1. General introduction

1.1. Urbanization and Agriculture Research

Urbanization is a global process in the developed and developing countries which might be due to shifting of rural masses in search of better facilities and population growth (Cohen, 2006; Drechsel and Dongus, 2010). Many socio-economic and human aspects are directly or indirectly related to urbanization (Satterthwaite et al, 2010). This emerging trend is particularly strong in Asian and African countries. It is estimated that about 60% of the world population will be urbanized in 2030 and if it continues at the same pace then it is expected that the urban population will double between 2000 to 2030 (De and Soni, 2009). This is happening due to food insecurity, conflict, land degradation, unemployment, and lack of infrastructure in rural areas (Ahmad et al, 2009).

Urbanization triggers economic development of cities by tackling unemployment through job creation opportunities (Cohen 2006). It also acts as a driving force of city planners to conserve energy, grow food and reuse nutrients within the existing urbanized area. Urban agriculture often is a result of urbanization processes and climatic change in the given area (De and Sohni, 2009).

1.2. Function of urban agriculture

Urban and per-urban agriculture is playing a significant role in food production strategies and creating job opportunities for the city dwellers in many developing countries. This development act as a driving force to combat economic crises, and environmental pollution due to expanding masses pressure. An additional reason for increasing interest in UPA is that this system provides fresh produce to meet the needs of the consumer demand; reduce transportation cost, create employment for poor households and provide a direct link between producers and consumers (Niang et al., 2002; Nguni and Mwila, 2007; van Veenhuizen and Danso, 2007; Thornton, 2008; Oludare and Ademiluiyi, 2009). The collected qualitative and quantitative data revealed that a number of urban poor are involved in

UPA system as a poverty alleviation strategy. It is estimated that globally about 800 million urban dwellers are engaged in UPA and their related enterprises and more will be involved in the future (Mougeot, 2000). Thus UPA provides an opportunity to strengthen directly and indirectly access to food for the urban poor (Zezza and Tasciotti, 2010). Moreover it also offers opportunities for city planners to sustain and integrate urban farming systems into urban dwellings. (Aubry et al, 2010).

1.3. Socio-economic characterization of UPA of Faisalabad

Agriculture plays a pivotal role in the economic development of Pakistan in the form of provision of food, export for foreign exchange, transfer of manpower to non agriculture sectors, industrial growth and contribution to capital formation. Agriculture accounts for 21% of the country's GDP and employs 45% of its labor force (Government of Pakistan, 2011a). The Indus Plain contributes 25% of irrigated land resources uses 52 million m^3 water of which 80% is utilized by the agriculture sector (Chaturvedi, 2000; Lipton et al, 2003; Government of Pakistan, 2011b). UPA farmers grow vegetables, field crops and fodder that cover the emerging demand of city dwellers. Their source of irrigation is canal and partially treated waste water or some time combination of both as need basis. This polluted water is often rich in nutrients and is mainly used for vegetable production especially in summer when there is shortage of canal water. This waste water is also a source of contamination with heavy metals and pathogens (Ensink et al, 2004; Murtaza, et al, 2008). The widespread environmental contaminations as a result of waste water irrigation poses concern to consumers and producers as it pollutions the underground water and adding heavy metals into the food chain. The typical annual cropping sequence in Faisalabad' s peri-urban areas is wheat-cotton and sugarcane- wheat while cauliflower, gourds and spinach are the most common at the peri-urban fringe.

1.4. Water and nutrient use efficiency in vegetable production

The short cycle vegetable production makes it an attractive enterprise for smallholders in urban areas who are able to sell their produce at their door step thereby saving costs for packaging and transportation (FAO, 2004). However, UPA vegetable production requires major inputs of water and nutrients even if high profits per unit area encourage gardeners to invest in widespread furrow irrigation and bed sowing which utilizes only half the amount of irrigation water compared to flood irrigation. This is particularly important as fresh water from river-derived irrigation canals is increasingly insufficient especially in the summer season to meet the demand of crop intensification and the expansion of irrigation areas (Malik, 1994; Palada et al, 2006). The situation becomes worse when salty ground water is applied for irrigation which results in hardening of cultivated land. A million tube wells were installed during the past 30 years which resulted in the widespread surface accumulation of salts (Sharif, 2011).

The readily available manure from intensive livestock systems in UPA systems decreases the need for mineral fertilizers. In this context quantification of nutrient-use efficiencies in UPA systems may help to formulate policies to foster producer and consumer interests in resource efficient and environmentally safe food production (Öborn et al, 2003; Onema et al, 2003; Safi, 2011).

1.5. Partial nutrient balances and leaching losses in UPA

Intensive UPA farming systems are characterized by high inputs intensities which may cause negative externalities such as heavy metals and pathogens build-up (Kauser et al, 2009; Abdu et al, 2011). Under these conditions nitrogen losses through volatilization, denitrification and leaching losses (Mander and Forsberg, 2000; Huang et al, 2006; Akegbejo-Samsons, 2008). Such vertical nutrient losses are a major challenge in nutrient management strategies and may leads to ground water pollution and low nutrient use efficiency (Fig 1.1). This however,

depends on soil type and irrigation frequency. Leaching of nitrate in Faisalabad has been also provided by Niaz et al. (2004).

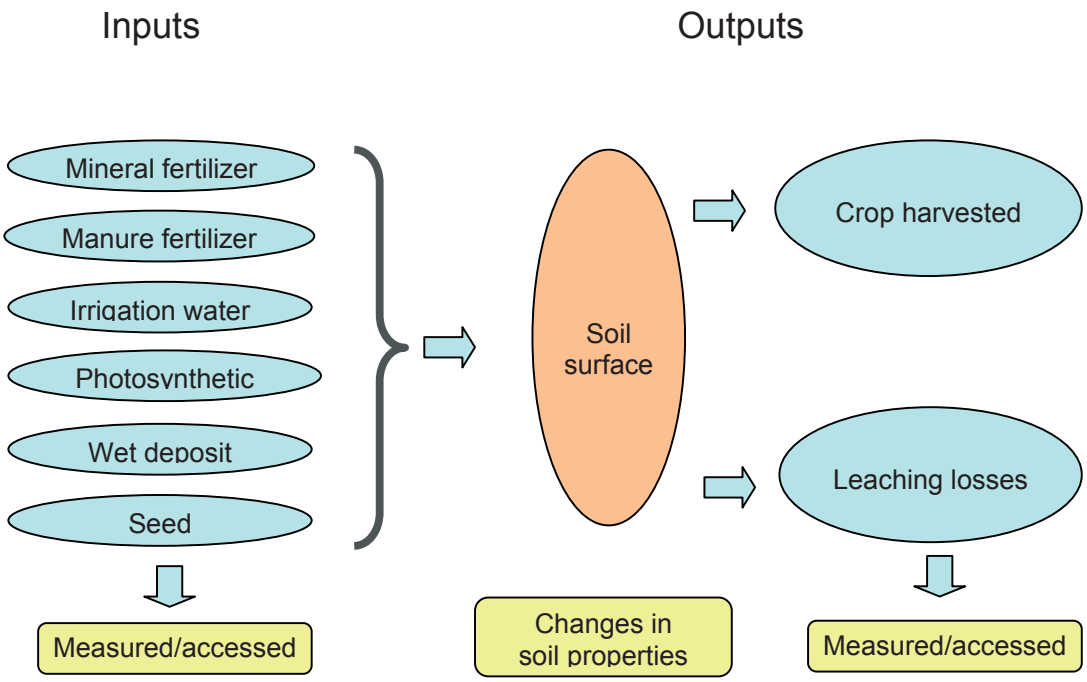

Figure 1.1: Schematic diagram of matter fluxes and leaching.

The soil nutrient status mainly depends upon nutrient inputs through organic, in-organic and irrigation sources and upon nutrient removal through harvested crops, leaching, and volatilization. To reduce nutrient losses by volatilization and leaching, in-depth studies of horizontal fluxes and nutrient balances at the field and farm levels are needed to allow informed management decisions (Öborn et al, 2003; Onema et al, 2003).

1.6. Research hypotheses

In view of the above, this research was designed to address the following hypo-theses:

1. Assessment of the status quo of UPA in Faisalabad will help to identify ineffi-ciencies and to develop strategies for appropriate corrective measures.

2. UPA in Faisalabad operates under economically viable, but ecologically critical conditions leading to substantial nutrient losses which pose risks for the groundwater and UPA-derived produce.

1.7. References

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