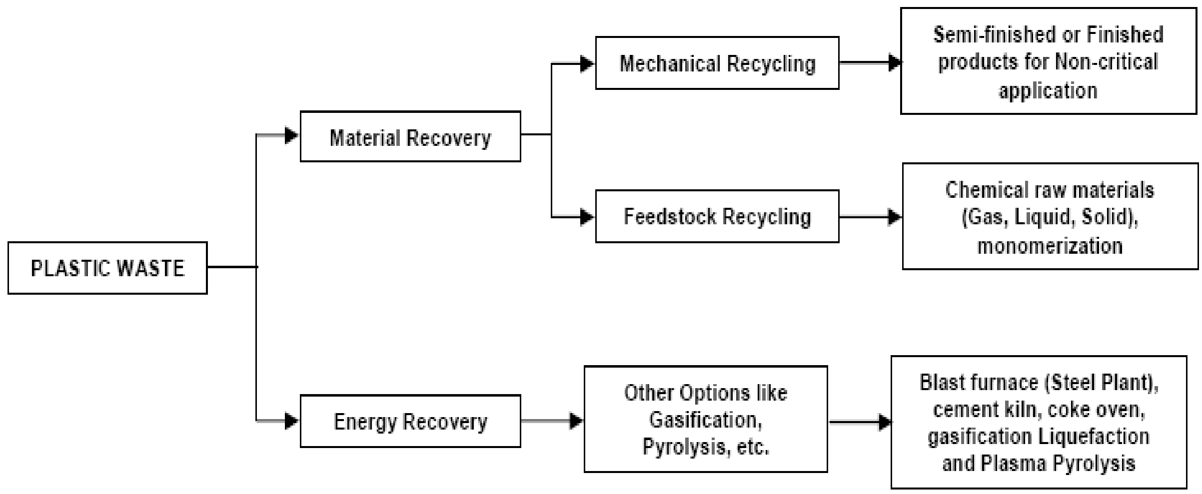

Figure 1: Schematic Diagram of Plastic Recovery Options

Source**:** Central Pollution Control Board (CPCB, 2009)

Table 1: Codes and Recycled Products of Plastics

Codes	Name	Properties	Packaging Application	Recycled Products
1 PET	Polyethylene Terephthalete (PET)	Clarity, strength, toughness, barrier to gas and moisture, resistance to heat	Packaged drinking bottles and soft drink bottles	Fiber fill for sleeping bags, carpets fibers, ropes, pillows etc
2 HDPE	High Density Polyethylene (HDPE)	Stiffness, strength, toughness, resistance to chemicals and moisture, permeability to gas, ease of processing	Raffia bags, knitted fabrics, water, gas and sewer pipes, small volume bottles to large barrels, house wares, storage bins, caps and closures, shopping bags, etc	Flower pots, trash cans, traffic cones, detergent bottles, soap cases, other household items, etc.
3 V	Poly Vinyl (PV)	Versatility, clarity, eases of blending, strength, toughness, resistance to grease. Oil and chemicals	Pharmaceuticals tablet packaging, potable water pipes and irrigation pipes and fittings, door and window profiles, cables, floorings, medical products like blood bags, footwear, etc.	Footwear, irrigation and other drainage pipes, mats, etc.
4 LDPE	Low Density Polyethelene (LDPE)	Ease of processing, strength, toughness, flexibility, ease of sealing, barrier to moisture.	Wide width films, agriculture films and pipes, heavy duty bags, shrink films, cable insulation and sheathing, extrusion coating, liquid packaging, etc.	Grocery bags, shelter films, household items, etc.
5 PP	Polypropylene (PP)	Strength, toughness, resistance to heat, chemicals, grease and oil, versatile, barrier to moisture	Raffia, monofilaments, strapping, automobile batteries and components, luggage and furniture, combs, ball pens, injection syringe, etc	Plastic lumber, household goods, luggage, etc
6 PS	Polystyrene	Versatile, insulation, clarity, easily formed	Disposable cups, packaging materials, meat trays, audio visual cassettes, etc.	Plastic lumber, cassette tape boxes, flower pots, etc
7 OTHER	Poly Acetals, Polycarbonate.	Dependent on resin or combination of resins	The category includes other plastics like nylon, ABS, poly acetals, polycarbonate.	Recycling of these high value plastics is special in nature.

Source: IS 14535: 1998 & ICPE Newsletter, Vol. 6, Issue 2, Apr- Jan 2005.

The selection of appropriate technology for plastic waste disposal and its processes for the management of plastic wastes are available in literature. Several processes and technologies have been explored and developed for plastic waste management. Some of these are: Chemical recycling of polyethylene terephthalete (PET) bottles into fibers, processing of plastic waste in blast furnace and co-incineration of plastic waste in cement kilns. Others include utilization of plastic waste in road construction with bitumen, plasma pyrolysis technology and gasification.

To aid disposal management of plastic waste materials specifically for ease of sorting and recycling, Table 1 shows the universally accepted standards marking code that has been developed to help consumers identify and sort the main types of plastic. It also helps in identifying whether the material used on the end product is virgin, recycled or a blend of virgin and recycled.

RESEARCH FOCUS

This study attempted providing answer to the following questions: What are the hazards associated with the indiscriminate disposal method of plastic materials? What are the disposal methods being deployed in other countries of the world? And how applicable are these disposal methods in Nigeria?

METHODOLOGY

The methodology adopted for the disposal management of packaged water materials in Nigeria was achieved by the standard approach for desk research, field studies, data collection through observation and interviews, analysis and interpretations. Primary data gathered from observation and personal interviews as well as secondary data were used for this study. Personal interviews were carried out with 120 individuals and 26 sachet/bottled water outfits randomly selected from the urban, semi-urban and rurals areas of Osun, Ondo, Ogun, Oyo, Lagos, Ekiti, and Anambra States in Nigeria.

FINDINGS

Hazards Associated with the Indiscriminate Disposal Method of Packaged Water Materials

The study found that packaged water is bedeviled with poor disposal method. While the empty bottled water are been collected and used for other purposes such as local production of sobo, kunu and yoghurt drinks; the waste sachet material are dumped on road sides, abandoned streams and constitutes eye sores. Some of the hazards posed by the improper disposal methods are as follows:

(i) Loss of soil fertility and air pollutant**:** The study observed that areas where the pure water nylons have been deposited in large quantities have lost soil fertility. This is mainly because the waste nylon bags cannot rot and decompose and therefore cannot lead to the formation of good soils. Also, when the waste nylons bags are burnt, they release toxic fumes and create dioxin causing air and chemical pollution.

(ii) Poor soil aeration and drainage**:** Polythene bags are non-biodegradable and water cannot easily percolate through them. Hence, when dumped, it makes the soil to lack aeration and drainage.

(iii)Diseases and Death**:** The study observed that large numbers of nylons that are resistant to the natural processes of degradation litter the streets where they have been dumped in the country. Hence, the site of dumps serves as breeding spot for various viruses, air and water-borne diseases and germs. This makes the inhabitants of those communities to be susceptible to diseases and vulnerable to death. Furthermore, domestic animals especially the cows and the goats after eating the polythene bags are choked to death.

(iv) Obstruction to water systems: Water systems like springs, ponds, rivers etc. are blocked during continued damping of these polythene materials along the shore, the water flow is affected and may be stopped causing floods, disease habitation and unpleasant scenery.

(v) Environmental Eyesore: The environments where waste polythene materials are dumped are usually flawed with dirt, filth and stink. An otherwise beautiful landscape and scenery are polluted with the waste nylon dumps.

Disposal and Recycling Practices in Nigeria

Individuals' and private sector efforts: The study found that packaged water wastes are generated by both individual consumers and also those involved in the production. In all of the firms interviewed, production error sometimes occurs that leads to the generation of large quantities of unexpected waste. Such wastes are often packed in trucks and dumped beside roads or streets that are less busy. Some of the firms provide incinerator within their business premises to burn the wastes. Meanwhile, individuals dispose their packaged water nylon waste like any other day to day waste. It then becomes obvious that those massive wastes of sachet water nylon seen beside streets and roads are dumped there by packaged water firms. On the issue of recycling, most of the firms visited had no plan for recycling at the moment. However, a peculiar case was found in eastern Nigeria. This was a factory that has equipments for recycling polythene waste such as broken plastics, pure water sachets, plastic bags, drip bags etc. These became finished products like motorcycle seats, drain pipe connectors, steering wheel plungers, bicycle foot rest etc. Findings reveal that the entrepreneur imported the machine for the recycling from Italy. Meanwhile, when the recycling business commenced, sachet water producers in the region had to shut down production because they feared he was recycling the sachets for pure water production. While the sachet water producers have since had a rethink , the effect is that one cannot find waste plastic bags in the city because an entrepreneur have been able to use waste packaged water materials, discarded rubber and plastics as raw materials to generate revenue and wealth. Furthermore, in northern Nigeria, small machines are used to recycle polyethene to a black substance which eventually become the black polythene carrier bags. Also in some parts of southwestern Nigeria, we have entrepreneurs who possess portable and moderate plastic recycling plants. However, they are extremely few and are yet to develop mechanism for eliminating package water waste in the environment.

Government and public sector efforts: At the Biotechnology Advanced Laboratory in Abuja, a part of the government's Sheda Science and Technology Complex, researchers are working to embed biodegradable starch in polymers, which are used to make plastics. Next, they identify microbes that would feed on the starch and cause it to break down completely into organic material, which would then be assimilated back into the soil. The microorganism isolated will use the polymer as its food and will dissolve it. The process involves using some proprietary solvents to reduce the amount of plastic waste with a process that breaks it down into powder. One of the uses of the powder is to make water-repellent paint. The project will eventually be commercialised to create new jobs. Litter bins for plastic waste will be set up nationwide, and people will be recruited to search through the dumps for plastics.

Feasibility of Disposal and Recycling Methods in Nigeria

Recycling of plastics has proven to be a difficult process. This is because it is difficult to automate the sorting of plastic wastes. The most environmentally friendly alternative for plastic waste disposal is the process by which we can re-utilize the energy content of the polymer in an ecologically acceptable way. Presently, only plastic water and soft drink bottles are recycled by using mechanical process as presented in the previous section. The mixed plastic wastes like multi-layer plastic laminates used for packaging wafers, biscuits, etc. with different polymer structure are not recyclable, hence, may litter around the cities/towns and keep piling up on garbage heaps and become eyesore, which often chokes the sewage pipes and drains. Ultimately, it leads to unhygienic conditions in the areas were dumped. Based on known work in the field, the various technological options for plastic waste recycling are presented in Table 2. Even though, mechanical recycling is the most preferred and accepted method for plastic waste recycling, it must be noted that it will only recycle the selected waste.

The cost of sorting, cleaning and separating selected polymers increases the operating cost of the process. The existing mechanical recycling process may emit harmful gases such as carbon monoxide (CO), gaseous formaldehyde (HCHO), gaseous hydrochloric acid (HCL), suspended particulate matter (SPM) and respiratory suspended particulate matter (RSPM) etc. The extruders used if old in design and local may not have provision for pollution control. The plastic waste like laminated and carry bag remains the challenge for the process. Recycling is not the complete solution for disposal of waste plastics. After the third/fourth recycling process, the plastic is totally unfit for reuse and hence ultimately it ends up in land filling. Some types of plastics also are not suitable for recycling. However, as earlier mentioned recycling methods are only suitable for processing segregated plastic materials and is not suitable for assorted municipal waste plastic. The problems associated with the recycling process are as follows:

• Many types of plastics are used hence it is difficult to segregate them for specific purpose.

• Plastics contain a wide range of fillers & additives.

• Sorting of plastic is technically difficult as well as expensive.

• Recycling of plastic degrades the quality of the end product.

Plastic waste contains high calorific value and thus a valuable energy resource. The calorific values of different polymers meet the standards required for injection fuel in blast furnace and cement kiln industries. The calorific value of plastic wastes can be utilized effectively by replacing coal. The use of plastic waste as alternative fuel will help to reduce the energy cost along with reduction in the CO_2 emission. Production for 1 ton of cement produces 0.6 to 1 ton of CO_2. With the use of plastic waste of say about 11 tons generated from Nigeria's sachet/bottled water factories can reduce same amount of the CO_2 emission. 1 million tons capacity cement plant can consume about 10,000 MTs to 30,000 MTs of plastics waste annually (ICPE Newsletter, 2006). Also 3 million tons per annum capacity steel plant can use up to 0.6 million tons of plastics waste per annum (ICPE Newsletter, 2008). Furthermore, with replacing plastic wastes as auxiliary fuel with coal in blast and cement kiln also saves the natures valuable resources. Hence, there are two viable options for disposal of plastics waste as follows:

(i) Utilization of Plastic Waste in road construction;

(ii) Co-incineration of Plastic Waste in Cement Kiln.

Table 2: Comparison of Various Technological Options

Category	Disposal Method	Merits	Demerits
Chemical Recycling	Degradation of Monomer	- About 50% recovery is possible	- Only PET flakes are required for process - Large scale process
Furnaces	Blast furnace	- Process includes use of all types of plastics including laminated plastic - 30% less CO_2 emission compared to coal - Slag can be used as cement & road construction	- Substitution of plastic waste with coke is limited to 40% - The process is commercially used in developed countries - Process is yet to be popular in Nigeria
	Gasification	- Production of Synthetic gas used in chemical industry	- Release of unburned toxic gases - High initial and operating cost - Used in developed countries - Requires controlled conditions
Others	Plasma Pyrolysis	- Cost is dependent on capacity - No harmful emission - Process all types of plastics including laminated plastic	- Can replace only 15% of coal - Process is yet to be popularized in Nigeria
	Cement Kiln	- Less CO_2 emission compared to coal	
	Road	- Saving of bitumen	- Nil

Source: Central Pollution Control Board, India 2009

IMPLICATIONS OF FINDINGS

The implication of the disposal management of packaged water materials is varied. First, cities and its dwellers are exposed to environmental and health hazards in the event of continued ill-disposal methods. Second, private sector involvement will imply the duplication of several small plants across the nation for environmentally friendly treatment of the waste packaged water materials. This is because gigantic projects and plants for sophisticated treatment of the waste are expensive and far-fetched in the immediate. Third, taking up waste packaged water materials as alternative fuel have implication for possible reduction in energy cost of the country particularly since the country is set at this time to privatize her energy sector. Fourth, utilization of plastic waste in road construction and cement kiln has implication for sustaining safe, clean and healthy environment. Fifth, this study notes that forums that will bring together knowledge centers (like tertiary institutions and RIs) and stakeholders in the private sector will be required to sustain adequate disposal management of packaged water materials. As part of this activity, government ministries such as ministry of environment, refuse management and sanitation boards, other environmental protection agencies and ministry of information at the state and local government level need to create awareness for recognition of the packaged water problem and potential solutions. Finally, this study consider important, a waste management policy having a framework for collection of the disused packaged water materials from house to house. It is also hoped that the activities leading to implementation of this policy will provide a source of new jobs in the country. This will go a long way even to boost Nigeria's economy.

CONCLUSION

A comparison of the various technological options as studied reveals that the complete solution to the 100% disposal of plastics waste can be achieved through burning of plastics waste in blast furnace and cement kiln as alternative fuel. The high flame temperature in cement kiln and blast furnaces ensures complete destruction of harmful pollutants. Furthermore, the processes involved shall be useful for all types of plastic resins unique/mixed polymer and hence sorting of plastic waste is not required. This will reduce the operation cost of process. It is to be noted that this preferred technological options succeed only if an efficient plastic waste collection system has been properly worked at first instant in the country. Meanwhile, government ministries such as ministry of environment, refuse management and sanitation boards, other environmental protection agencies and ministry of information at the state and local government level need to make producers more responsible for disposal management, and create awareness for recognition of the packaged water problem and potential solutions. Furthermore, forums between knowledge institutions and the private sector on disposal management will go a long way in sustaining the environment.

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USE OF AGRICULTURAL WASTE MANAGEMENT OGBOMOSO METROPOLIS

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Abstract

This study sought to ascertain the extent to which people find uses for agricultural waste materials in Ogbomoso metropolis of Oyo state. The study identified the waste materials they deal in, the uses to which they are applied and the constraints associated with the use of the waste materials. The study was carried out in Ogbomoso metropolis, comprising Ogbomoso North and South local government areas. Cluster sampling technique was used to select those who collect selected agricultural waste materials for re-use. Data collected from the respondents were analysed using descriptive statistics and OLS regression model.

The study found that 71.1% of the respondents deal in the agricultural waste materials to generate income; while the materials they deal in are bones, blood, horn, rumen content and cassava peels. The uses to which the waste materials are put depended on the nature of the waste materials, which included consumption, animal feed, decoration items, fertiliser among others. The listed constraints to re-use agricultural waste materials are scarcity of materials, bulkiness, anti-nutrient nature, storage, seasonality and perish-ability. Result of OLS regression analysis revealed that extent of dealing in agricultural waste collection is significantly influenced ($t=9.585$; $p=0.000$) money realised from the activities while constraint assessment ($t=-0.038$; $p=0.970$) does not influence the activity. The benefits realised from agricultural waste collection perpetuate people's involvement in the activities and the constraints are not strong enough to dissuade their involvement.

INTRODUCTION

One of the most important responsibilities of governments, in which conspicuous lapses have been noticed, in Nigeria, is effective waste disposal. With ever increasing population, rate of waste generation is increasing, which implies attendant burden of disposal on the government. Waste management is an essential task because it has important consequences for public health and well-being. The urban residents are known to demand more on the environment as they generate more wastes than rural dwellers (UNEP, 2010). This makes waste management serious tasks for the governments in urban centres in the country.

Agricultural wastes constitute most of the materials in a waste dump (Cornwall Country Council, 2004). Given the inherent opportunity of re-use and recycling of agricultural wastes, a large number of people have made enterprises out of the collection, sale and re-use of the waste materials (CASSAD, 1998:16). It is therefore necessary to see the extent to which these set of enterprises can be sustained so that waste volumes reduction can be sustained; as the enterprises will only be sustained only if they are profitable to the entrepreneurs.

Given the foregoing, this study will pursue the following objectives:

1. identify the agricultural wastes collected by the respondents
2. ascertain the sustainability of generation of the waste items in the study area
3. determine uses to which the agricultural wastes are applied
4. determine the cost and return of dealing in waste use enterprises

5. determine the constraints associated with dealing in the use/marketing of the waste materials

METHODOLOGY

Ogbomoso metropolis, which is the study area comprised of Ogbomoso North and Ogbomoso South local government areas. It is located on latitude $8^0 8'$ North and longitude 4^0 14' East of the meridian. The town shared territorial boundaries with Oyo, Ilorin and Ejigbo. It also falls in the rainforest and derived savanna zones of the country biomes. Farming is one of the predominant occupations of the people of this area. There are others who are engaged in art and craft, hunting, butchery, drumming, masonry, carpentry and a host of other means of livelihood serving as their primary and secondary occupations.

A two-stage sampling procedure was used to select the respondents of the study. The first stage involved the selection of relevant locations using cluster sampling technique and the second stage involved the selection of the entrepreneurs using snowball technique. This gave sample size of 90 respondents.

The dependent variable of the study was the amount of money realised from dealing in agricultural waste use enterprises. This was derived from the analysis of the cost benefit ratio of the activities of the entrepreneurs of agricultural waste. The independent variables of the study are extent of dealing in waste collection and extent of constraint realised by the respondents to dealing in waste recycling enterprises.

The data collected was analysed using a combination of analytical tools which include descriptive statistics such as frequency, percentage, and standard deviation; while inferential statistics such as Pearson's correlation analysis was used to test the stated hypothesis.

RESULT AND DISCUSSION

Purpose of dealing in agricultural waste

The respondents were asked the reasons for dealing in agricultural waste recovery. Their responses indicated that 14.4% of the respondents re-use the recovered waste, 71.1% of the respondents sold the waste recovered for money while 14.4% of them consume them. This means that the dominant purpose of dealing in agricultural waste recovery by most of the respondents is for money making. This might be due to resolve to evolve convenient poverty alleviation strategy within their locality. This can be seen as an important livelihood activity that fulfil the entrepreneurs' needs and also with desirable consequence on the environment.

Availability of agricultural waste

The respondents were required indicate the waste materials that were consistently available in their waste recovery activities. Their responses as given in Table 1 showed that cassava peel was the only agricultural waste indicated to be mostly available to majority (60.0%) in the locality. The reason adduced to non-availability of most of other waste materials was that most of the waste generators have found uses for them. This implies that apart from those who take waste recovery as enterprises, there are lots of people who deal in waste recovery activities. This finding established the extent to which waste recovery/re-use activities have been entrenched among the people in the locality.

Table 1: Distribution of respondents by the availability of agricultural waste

Agricultural waste	Always available	Not always available
Bone	23 (25.6)*	67 (74.4)
Blood	33 (36.7)	57 (63.3)
Hide and skin	20 (22.2)	70 (77.8)
Horn	23 (25.6)	67 (74.4)
Hoof	23 (25.6)	67 (74.4)
Rumen content	20 (22.2)	70 (78.8)
Hair and brittle	20 (22.2)	70 (78.8)
Cassava peel	54 (60.0)	36 (40.0)
Yam peel	10 (11.1)	80 (88.9)

*Figures in parentheses indicate the percentage of the frequencies.

Uses of agricultural waste

The respondents were asked to indicate the uses to which they put the recovered waste materials, in a multiple response format. Their responses, as shown in Table 2 revealed that bones are mostly (33.3%) used as animal feed (bone meal/calcium) supplements and to an extent (15.6%) for ceramic materials. The uses to which blood are put by the respondents are (40.0%) livestock feed (blood meal) component and (34.4%) human consumption. Hide and skin are consumed by 18.9% of the respondents; horns and hoofs are usually sold out to those who process them to make ornamental and other fibre materials; and rumen content are used as fertiliser by 22.2% of the respondents. It also revealed that cassava peels are used by most (93.3%) of the respondents as livestock feed; and yam peels are used by 24.4% of the respondents as food.

Table 2: Distribution of respondents by uses to which of agricultural waste are put

Agricultural waste	Uses	Frequency*	Percent
Bone	Consumption	6	6.7
	Bone meal/calcium	30	33.3
	Ceramic material	14	15.6
Blood	Consumption	31	34.4
	Livestock feed component	36	40.0
Hide and skin	Consumption	17	18.9
	Drum making	11	12.2
Horn and hoof	Just sell to collectors	11	12.2
	Used in making of fibre products	12	13.3
Rumen content	Fish fed	6	6.7
	Fertiliser	20	22.2
Cassava peel	Consumption	1	1.1
	Livestock feed	84	93.3
	Fertiliser	3	3.3
Yam peel	Livestock feeds	22	24.4
	Yam flour	11	12.2
	Fertiliser	1	1.1

* Multiple responses

Constraint encountered

The respondents were made to indicate the constraints they encountered in their waste recovery activities. Their responses as given in Table 3 revealed that the problems encountered by most of the respondents in order of severity are anti-nutrient component of materials, bulkiness, storage problem, seasonality, and unavailability. Other problems with lesser severity are low value attached to materials, perishability, transportation, accessibility and cultural reservation.

Table 3: Distribution of respondents by constraint encountered in waste recovery enterprises

Constraints	Serious constraint	Mild constraint	Not a constraint	Weighted score
Anti-nutrient	0 (0.0)	46 (51.1)	44 (48.9)	51.1
Bulkiness	1 (1.1)	39 (43.3)	50 (55.6)	45.5
Storage	0 (0.0)	29 (32.2)	61 (67.8)	32.2
Seasonality	0 (0.0)	27 (30.0)	63 (70.0)	30.0
Waste unavailability	0 (0.0)	19 (21.1)	71 (78.9)	21.1
Low value	1 (1.1)	15 (16.7)	74 (82.2)	18.9
Perishability	0 (0.0)	16 (17.8)	74 (82.2)	17.8
Transportation	2 (2.2)	7 (7.8)	81 (90.0)	12.0
Waste accessibility	1 (1.1)	2 (2.2)	87 (96.7)	4.4
Cultural reservation	0 (0.0)	4 (4.4)	86 (95.6)	4.4

The index of constraints encountered was constructed and used to categorise the respondents based on 'above and below the mean' criterion into level of constraints. Table 5 showed that more (55.6%) of the respondents have low level of constraints. This implies that constraints encountered in waste recovery activities are appreciable but not serious enough for most of the respondents in the study area.

Amount realised

The study also pursued to know the amounts realised from waste recovery activities. The amount realised was grouped into low and high level categories based on 'above and below the mean' criterion. The distribution of the categories, as given in Table 6, showed that most (78.9%) of the respondents are in the low level category of income from waste recovery activities. This might be as a result of the fact of unavailability of most of the waste materials on regular basis (see Table 1). Meanwhile, other waste recovery entrepreneurs use the materials for other purposes other than making money from them as discussed earlier.

Hypothesis testing

The hypothesis tested in the study sought to test relationship between amounts realised from dealings in waste and constraints encountered as well as extent of dealing in waste recovery activities. It is expected that if the activity is really worthwhile, extent of dealing in it should positively influence amount realised from it. Also, It is expected that the constraints encountered should negatively influence the amounts realised from the waste recovery activities. The hypothesis was pursued using Pearson's correlation analysis. The result of the analysis as given in Table 4 showed that the amounts realised from waste recovery activities was significantly influenced by extent of dealing in waste recovery activities but not significantly influenced by constraints encountered. These findings implied that people realise financial benefits from waste recovery activities according to the extent of their involvements. This means that the activity is capable of giving substantial financial benefit to entrepreneurs, which imply that the activity may be engaged in on sustainable basis. Lack of significant relationship between amount realised from the activities and constraints encountered implied that the constraints were not severe enough to remove/reduce financial benefits accruable from dealing in the waste recovery activities.

Table 4: Pearson's correlation analysis between amounts realised and waste recovery factors

Factors	r - value	p – value
Constraints encountered	0.025	0.814
Extent of dealing in waste recovery	0.717	0.000*

* Correlation significant at 0.05 level

CONCLUSION

Based on the findings of the study, it is convenient to conclude that:

1. The finding that most of the waste materials are not readily available might be as a result of the fact that there are lots of people who deal in waste recovery activities. This might not be unconnected with poverty adjustment strategies of the people.
2. The strategy in which people derive benefit from waste is seen as one that can encourage involvements in waste recovery activities. This is a development that would significantly affect waste management in the country.
3. Given the fact that cultural reservation is the least of constraints listed, this attests to the fact that waste recovery activities is socially accepted and may witness entry of more entrepreneurs in the nearest future in the study area.

RECOMMENDATIONS

Based on the findings and conclusions of the study, it is relevant to recommend as follows;

1. Agencies, public and private, involved in solid waste management should encourage waste recovery enterprises because it is an effective way of waste reduction
2. Waste recovery entrepreneurs should be sensitised about the health implications of dealing in waste recovery so as to ensure problem-free activities.

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MOTIVATIONS FOR ADOPTION OF CLIMATE RISK MANAGEMENT STRATEGIES BY ARABLE CROP FARMERS IN IFE AREA, OSUN STATE, NIGERIA

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Abstract

Largely, food production by arable crop farmers in Nigeria is a peasant activity. Several research findings already show that the tropics and developing world would be the worst hit by the adverse consequences of climate change. Sad enough, Large proportion of the population in Nigeria are already subjected to other stresses such as poverty, illiteracy, food insecurity, malnutrition and diseases all of which could interact with climate change to further diminish their wellbeing. The issue of creating a defense against climate change mainly revolves around farmers' level of awareness of climate change and the capacity and capability to adopt necessary climate mitigations or adaptations strategies. In view of this, the study, investigated the factors that motivated arable crop farmers in Ife area, Osun state Nigeria to adopt climate risk management strategies on their farms. Data was collected from 120 randomly selected farmers in Ife central local government area of Osun State. The data were analyzed using descriptive statistics and the logit regression analysis. Results show that 91.6% of the farmers' age falls between 21 and 60 years, 89.1% of the farmers have formal education, 33.6% of the farmers have between 11 – 20 years farming experience, 93.1% have between 1-5ha, 59.7% have knowledge of climate change while 31.1% apply climate risk management strategies. Furthermore, the marginal coefficients of the logit regression indicate that farming experience and farmers' knowledge of climate change were the two important factors that motivated farmers to adopt climate risk management strategies. While farming experience reduced the probability ($P>0.10$) of adopting climatic risk management strategies, farmers' knowledge of climate change significantly increased the probability ($P>0.01$) of adopting it. The study recommends sustained increase in the quality of information dissemination on climate issue through competent extension officers while farmers' wealth of experience should be supported with relevant capacity building opportunities that would help boost their food production potential in the study area.

INTRODUCTION

Nigeria like other countries is not insulated from the effects and consequences of climate change. Globally, efforts are already underway to either mitigate or adapt to the changing climate. While countries classified by United Nations Framework of Climate Change Convention (UNFCC) and Organisation for Economic Co-operation and Development (OECD) as annex 1 and annex 2, the major contributors of green house gases are charged mainly with effort towards mitigation, other countries are charge with effort towards adaptation.

Studies have shown that adaptation efforts are crucial and have helped to reduce the effects of climate change (Easterlings *et. al*., 1993) and Adams *et al*., 1998). Interestingly, Houghton (1996) asserted that even with aggressive policies on reducing the emission of green house gases, they will continue to accumulate thus making adaptation inevitable.

The Agriculture sector is one of the highly vulnerable to climate change in Nigeria and Africa (Mendelsohn and Tiwari, 2000, Parry et. al, 2004). Meanwhile, available information show that developing countries will be more adversely affected by climate change than the industrialized economies. For instance, Houghton, et al., (1997) projects a reduction in the gross domestic product (GDP) of developing countries of between 2 – 9% per year against 1 – 2% for industrialized countries because of climate change. Therefore, crop production must increase by 40% and meat products by 58% in developing countries by 2020 to meet the expected demand that may arise by population growth and increased incomes (Sanchez, 2000).

Though the timing of expected climate change cannot be accurately predicted as observed by Reilly (1995), it becomes critical for developing countries especially Nigeria to show commitment and preparedness to maximize the benefits and reduce the negative impact of climate change through proper planning despite other daunting economic challenges. Experiences of climatic catastrophes in Asia and Latin America with similar economic challenges indicated shortcomings in government's preparedness (Salinger, et al., 2000). Erda *et al.*, (2005) suggested therefore that anticipatory and precautionary adaptation which is more cost effective and less costly compared to forced, last minute emergency adaptation, disaster relief would be ideal in these situations. He stated further that immediate benefits can be gained from better adaptation to existing climate variability and can be gained by removing current bad adaptive policies and practices.

Farmers in Nigeria are observed to have little adaptive capacity. The reason for the shortage of adaptive capacity is the lack of scientific, technical, financial and institutional capacity to evaluate the impact of climate change. Also, large proportion of the farming population is subject to stresses such as poverty, illiteracy, food insecurity, malnutrition and diseases. All of which could interact with climate change to further diminish their wellbeing. In Nigeria support given to farmers to support climate relate disaster is uncommon, thus the business of adopting a climate risk management strategy (CRMS) is private. Therefore farming households engage in farm management practices that help to reduce their losses against the adverse effects of climate change. Thus it is at the discretion of farmers to engage or not in these Climate risk management strategies (CRMS). The CRMS are climate adaptation strategies and these involve (a) the farmers systematic use of climate information to reduce the uncertainty that impacts planning and decision making, (b) climate-informed technologies that reduce vulnerability to climate variability (e.g., crop diversification, water harvesting, irrigation, improved water use efficiency, breeding for heat or drought tolerance), and (c) climate-informed policy and market-based interventions that transfer some part of risk away from him.

Efforts to adapt to the impact of climate change can therefore hope to succeed only if they prove effective at managing the challenges that climate risk currently imposes on agriculture. To this end this study seeks to investigate the factors that influence whether farmers adopt any climate risk management strategy on their farms or not in Ife central local government area of Osun-state.

THEORETICAL FRAMEWORK

It is widely acknowledged that the risk factor is an important component in determining whether a farmer will adopt a technology which is new to him, and that it operates particularly against the poorer farmer, in that he has few reserves to protect him in the event of failure. Roiling, (1985) opined that the role risk aversion play in slowing down the adoption of new technology small-scale farmers have no margin of error, because there is little or no production surplus. He stated Further that both common sense and several published surveys indicate that small-scale farmers are likely to be slower to adopt new technology, when the risk involved is high; however in practice the risk factor seems to have had a surprisingly small effect on research or technology recommendations where small effect farmers are concerned.

This study takes after similar studies that have investigated technology adoption by farmers. Generally technology adoption has been said to be affected by factors such as; availability of credit, limited access to information, aversion to risk, inadequate incentives, farm tenurial arrangements, insufficient investment in human capital, inadequate farm size, abscence of equipment to relieve labour shortages, unreliable and insufficient complementary inputs and inapropriate transport infrasture (Feder et al., 1985). Following other studies, this study represented farmers who use a CRMS as "1" while those that do not use is represented as "0" (Amemiya, 1981; Jamnick and Klindt, 1985). Further it is assumed that the farmer is an independent decision maker who makes rational choices and maximizes his utility (Amemiya, 1981; Rahm and Huffman, 1984).

Based on the cumulative logistic probability function, the logit model was used for transforming the dependent variable to predict probabilities within the bound of 0 and 1. The dependent variable thus becomes the natural logarithm of the odds when a positive choice is made and the model is specified as

$$\ln\left[P_x/(1-P_x)\right] = \sum B_i X_i \text{..............................(1)}$$

Where P_x = the probability that farmers use tractor for an observed set of independent variables X_i where B_i = the regession coefficient to be estimated.

The relationship between the adoption or rejection of new technology and risk aversion is not a simple one. As Feder et al (1981) observed, innovation entails both subjective risk, in the lack of familiarity with new technology makes the farmers yield less certain and an objective risk, in that the innovation may be more vulnerable to bad weather or pests than the traditional practice it replaces. Farmers' assessment of the risk involved is a composite of many factors, of which the nature of technology itself is very important. Others include his faith in the extension workers competence previous experience in agriculture and the amount of information he is given concerning the new technology.

The difficulty involved in isolating or measuring the different variables mean that, although risk aversion is assumed to be a component in the behavior of the small-scale farmers, there is very little certainty as to its relative importance and as to the extent to which the farmer's perception of risk is a correct one. In line with the preceding argument, this study attempted to investigate farmers' attitude to climate risk by classifying them into adopters and non-adopters of climate risk management strategies as well as identifying the factors that influence this classification.

MATERIALS AND METHODS

The study area is Ife central local government area and falls within the rainforest zone of Osun state. This local government is purposely selected because it is peri-urban, comprising substantial population of civil servants as well as residents with farming as their primary occupation. Ife central local government area covers communities such as Ajebamidele, Ajegunle, Eleyele, Ilare, Iremo, Moore, Opa-seminary, Oluorogbo, Obafemi Awolowo Teaching Hospital and Sabo. However substantial agricultural activities take place in Ajebandele, Mayfair and Opa-seminary

The field survey took place between January and February 2009. The researcher and staff of the Agricultural Development Programme (ADP) Osun state participated in the survey. Questionnaires were administered on 40 randomly selected farmers in the 3 major farming communities namely; Ajebandele, Mayfair and Opa-seminary to give a total of 120 respondents. Information were collected on their demographic, socioeconomic, farm and production variables.

The logit model was used to identify factors that motivated farmers to adopt climate risk management strategies (CRMS) on their farms. This model has been widely used to capture decision making on the use of a technology with binary outcomes of the dependent variable. (Awotide *et al.* (2004) and Oni *et al.* (2004). The model postulates that the probability (Pi) that a farmer would adopt a CRMS is a function of an index Zi, which is also the inverse of the standard logistic cumulative function of P_i i.e

$$P_i\,(Y=1) = F^{-1}(P_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

$$\text{Then, } Z_i = F^{-1}(P_i)$$

This index summarizes a set of attributes (X_{is}) and is a linear function of the attributes i.e

$$Z = b_0 + b_1X_1 + b_2x_2 +, \ldots\ldots\ldots\ldots.. + b_nX_n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

The probability that a farmer will adopt a CRMS is given by

$$Pi(Y=1) = \frac{1}{1+e^{zi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

While the probability of not being able to adopt a CRMS is given by

$$1 - Pi(Y=1) = \frac{1}{1+e^{zi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ (5)$$

and

$$e^{zi} = \frac{Pi(Y=1)}{1-P(Y=1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(6)$$

The dependent variable, (Y_i) takes the value 1 if the farmer adopts any CRMS and 0 if he does not. Since the dependent variable is binary, the ordinary least square (OLS) technique is inappropriate to estimate the model (Pindyck and Rubinfield, (1981), Scolt et al., 1997). The maximum likelihood estimate MLE is used to model the regression. The probability of a farmer to adopt a CRMS can be estimated from the average value of Zi as

$$z_i = \ln\frac{P_i}{1-P_i} = b_0 + b_iX_i + b_2X_2 + \ldots\ldots\ldots.. + b_nX_n \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(7)$$

The dependent variable (Y) is adoption of a CRMS. A farmer that adopts any of the CRMS is scored “1” while a farmer that do not adopt is scored ‘0”

The independent variables are;

X_1 = Age in years (AGE)

X_2 = Household Size in numerical value (HSIZE)

X_3 = Educational status in years (EDSTAT)

X_4 = Frequency of contact with extension agent per year (EXTAGN)

X_5 = Farm size in Hectares (FARMSI)

X_6 = Farming experience in years (FRMEXP)

X_7 = Total crop output computed as their grain equivalent following Olayemi *et., al.* (1986) (TOTOUT)

A priori expectations of variables included in the models

The variables X_1(Age) , X_2 (household size) , X_3 (educational status) , X_4 (contact with extension agent), X_5 (farm size), X_6 (farming experience) and X_7(total output) respectively, all have positive relationship with the probability of adopting a CRMS.

RESULTS AND DISCUSSION

The socioeconomic characteristics of farmers in the study area are presented in Table 1. Results show that 91.6% of the farmers' age falls between 21 and 60 years, 89.1% of the farmers have formal education, 33.6% of the farmers have between 11 – 20 years farming experience, 93.1% have between 1-5ha, 59.7% have knowledge of climate change while 31.1% apply climate risk management strategies. The socioeconomic characteristic show that most farmers are in their active production stage, they operate small farm holdings. Surprisingly, while over half of the population is aware of the effect of climate change only a third makes effort to introduce measures that help them reduce the impact of the consequences of climate change. This may be due to the cost associated with making improvements that can reduce climate shocks on their farms.

Table 1: Socioeconomic Characteristics of Famers in Ife Central Local Government Area

Variable	Frequency	Percentage (%)
Age (Yrs)		
21 – 40	52	43.7
41 – 60	57	47.9
61 – 70	10	8.4
Total	119	100
Education (years)		
Primary	21	17.6
Secondary	51	42.9
Tertiary	34	28.6
No formal Education	13	10.9
Total	119	100
Farm size (Ha)		
1 – 5	111	93.3
> 5	8	6.7
Total	119	100
Farming experience (years)		
1 – 10	38	31.9
11 – 20	40	33.6
21 – 30	26	21.9

31 – 40	8	6.7
41 – 50	6	5.0
> 50	1	0.9
Total	119	100
Contact with extension agent per year		
1 – 4	107	89.9
5 - 8	11	9.3
9 - 12	1	0.8
Total	119	100
Knowledge of climate change		
Have Knowledge	71	59.7
Do not have knowledge	48	40.3
Total	119	100
Strategies to adapt to climate change		
Apply	37	31.1
Do not apply	82	68.9
Total	119	100

Factors that Influence Farmers' Adoption of Climate Risk Management Strategies

Table 2 reveals that farm size (FARMSI) increases the probability of adopting a CRMS while farm experience (FRMEXP) reduces the probability. It is expected that as farm size increases, farmers tend to increase their farm investment accordingly, thus more of the household resources is committed to the enterprise and farmers invest more in strategies that helps them reduce any loss that may arise from the effect of bad weather. In the case of a favourable weather, farmers tend to gain more from these investments. Interestingly, farming experience reduces the probability of adopting a CRMS. This is contrary to a priori expectation. It is likely that because farmers have small farm holdings and are resource poor, there is little incentive to invest on a CRMS. Thus farmer may have decided to be indifferent in their response to threats of climate change and relied on experience gather over the years by keeping to farming practices that has always provided a sure but less than optimal returns. Table 3, which shows the distribution of the dependent variable indicate that only 37 farmers adopt a CRMS while 82 do not of the 119 farmer used for analysis. The diagnostic statistics however shows a weak relationship between the dependent and the independent variables but was able to achieve the study objective. Furthermore, the Marginal effects of the dependent variables on the independent shows that farmsize can substantially increase the probability to adopt a CRMS while farming experience has very negligible effect on reducing it (Table 4).

Table 2: Result of the Logit Model

Variable	Coefficient	S/Error	T value	P value
CONSTANT	3.715	3.797	0.978	0.328
HSIZE	-1.507	1.084	-1.390	0.164
EDUSTAT	0.486	0.499	0.975	0.329
EXTAGN	-0.768	0.968	-0.793	-0.427
FARMSI	0.556***	0.316	1.760	0.078
FRMEXP	-0.002**	0.000	-2.320	0.020
TOTOUT	0.389	0.019	0.202	0.840
Log likelihood	-69.60755			
Restricted log likelihood	-73.76075			
Chi-Squared	8.306402			
Significance	0.3063526			

*Significant at 10% and **Significant at 5%

Table 3: Dependent variable component of the regression model

Dependent variable (Yi)	Population of farmers
Farmers that apply climate adaptation strategies	37
Farmers that did not apply climate adaptation strategies	82
Total	119

Table 4: Marginal effects of logit regression coefficients

Variable	Coefficient	S/Error	T value	P value
CONSTANT	0.772	0.793	0.974	0.330
AGE	-0.313	0.225	-1.392	0.164
HSIZE	0.101	0.103	0.975	0.329
EDSTAT	0.108	0.108	0.992	0.321
EXTAGN	-1.596	0.201	-1.793	0.427
FARMSI	0.115***	0.659	1.754	0.079
FRMEXP	-0.000**	0.000	-2.297	0.021
TOTOUT	0.000	0.003	0.205	0.838

*Significant at 10% and **Significant at 5%

CONCLUSION AND RECOMMENDATIONS

The study identified factors that motivate farmers to adopt any of the climate risk management strategies. Though the logit model indicated a weak relationship between the dependent and independent variables, farm size and farming experience are two important considerations taken by farmers to adopt a CRMS. The study recommends sustained increase in the quality of information dissemination on climate issue through competent extension officers while farmers' wealth of experience should be supported with relevant capacity building opportunities that would help boost their food production potential in the study area. Also, Land reforms that would allow farmers access to large cultivable land areas should be introduced by the state government.

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DETERMINANTS OF PUBLIC WILLINGNESS TO FUND URBAN TREE PLANTING IN LAGOS METROPOLIS, NIGERIA

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Abstract

This study examined the public willingness to finance urban tree planting in Lagos metropolis, Nigeria and the associated factors capable of influencing the willingness. Descriptive statistics and Tobit model at 5% level of significance were used to analyse data obtained from multi-stage randomly sampled 873 Lagos metropolitan residents.

The results revealed that 84% of the respondents were willing to contribute funds to Urban Tree Planting (UTP) in Lagos metropolis with ₦1000 being the modal value of what they were willing to contribute annually. Furthermore, 78.92% of the respondents expressed interest in tree planting, 81.67% were living or working in a green environment and 91.18% were aware of environmental issues. Also 18.10%, 22.45%, 23.25% and 30.24% had made use of Nature Park, Botanical Gardens, Zoological Gardens, and Street Trees respectively, while 20.73%, 12.83% and 12.83% had made use of urban forest for religious purposes, provision of medicinal plants and solitude respectively. Fourteen of the 25 regressors were found to significantly affect both the willingness to fund and the prospective contributory amount for UTP in Lagos metropolis.

The large proportion of the respondents who expressed interest in tree planting and were willing to contribute funds to urban tree planting portends a great potential for community funding of urban tree planting in Lagos metropolis.

INTRODUCTION

Sustainable urban forestry development calls for a regular and consistent funding both for the establishment and management of the urban trees and forests.

Like any other public service, the establishment and management of urban trees are largely dependent on government funding which are basically prone to changes in political priorities. Therefore, sustained government funding of urban forestry development is fraught with great challenges because of competing demand for government funds and the little immediate direct money benefits accruable to urban forestry development, particularly in developing countries. Consequently there is an urgent need to explore all possible sources of private funding for urban forestry development and subsequently set up appropriate mechanisms to harness such funding opportunities. Lagos state government effort in urban forestry development started in 1985 with the planting of *Delonix regia* and *Azadiracta indica* (Neems) on some of the streets adjoining the state's secretariat.

However, progress in urban forestry development has been very slow, until 2001 when government commenced to solicit for private participation in the development of the state through the private support initiative (PSI) programme. The PSI has inadvertently brought some progress to the development of urban forestry in the state through the participation of some companies in the development of nature parks and beautification of roundabouts. Nevertheless, it is still very imperative to look into other possible private based innovative funding for urban forestry development in the state. The objective of this study therefore is to investigate the Lagos residents' willingness to fund tree planting programme in the metropolis.

DATA COLLECTION AND ANALYSIS

The data for this study were obtained from a questionnaire survey of 900 residents of Lagos metropolis, using contingent valuation method. Adapting Aluko's (1996) socio-economic stratification of Lagos metropolis according to property values, a multi-stage random sampling procedure was adopted to stratify the metropolis into three socio-economic communities, viz. high, medium and low class communities. Thereafter, each of the three (3) communities was then stratified into neighbourhoods. Five (5) neighbourhoods were subsequently randomly sampled from each of the communities. Names of major streets in each of the resulting neighbourhoods were collected from the metropolitan planning authority. Using a table of random numbers, three streets were picked from each of the fifteen neighbourhoods. Twenty respondents were sampled in each of the three selected streets of the fifteen neighbourhoods. This gave a total sample size of 900 respondents. In all 873 questionnaires were used for the analysis, having discarded 27 for inconsistency. Data obtained were analysed with descriptive statistics and Tobit model at 5% level of significance.

The Analytical Model

Willingness to fund Lagos metropolitan tree planting programme is conceptualised to involve a two step simultaneous decision by the respondents. This entails:

i. whether or not to participate in funding the project; and

ii the amount of money the decision maker is willing to contribute after the initial decision has been made.

Tobit model (a hybrid of probit and multiple regression models) is appropriate in capturing such a decision process (Tobin, 1958).

Model Specification

The one limit Tobit model for this study is specified as follows:

$$WF = WF^* = X_i\beta + e_i \quad \text{if } X_i\beta + e_i > 0$$
$$= 0 \quad \text{if } X_i\beta + e_i = \leq 0 \qquad \text{equation (1)}$$

Where;

X_i = the vector of explanatory variables.

WF = limited dependent variable

WF * = continuous dependent variable which is observed only when it is positive.

β = vector of unknown coefficients

e_i = error term ; $\sim NI(0,\sigma^2)$

Following McDonald and Moffit (1980), the expected value of **WF** in the model is:

$$EWF = X\beta F(z) + \sigma f(z), \qquad \text{equation (2)}$$

Where $z = X\beta/\sigma$,

f(z) = the unit normal density,

F(z) is the cumulative normal distribution function.

σ = standard error of the estimate of the dependent variable WF.

X and β are as previously defined in equation (1).

Furthermore, the expected value of **WF** for those willing to participate in contributing funds to tree planting programme in the metropolis (i.e. prospective contributory amount) is given as

$$EWF^{*} = X\beta + \sigma f(z)/F(z). \qquad \text{equation (3)}$$

Consequently, the basic relationship between the expected value of all observations; *EWF,* the expected value conditional on willingness to contribute funds to urban tree planting in the metropolis; EWF^{*} (i.e. the expected contributory amount), and the probability of contributing; *F(z)* is

$$EWF = F(z)\, EWF^{*} \qquad \text{equation (4)}$$

If we consider the effect of a change in the ith explanatory variable 'X' on WF:

$$\delta E\mathrm{WF} / \delta X_i = F(z)(\delta E\mathrm{WF}^{*} / \delta X_i) + E\mathrm{WF}^{*}(\delta F(z) / \delta X_i) \qquad \text{equation (5)}$$

Equation (5) shows the total change in WF being disaggregated into two parts: (1) the change in WF of those that are willing to contribute money (expected value of amount to be contributed weighted by the probability of contributing money), and (2) the change in the probability of contributing money weighted by the expected value of the amount of money to be contributed.

Also the change in the probability of contributing funds to urban tree planting in Lagos metropolis as independent variable X_i changes is;

$$\delta F(z) / \delta X_i = f(z)\beta_i / \sigma \qquad \text{equation (6)}$$

And the change in contributory amount with respect to a change in an explanatory variable among the participant is

$$\delta E(\mathrm{WF}^{*}) / \delta X_i = \beta_i \{1 - zf(z)/F(z) - f(z)^2 / F(z)^2\} \qquad \text{equation (7)}$$

β and σ were obtained from the maximum likelihood estimates (MLE) and used to compute each of the terms in equations (5) (6), and (7).

RESULTS AND DISCUSSIONS

Analysis of Willingness to Contribute Money to Urban Tree Planting in Lagos Metropolis

The results in Figures 1 and 2 show that 84% of the respondents were willing to contribute funds to UTP in Lagos metropolis with a modal value of N1000 per annum.

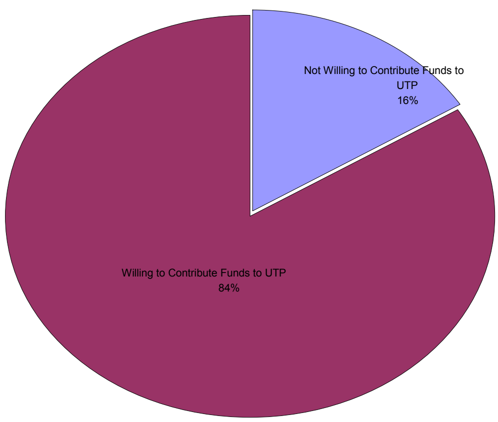

Figure 1: Percentage Distribution of Respondents Willing to Contribute Funds to UTP in Lagos Metropolis

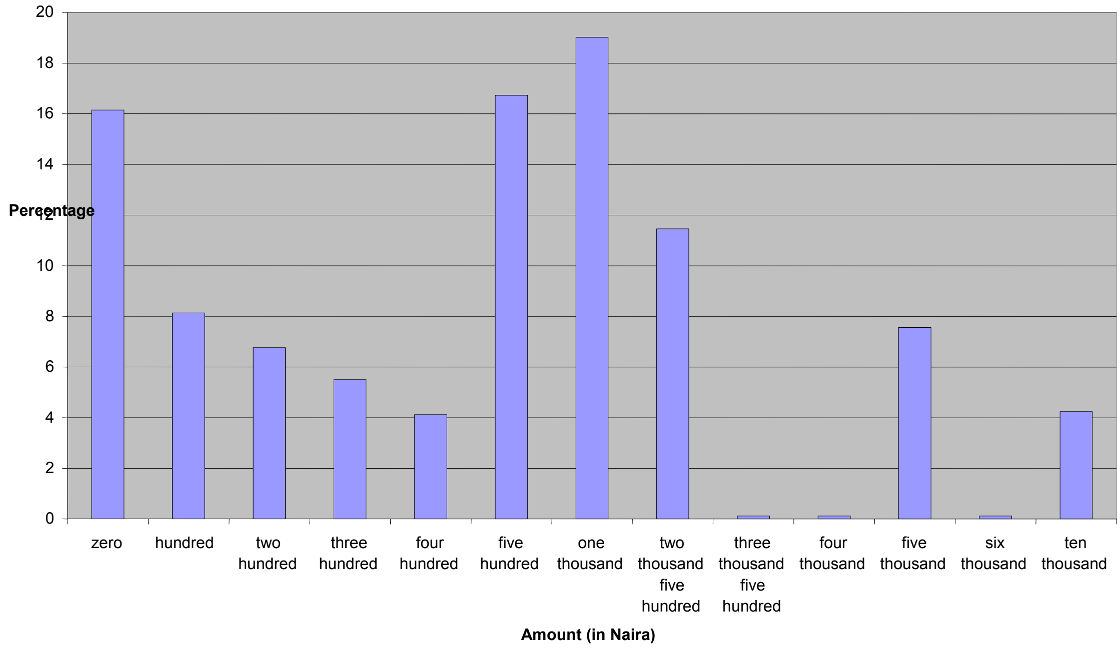

Figure 2: Percentage Distribution of Prospective Contributory Amounts to UTP

The MLE coefficients of the Tobit model used to investigate factors affecting the probability of contributing money to urban tree planting in Lagos metropolis and the prospective contributory amount are shown in Table 1 below.

Table 1: Tobit Model Estimates for Evaluation of Public Willingness to Finance Urban tree planting in Lagos Metropolis

Variable	Coefficients	Standard Error	Mean	P[|Z|>z]	Total change $\delta EWF / \delta X_i$	Change in the probability of contributing money $\delta F(z) / \delta X_i$	Change in the contributory amount $\delta EWF^* / \delta X_i$
Constant	-1920.85***	385.07	-	0.0000	-8.7738	-0.0154	-162.39
LIWOGRENT	488.93**	243.28	-0.3272	0.0445	2.2333	0.0027	41.33
AWENVTIS	993.80***	359.69	-0.2323	0.0057	4.5393	0.0054	84.02
MEMSORG	-511.79	396.71	-1.0915	0.1970	-2.3377	-0.0028	-43.27
NATUPARK	-88.96	234.85	-0.9622	0.7048	-0.4063	-0.0005	-7.52
BOTGARD	169.43	208.34	-0.9188	0.4161	0.7739	0.0009	14.32
ZOOGARD	1.10	1.76	-3.1968	0.5318	0.0050	0.000006	0.09
SOLITUDE	-74.80	259.59	-1.0149	0.7732	-0.3417	-0.0004	-6.32
PICNIC	188.52	258.09	-1.0092	0.4651	0.8611	00010	15.94
MEDPLANT	584.25**	254.90	-1.0149	0.0219	2.6686	0.0032	49.39
INTREP	711.98***	234.54	-0.3547	0.0024	3.2521	0.0039	60.19
URWOOL	529.78**	215.38	-0.9359	0.0139	2.4198	0.0029	44.79
STRTREES	592.64***	191.66	-0.8410	0.0020	2.7070	0.0033	50.10
RESDOWN	357.09*	183.65	-0.5904	0.0518	1.6311	0.002	30.19
EMPLOYED	237.15	215.60	-0.4954	0.2714	1.0832	0.0013	20.05
PENSIONER	1072.26***	353.84	-1.0858	0.0024	4.8977	0.0059	90.65
STUDENT	396.44*	227.02	-0.9027	0.0808	1.8108	0.0022	33.51
TEREDU	139.33	288.10	-0.3741	0.6287	0.6364	0.0008	11.78
SECEDU	-111.77	337.12	-1.0126	0.7402	-0.5105	-0.0006	-9.45
PRIMEDU	869.47*	455.64	-1.1041	0.0564	3.9714	0.0048	73.50
GENDER	0.98	1.75	-2.8844	0.5759	0.0045	0.000005	0.08
INCOME	0.01***	0.003	22572.22	0.0022	0.00005	$5.49x10^8$	0.00085
HICLAN	243.84**	110.43	-8.8078	0.0272	1.1138	0.0013	20.61
MECLAN	-244.53**	110.43	-8.8318	0.0268	-1.1169	-0.0013	-20.67
AGE	-1.52	2.30	28.33	0.5099	-0.0069	-0.000008	-0.13
Sigma	2431.25	64.42	-	0.0000			

Number of samples	= 873
Number of positive observation	= 733
Proportion of positive observation (%)	= 83.96
Z-score	= -2.61
f(z)	=0.005
Log likelihood function	= -6857.13***

Note: NS= Not Significant; * = significant at p<0.1; ** = significant at p<0.05; *** = significant at p<0.01.

Results from Table 1 show that 14 of the 25 regressors had significant influence on *WCM* (the probability to contribute money to urban tree planting in Lagos metropolis and the prospective contributory amount). The intercept value of -8.7738 which is the autonomous total change in willingness to contribute money to UTP in Lagos metropolis as can be observed from Table 1 is significant and has negative sign. This is decomposed to 0.0154, the autonomous probability of contributing money to UTP in Lagos metropolis, and 162.39 the autonomous prospective contributory amount to UTP in Lagos metropolis.

Results from Table 1 further show that "living or working in green environment" (LIWOGRENT) significantly and positively influence *WCM*. The coefficient of the intercept dummy of the respondents who are living or working in green environment and are willing to contribute money to UTP in Lagos metropolis is 41.33. This implies that relative to those who are not living or working in green environment; the prospective contributory amount to UTP in Lagos metropolis is expected to increase by ₦41.33 for those living or working in green environment than that of those who are not working or living in green environment. Similarly, the coefficient of the intercept dummy for those who are living or working in green environment but are not willing to contribute money to UTP is 0.0027. This also implies that relative to those who are not living or working in green environment; the level of autonomous probability (0.0154) of contributing money to UTP in Lagos metropolis will increase by 0.0027 for those living or working in green environment. Summarily put the probability of a person who is living or working in green environment to contribute money to UTP in Lagos metropolis is 0.0181 (1.8%), while that of a person not living or working in green environment is 0.0154 (1.5%). Also the individual living or working in a green environment is expected to contribute ₦41.33 above the amount the person who is not living or working in green environment will contribute to UTP in Lagos metropolis. Following the same procedure for the interpretation of decomposed coefficients for all the other significant dummy variables in the model, the following results were achieved.

Awareness of environmental issues (AWENVTIS) has significant and positive influence on *WCM*. The probability of a person who is aware of environmental issues to contribute money to UTP in Lagos metropolis is 0.0208 (2.1%) as compared to 0.0154 (1.5%) for those who are not aware of environmental issues. Such an individual is expected to contribute ₦84.02 above what the person who is not aware of environmental issues will contribute to UTP in Lagos metropolis. These results reinforce the need for effective information dissemination on environmental issues, particularly with reference to the invaluable role of the urban forests in mitigating climate change.

Collection of medicinal plant (MEDPLANT) has significant and positive influence on *WCM*. The probability of a person who has collected medicinal plants from an urban forest in the metropolis is 0.0189 (1.9%), while such an individual is expected to contribute ₦49.39 above what the person who has never collected medicinal plants from the metropolitan urban forests. The importance of medicinal plants as benefits obtained from the urban forest was corroborated by Popoola and Ajewole (2001) and Ajewole and Aiyeloja (2004) who reported that medicinal plants ranked second in importance among the benefits from the urban forest. Previous use of urban woodlot for religious purpose (URWOOL) also has significant and positive influence on *WCM*. The probability that an individual who has made previous use of an urban woodlot for religious purpose will contribute money to UTP is 0.0183 (1.8%), while such an individual is expected to contribute ₦44.79 above what the person who never used an urban woodlot for religious purpose would contribute.

Furthermore, previous use of street trees (STRTREES) has significant and positive influence on *WCM*. The probability that an individual who has made previous use of street trees will contribute money to UTP is 0.0187 (1.9%), while such an individual is expected to contribute ₦50.10 above what the person who has not made previous use of street trees would contribute to UTP in the metropolis. The significance and the signs of the three foregoing variables conform with the findings of Ajewole (2003) which found out that being a past beneficiary of the urban forests of Ibadan metropolis had positive and significant influence on willingness to contribute finances to the rehabilitation of the degraded forest reserves of Ibadan metropolis.

Interest in planting trees also has significant and positive influence on *WCM*. The probability that such an individual will contribute to UTP is 0.0193 (2%), while the individual is expected to contribute ₦60.19 above what the person with no interest in tree planting would contribute to UTP in Lagos metropolis. This information is very germane to UTP programme in the metropolis bearing in mind that 79% of the respondents indicated interest in tree planting. This suggests that with appropriate presentation, many members of the public will be ready to buy tree seedlings for amenity planting, which can also be a form of financing of urban forestry development in the metropolis.

Owning one's residence (RESDOWN) has significant and positive influence on *WCM*. The probability that the person who owns his/her residence will contribute money to UTP is 0.0174 (1.7%), while such an individual is expected to contribute ₦30.19 above the amount that an individual who does not own his/her residence would contribute to UTP in Lagos metropolis. This group of people can be effectively used to mobilise support for urban tree planting, since in many neighbourhoods in Nigeria, there is often an association of owners of residence ("Landlords") which has community development as one of its major objectives.

Being a pensioner and being a student have positive and significant influence on *WCM*. The probabilities that a pensioner or a student will contribute to UTP in Lagos metropolis are 0.0213 (2.1%) and 0.0176 (1.8%) respectively. An average pensioner and student are expected to contribute ₦90.65 and ₦33.51 respectively above what a job seeker would be willing to contribute to UTP in Lagos metropolis. Having primary education is the only educational variable that is significant with positive influence on *WCM*. The probability that a person with primary education will contribute to UTP in Lagos metropolis is 0.0202 (2%), while such an individual is expected to contribute ₦73.50 above the amount the people without formal education would be willing to contribute to UTP in Lagos metropolis. Although income has positive and significant influence on willingness to contribute money to UTP in Lagos metropolis and the prospective contributory amount, the values of its influence on *WCM* are so negligible.

Living in high class neighbourhood (HICLAN) has significant and positive influence on *WCM*. The probability of a person living in high class neighbourhood to contribute money to UTP in the metropolis is 0.0167 (1.7%), while such a person is expected to contribute ₦20.61 above the amount the person that is living in low class neighbourhood would be willing to contribute to UTP in the metropolis. However, living in medium class neighbourhood (MECLAN) has a significant but negative influence on willingness *WCM*. The probability of a person living in medium class neighbourhood to contribute to UTP in Lagos metropolis is 0.0141 (1.4%), while such a person is expected to contribute ₦20.67 less than the amount the person living in low class neighbourhood would be willing to contribute to UTP in Lagos metropolis.

CONCLUSION

The need for a dramatic increase in urban forests in view of their great potential in the mitigation of climate change, contribution to the socio-economic wellbeing of the society, coupled with inadequacy of public funds suggest that private funding will be the most essential component of funding urban forestry development. A creative mix of public and private funds from national, regional (state) and private sources will have to be put in place to achieve sustainable urban forestry development. Interestingly this study has revealed great public potential financial support for urban tree planting in Lagos metropolis. All that is required is to develop effective schemes in harnessing these supportive resources. Some of these may include: collection of entrance fees for parks and herbal arboretum/farms; reduction of company's (land) tax in return for planting and management of urban forests of a specified minimum size; solicitation for philanthropic donations in cash and kind; corporate donations in exchange for publicity; enacting and enforcing laws to ensure that real estate developers allocate and develop a certain percentage of land development for green space (nature's park) as well as sales of souvenirs .

Although Lagos state government is currently making commendable progress in the on-going metropolitan beautification project through its private sector initiative programme, yet some of the aforementioned schemes have to be appropriately adopted in order to achieve sustainable funding of urban tree planting in the metropolis. This study has discovered the significant interest of three major and important groups in contributing finances to urban tree planting in the metropolis. These are students, pensioners and house owners. The youthful zeal and optimism of students if well harnessed can go a long way in raising funds for urban forestry development in the metropolis. Pensioners in their own case are often interested in spending their resources on community development projects. House owners in the metropolis often belong to the association of house owners, which can be used to mobilise funds for the establishment and management of community nature's park. Each of these groups can be used to mobilise a considerable amount of funds for urban forestry development in the metropolis. However strategies to harness the resources of each of these groups will have to be customised since each of them has its own peculiarity and requires different approach. For instance the package that may be appealing to pensioners may not work for the students.

The importance of effective public education on the significance and safety of trees in and around living and working environment can not be over emphasised since findings from this study show that awareness of environmental issues significantly and positively influences willingness to contribute money to UTP in the metropolis. Moreover, since collection of parts of urban trees for medicinal use is a significant factor positively affecting willingness to contribute money to UTP, it becomes very crucial to incorporate medicinal herbal arboretum into nature parks in the metropolis. Interested visitors to these arboreta will have to pay entrance fees and a token to be able to take some herbs from the arboretum. Since high proportion of the respondents (79%) indicated their interest in tree planting, sales of tree seedlings for amenity planting in houses, neighbourhoods and community open spaces can also be one of the mechanisms to harness the funds. Finally, harnessing this potential fund will require the setting up of a board -comprising individuals with proven integrity from different sectors of the society- that will put in place appropriate mechanism to harness and manage the funds

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