Adhitya Wardhono

The Influence of Market Access on Land Use in Central Sulawesi-Indonesia

An Econometric Study Using Panel Data

Cuvillier Verlag Göttingen

The Influence of Market Access on Land Use in Central Sulawesi-Indonesia: An Econometric Study Using Panel Data

Dissertation
zur Erlangung des Doktorgrades
der Fakultät für Agrarwissenschaften
der Georg-August-Universität Göttingen

vorgelegt von
Adhitya Wardhono
geboren in Surakarta

Göttingen, November 2006

Bibliografische Information Der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.ddb.de abrufbar.
1. Aufl. - Göttingen : Cuvillier, 2007
Zugl.: Göttingen, Univ., Diss., 2006

978-3-86727-269-8

D 7

1. Referent: Prof. Dr. Manfred Zeller

2. Korreferent: Prof. Dr. Dr. Winfried Manig

Tag der mündlichen Prüfung: 2 November 2006

Gedruckt mit Unterstützung des Deutschen Akademischen Austauschdienstes.

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1. Auflage, 2007
Gedruckt auf säurefreiem Papier

978-3-86727-269-8

für
meine Geliebten:

Papa
Verstorbene Mama (Allahu yarhamaha)
Ciplis, Pradipta
alle Geschwister

und alle bewunderten „Gurus“,
die mir geduldig in der Weisheit der Wissenschaft vorangegangen sind.

Abstract

Adhitya Wardhono: The Influence of Market Access on Land Use in Central Sulawesi - Indonesia: An Econometric Study Using Panel Data

This study aims to identify and analyse the influence of market access on land use of rural households in the vicinity of Lore Lindu National Park. The descriptive analysis addresses the ownership of land and the characteristics of land use with a special emphasis on market access. Moreover, the causal analysis seeks to answer the questions which micro-economic factors influence land use with special emphasis on market access. The analysis of land use is focused on the three major crops in the research area: paddy rice, cocoa, and coffee. Data was collected through a standardised, formal questionnaire from 264 randomly selected data in two-period surveys during the years 2001 and 2004. The objectives of the study are to: (1) explore the relationship between households' access to market and land use as well as to describe the changes in land use between 2001 and 2004 with respect to the market access, (2) analyze the influence of market access on land use between 2001 and 2004 focusing on three main crops: paddy rice, coffee and cocoa, and (3) provide recommendations to support policy forms and implementation of a rural development program.

The issue of market access influencing the decision of the households to cultivate agricultural land use becomes a central theme in this study. Concerning the differences households of access to markets by the poverty group both survey periods is significant whereas 54% in 2001 and 62% in the year 2004 poorest households were able to reach markets. The percentage of the poorest and less poor group increased, but that of the poor group decreased in terms of the market access in both survey periods. It is striking that the households with the lowest access to markets are all classified as the poorest.

Using the two survey observations of a set of panel data for STORMA rural households, the econometric results have important implications for my understanding of the influences of the market access on land use pattern and determinant of the households

using fertilizers. The Tobit and Probit model further provides evidence that several variables have a significant effect on the agricultural land use and the allocation of land by crop. These results may, in turn, inform the design of policies and projects directed at the development of upland agriculture and the conservation of forest and land resource in the vicinity of Lore Lindu National Park Sulawesi.

Furthermore, the econometric analysis shows that most of the market access variables significantly influence the households growing crops across the model of estimations. The study highlights the importance of market access for the household decision to grow paddy rice, coffee and cocoa. Another key factor affecting the decision of households to cultivate the farm lands associated with the market access is social capital. Ethnic affiliation has a statistically significant effect on the average share of the households growing paddy rice crops. The negative indication of the variable describes that the ownership of the non-indigenous ethnicity decreased the average share of the households growing paddy rice.

The second part of the econometric model examines the factors influencing the households' fertilizer use. The Tobit random effect and probit random effect of the estimation models show that the number of the organisations as proxy of social capital and distance from homestead to market was statistically significant. With respect to the probability of the households' fertilizer use, this study points out that the more accessible the market for households was, the greater the use of fertilizers.

The results of the analysis are used to suggest some policy conclusions with respect to the changing of land use and accessibility of market and improvement of human capital with respect to poverty alleviation.

Acknowledgements

The past three years have been an incredible journey for me, replete with challenges, tears, and laughter – all requiring a great deal of heart. I was frequently reminded that I did not have enough "heart" to continue pursuing this endeavor by a number of amazing people. This dissertation would not have been accomplished without support of my supervisors, mentors, colleagues, friends and family.

First of all, I would like to thank God 'Allah SWT' for his blessing from the first until the last step of the writing process.

I would like to thank my first supervisor, Prof. Dr. Manfred Zeller for his incredible dedication, infinite encouragement, patience, mentoring and guidance. I have come to realize that he is the role model of a scholar, who I shall try to emulate. Professor Zeller's intellectual curiosity, commitment to the field of rural development economics and immense ability to work has always been a source of inspiration. Throughout this journey, he has instilled in me the dedication to rigor in research. His attention to detail has taught me a great deal not only in the field of my own research but also in teaching. I am also thankful to Prof Dr. Dr. Winfried Manig as my second supervisor, for his helpful suggestions, evaluations and comments on this work.

I am particularly grateful to my best friend Dr. Stefan Schwarze for his valuable discussion, feedback, psychological support and empathy throughout the course of this research.

Without the kind cooperation of those involved in the field research in Central Sulawesi Province, this study would not have been possible. I am grateful to all the research assistants; Sumarno Syamsuri, Yasin, Umar Turunggu, Jonathan, Mohamad Rifai, Raditya Wijaya, Muamar deserve special thanks for the effort they made to collect reliable data, their commitment and their good-humored way of working together as a team. Furthermore, I have to thank all our respondents for patiently answering our

questions. Special thanks go to the village headmen and their families for the warm welcome and cooperation during our field stays.

I particularly appreciated the cooperation with Dr. Nunung Nuryartono, Dr. Alwin Keil, Dr. Istiqomah and Dr. Regina Birner, Christina Seeberg-Elverfeldt, Meike Wollni, Mohammad Asif Khan, Julia Johannsen; all from the Institute of Rural Development and members of STORMA (Stability of the Rainforest Margin) project in Central Sulawesi province, Indonesia.

I would also like to thank the administrative staff members and the librarians at the institute, Mrs. Sabine Hippe, Mrs Gisela Holler, Mrs. Ute Döring, and Mr. Albert Germershausen for their constant help. I would like to express my special thanks to Mr. Fintan Whelan and Mr. Handoyo P. Widodo for help with proofreading the dissertation.

I owe my deepest thanks and appreciation to the German Academic Exchange Service (DAAD) that provided me with scholarships. Special thanks are due to Mrs. Barbara Schwarz-Bergmann and all of the administrative staff at the DAAD desk 422 in Bonn for their kind assistance and support.

Special thanks to all of the Indonesian students and families in Göttingen who supplied a very pleasant atmosphere during my stay in this “city of education”.

Immeasurable thanks to my late Mother, Ibu Ken Darsawarti, who taught me how to successfully combine a professional life and to my Father, Bapak Suhardono Asmo, who taught me how to explore everything beyond face value. My mother in law, Ibu Sukadi, and my grand mother, for their continual support and love that give me the strength to achieve my goals while providing me with the perspective to know what is truly important.

Finally, I would like to thank my wife, Ciplis Gema Qori’ah, for her support and for believing in me during all these years. I would also like to thank my son, Pradipta

Pawitradyaka Wardhono, for cheering me up every time I was tired and depressed and for accepting me as a "part-time" father. Pradipta: No more sleeping without your dad's goodnight kiss; I promise to never come home late again!

This work is dedicated to my late mother, Ibu Ken Darsawarti who taught and gave me the important meaning of life.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ANOVA	Analysis of Variance
BPS	Badan Pusat Statistik
FE	Fixed Effect
GDP	Gross Domestic Product
GDPR	Gross Domestic Product Regional
Ha	Hectare
IDR	Indonesia Rupiah
Kg	Kilogram
LLNP	Lore-Lindu National Park
mill.	million
MLE	Maximum Likelihood Estimators
n.a	not available
OECD	Organisation for Economic Co-operation and Development
RE	Random Effect
SPSS	Statistical Programme for the Social Sciences
STORMA	Stability of Rain Forest Margin
UN	United Nations
UNECE	United Nations Economic Commission for Europe

1. Introduction

1.1 Background

The agricultural sector and rural areas play important roles in the economy of Indonesia. Based on the data taken from the 2000 Year Population Census, approximately 58 percent of the Indonesians are rural inhabitants. Besides contributing to food supplies for the overall economy, the rural areas provide significant contribution to exports and thereby foreign exchange earnings. Nevertheless, the rural areas are less advanced than urban areas in terms of physical infrastructures as well as socio-economic welfare. Consequently, roughly 80 percent of the poor in the country are found in rural areas (SURYAHADI et al., 2006). INDONESIA'S CENTRAL BOARD OF STATISTICS (2001) reported that the poor population in Indonesia was approximately 37.1 million, with 28.6 million living in rural areas.

For this reason, poverty reduction in rural areas is of great priority in many developing countries (PALOMO et al., 2000), including Indonesia. One way to reduce poverty is to increase market access for rural households. Better market access can lead to the reduction of input prices and the increase of output prices at the farmgate level; thus positively influencing productivity (HAU and VON OPPEN, 2002) and increasing household incomes.

The concepts of market access are multi-dimensional and dynamic (PENDER et al., 2001), including access to transportation facilities, distance to roads, condition of roads, distance (or travel time) to populated places, as well as the structure of the market (i.e. the number of traders), as MINTEN (1999), FAFCHAMPS and MINTEN (1998), and REIS and DIANA (2004) exemplify. Households in rural areas often face barriers to market access. It takes much time for them to get access to reliable markets, which are located sometimes far away from their homes. Few households, who have assets (e.g. vehicles), are directly able to reach certain markets (MAKHURA, 2001). The accessibility of the market and market participation embrace potential possibilities for a sustainable improvement of incomes for rural people. Due to the importance of agricultural development in accelerating rural development, the rural markets, a medium of physical and marketing infrastructure, should be improved in the agricultural sector.

1.2 Problem Statement

The vicinity of the "Lore Lindu National Park" (LLNP) is classified as one of the poorest regions in Indonesia. In 1997, mean income was 597,300 IDR, which was more than 50 percent below the poverty line of 1,165,750 IDR per household. Based on the same figure, 97 percent of the villages were classified as below the poverty line (ANZDEC, 1997).

The new phenomenon in this study area is also characterized by an increase in population by 60 percent over the last twenty years, of which 21 percent is due to immigration. In some of the districts, even, population has doubled in the last twenty years. These people have been attracted by the income opportunities in the cultivation of coffee and cocoa cultivations. The areas planted with cocoa have often been located inside the LLNP, and the cocoa area has increased from almost zero to 18,000 hectares during the past two decades. Unfortunately, such areas have been a major source of deforestation (MAERTENS, 2003). Ninety-six percent of households in the vicinity of

the LLNP earn a living from crop production, and crop production accounts for 44 % of the total household's income (SCHWARZE, 2004).

The region surrounding the Lore Lindu National Park is also characterized by inadequate access to credit, to markets for agricultural input and outputs as well as to technology (SFB, 2003, p.193). The low level of rural infrastructure leads to higher input prices and lower output prices at a farmgate level as well as higher transport and transaction costs for farmers procuring seeds and fertilizers. Only two asphalt roads connect the villages in the districts to the provincial capital. MAERTENS et al. (2002) shows with the samples of 80 villages that one fourth of the sample villages mainly in the district of Kulawi and Lore Selatan cannot be reached by car. It takes up to three days for some villagers on foot or by horse to reach the nearest asphalt roads.

1.3 Objectives of the Study

This study is aimed at describing changes in land use during the period of 2001 to 2004 with specific emphasis on market access (agricultural input and output markets). It is part of project A4 "Economic analysis of land use system of rural households" in the scope of the Collaborative Research Centre Stability of Rainforest Margin Areas in Indonesia (SFB 552 - STORMA).

The analysis of the influence of market access on land use by rural households is conducted through a descriptive analysis and causal analysis. The descriptive analysis addresses the ownership of land and the characteristics of the land use. Moreover, it describes the changes in the land ownership and land use between 2001 and 2004. The causal analysis attempts to answer the question of what factors influence the land use with special emphasis on market access. The analysis of land use is focused on the three major crops in the research area: wetland rice, cocoa and coffee. Thus, the objectives of the study are to:

- explore the relationship between households' access to market and land use as well as to describe the changes in land use between 2001 and 2004 with respect to market access,
- analyze the influence of market access on land use between 2001 and 2004 focusing on the three main crops: rice, coffee and cocoa, and to
- provide recommendations to support policy reforms and implementation of rural development programs.

1.4 Organisation of the Study

This study is organized in seven chapters. After the introduction in the first chapter, the second chapter highlights the theoretical framework and empirical literature on the basis of different theoretical concepts that are useful to analyse the influence of market access on land use. The second chapter also reviews the empirical evidence of the influence of market accessibility on land use. This chapter ends with the conceptual framework, which is described for further analysis, and the hypothesis of study is provided.

The third chapter discusses the research methodology and the approach used in the analysis throughout this work. It presents the sampling frame and describes the selection of households. The third chapter ends with the presentation of the methodology employed in the causal analysis. It shows the different econometric models which are applied to analyze the influence of market access on land use as well as the influence of market access on households using agricultural input.

Chapter four provides an overview on the environmental and social conditions of Indonesia particularly in Central Sulawesi and the research area around the Lore Lindu National Park. It focuses on site, geophysical and climatic conditions and the economic structure and land use conditions.

Chapter five provides a detailed result of descriptive analysis of relationship between market access and land use in the study area. This section specifically seeks to explore

the relationship between households' access to market and land use as well as to describe the changes in land use between 2001 and 2004 with respect to the market access.

Chapter six presents the result of the econometric model used in this dissertation. The model is designed to present the influences of market access on land use patterns and to investigate the influence of market access on fertilizer use. The second part of this chapter presents the descriptive statistics of variables. The third part presents the results of the econometric model analyzing the crop choices made by households. Then, the fourth part presents the results of the econometric model analyzing the use of fertilizer.

Finally, the conclusions are presented and recommendations are drawn in chapter seven.

2. Literature Review and Theoretical Framework

2.1 Introduction

This chapter develops the theoretical framework and empirical literature based on the different theoretical concepts that are useful to analyse the influence of market access on land use. This chapter consists of five sections. First, the concept of market access will be explored, and the definitions of accessibility of markets are discussed. Then, the concept of land use is explained. The fourth section presents the definition of the (farm) household. The fifth section reviews the empirical evidence regarding the influence of market accessibility on land use. This chapter ends with the conceptual framework, which is described for further analysis and the hypotheses of study are provided.

2.2 Concept of Accessibility of Market

2.2.1 Transaction Cost Economics

Formerly, transaction cost economics was acknowledged in the economic literature by COASE (1937) in his seminar paper 'The Nature of the Firm', which explained that the decision whether to have a transaction within a firm or in the market place will be determined by transaction costs. WILLIAMSON (1979, 1985, and 1993) views transaction costs as costs associated with reaching and enforcing agreements.

Moreover, he emphasized that transaction costs are seen as a trade-off between the costs of coordination within an organization and the costs of transacting and forming contracts in the market. Transaction costs also refer to those for measuring the valuable attributes of the commodity exchanged and the costs of providing and ensuring the desired attributes (NORTH, 1990).

Nevertheless, transaction costs are difficult to define precisely. Economic literature provides various definitions of transaction costs. FURUBOTH and RICHTER (as quoted by BENHAM and BENHAM, 2000) distinguish two examples of transaction costs: the cost of using the market (market transaction cost) and that of exercising the right to give orders within the firm (managerial transaction costs). Moreover, RANDALL (1972) describes that transaction costs include costs of obtaining information, establishing the bargaining positions, bargaining and arriving at a number of decisions and enforcing the decisions made. On the contrary, on the basis of Coase's work in HOBBS (1997), transaction costs are classified into the costs for information gathering, negotiation and monitoring and the enforcement of contracts.

Addressing the types of activities, EGGERTSON (1990) identifies five types of activities in which transaction costs are incurred. Among them are:

- searching for information about potential for contracting parties and the price and quality of the resources in which they have property rights (i.e. personal time, travel expenses and communication costs),
- bargaining needed to find the true position of contracting parties, especially when prices (e.g. wages, interest rate, etc) are not determined exogenously,
- initiating formal or informal contracts, that is, defining the obligations of the contracting parties,
- monitoring contractual partners to see whether they abide by terms of the contract, and
- enforcing the contract and collecting damages when the partners fail to observe their contractual obligations.

The issue of transaction costs has always been figured importantly in agricultural markets and in marketing agricultural production. In the context of marketing agricultural production, JAFFEE and MORTON (as quoted in MAKHURA, 2001) provide two dimensions of transaction costs, namely:

- screening cost, referring to the uncertainty about the reliability of potential suppliers or buyers and the uncertainty about the actual quality of the goods, and
- transfer cost, concerned with the legal, extra legal or physical constraints on the movement and transfer of goods. This dimension commonly includes handling storage costs, transport costs and so forth.

In agricultural marketing, traders and agro-processors deal with a large number of small farms and face different types of transaction costs (HAYES (2000), PINGALI (2005), and MAKHURA (2001)):

- the bureaucratic costs associated with managing and coordinating integrated production, processing and marketing,
- the opportunity costs of time used to communicate with farmers and coordinate them,
- the costs involved in establishing and monitoring long-term contracts,
- the screening costs linked to uncertainties about the reliability of potential suppliers or buyers and the uncertainty about the actual quality of the goods and
- the transfer costs associated with the legal or physical constraints on the movement and transfer of goods. They also include handling and storage costs, transport costs and so forth.

Some costs are also related to physical details of the transaction, such as transport, marketing, packaging or handling. This is conceptually similar to Haddad and Zeller's idea (1997) that transaction costs are associated with the administrative cost of screening, delivery and the monitoring of implementation program. This view of cost is relevant to this study, as pointed by ZEIBET and DUNN (1998). They emphasize that transaction costs include high transport costs due to the distance of the farm from

market, poor or non-existent infrastructure, high marketing margin due to monopoly power and the high cost of searching and monitoring contracts.

2.2.2 Transaction Cost in Smallholder Farming

Transaction costs can be distinguished as observable costs (i.e. transportation and administrative costs) and unobservable costs (costs of information and contract management), as MAKHURA (2001) points out. GABRE-MADHIN (1999) adds that regarding market exchange, transaction costs occur and involve the costs of information, search, negotiation, screening, monitoring, coordination and enforcement. Further, the concept of transaction costs consists of costs resulting from distance from market, poor infrastructure, imperfect information, high marketing margins supervision and incentive costs. Some of the studies emphasize transaction costs in farmer households, as in the study of de JANVRY et al. (1991) in which they point out the effect of 'missing markets', using a household model to represent a generic Africa household. The study concludes that in the absence of food markets households must be self-sufficient in terms of food, which confines their ability to reallocate land and labour to cash crops. As a result, households paid the broad margin of products between low selling price and high buying price. Moreover, the costs are relevant in the context of the rural economy in which communications and transportation facilities are under-developed; markets are segmented and access to market participation is restricted.

Determination of household-specific transaction costs

Transaction costs, to most farmers, are associated with the participation in the increasingly vertically coordinated markets. The costs in output markets, for example, can affect the choice of market channel, which farmers use (PINGALI et al., 2005). The study of GABRE-MADHIN (1999) describes that in Ethiopia grain brokers have been believed to be the preferred choice among small farmers. Furthermore, transaction costs force wedges between purchasing and selling prices of a household, based on the concept of non-tradable goods taken from international trade theory. The

study of GOETZ (1992) using switching regression model at the household level argues that transaction costs affect farmer decisions whether to buy, sell or participate in the market.

Moreover, if risks are considered, a household will spread the markets for its product, the transaction costs are likely to differ among households within the same village for the same or different market outlets. This, then, can explain the mixed marketing destinations chosen by farmers (ESCOBAL, 2001). Making marketing decisions under transaction costs is therefore influenced by specific household factors. Examples of such factors are asset ownership, access to information (i.e. local knowledge), risk and uncertainty, credit availability, and participation in local networks (PINGALI et al., 2005). Fundamentally, there is a range of factors affecting the behaviour of households in the decision making process regarding market participation. Firstly, the risk or uncertainty of the outcome of participation may sometimes be a major source of transaction cost. However, their effect on transaction costs may not be as direct as transport costs would be or other socio-economic factors that influence the participation decision (MAKHURA, 2001).

The extended findings of risk behaviour regarding market participation by ELLIS (1993) point out that risk behaviour and market participation are interlinked. The explanation of this interplay can indicate that risk and uncertainty play a role in determining the household's decision to go into markets (PINGALI et al., 2005). The uncertainty is decreased by market participation, provided this is based on improved information, communication, market outlets and so on. Nonetheless, the uncertainty can also be worsened by larger market participation, since the safety of subsistence is replaced by the insecurity of unstable markets and adverse price trends. The market participation declines as a result of inhibitive transaction costs. The study of ZEIBET and DUNN (1998) argues that internal transaction costs involve intra-household factors, such as the number of family members and the dependency ratio.

Another perspective of transaction costs related to household decision is recognized by OMAMO (1998) that transaction costs will differ and depend on whether the household is a self-sufficient, a deficit or a surplus producer. The hypothesis is that high transaction costs will influence the commercialisation pattern of the household. This is due to the net buyers of staples, who will prefer to buy less and produce more by themselves and the sellers of cash crops, who will prefer to sell more and produce less for their own consumption.

Addressing the human capital with respect to transaction costs, some variables (i.e. age, gender and education) can have an impact on transaction costs in different ways. In many instances, age can often be indicative of farming experience which makes certain informational and searching costs easier and cheaper, as well as education to reduce the information and search cost. Social capital also can influence the household's decision to reduce transaction costs. Often, the existing network ensures cooperation among farmers in the use of scarce and communal resources such as water (PINGALI et al., 2005).

The basic theoretical explanation of the effects of transaction costs on participation in a competitive market has been proposed by SADOULET and de JANVRY (1995) and DELGADO (1991), FAFCHAMPS et al. (1995), MAKHURA (2001), KOMAREK and AHMADI-ESFAHANI (2006). For instance, Fig 2.1 shows the case of variable transactions costs on the market for food products considered by three different households. The horizontal line represents the quantity of food and the vertical line represents the price. The basis is that transaction costs affect price, which in turn affects traded output. The effective price of the food crops is Ps (i.e., the market price p_m net of transactions costs t_{ps} incurred in selling) and the effective purchase price of the food product is Pb (including the transaction costs t_{pb} incurred in buying). We suppose that, on the one hand, there is the supply of food, $S(p, z_{qi})$, coming from three households, i = 1, 2, 3 and demand for food (D), which own farms of different sizes Zqi. On the other hand, we assume that they all have the same demand for food, $D(p,$

z_c), depending on the characteristics *zc* of the household as a consumer to assist comparison across households.

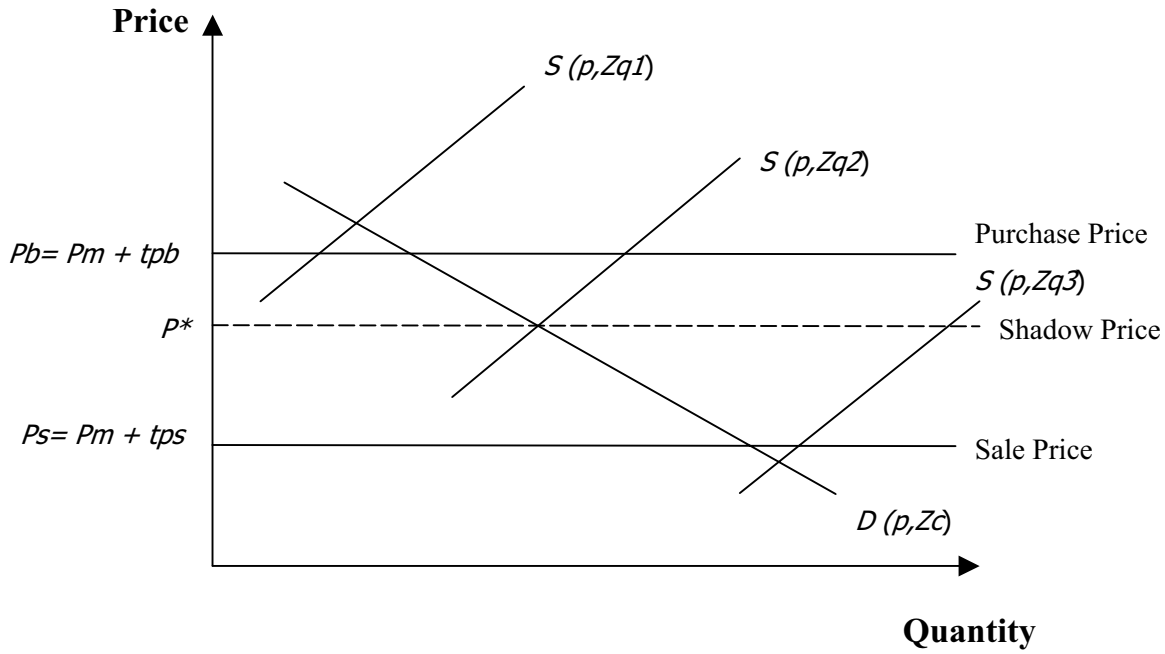

Figure 2.1 Price Band and Market Participation
(Source: de Janvry and Sadoulet, 1995)

Furthermore, figure 2.1 illustrates that the participation of households in the market relies on the relative position of their supply and demand functions and hence, on its endowments in productive resources z_q and on its demand characteristics z_c. The households will be considered net sellers if their supply curve intersects with the demand curve below the sale price, the household's shadow price of the crop is at this intersection. Transaction costs create a price band for self-sufficient households where:

$$Ps \leq P^* \leq Pb$$

In other words, a non-zero price interval exists where households do not participate in the market due to transaction costs. Figure 2.1 also shows that for these households (of type z_{q2} in the figure), it is optimal to remain self-sufficient and adjust production and consumption decisions accordingly. Their behaviour is, consequently, the non-

separable type and their internal equilibrium defines a shadow price $p^*(z_q, z_c)$. Therefore, heterogeneity in household resource endowments corresponds with market participation decisions. A second source of heterogeneity may be derived from differences in transactions costs t_{ps} and t_{pb} among households.

As transactions costs are fixed, they enter the household model. Supposed the case of a single market price (i.e. a case where there are no variable transactions costs) exists, the relative positions of the household's supply and demand curves at that price determine the marketed surplus, which is negative in case of a purchase.

Shortly, the framework analysis above indicates the possible behaviours of deficit and surplus producers when faced with transaction costs. In other words, the existence of transaction costs leads to a lower number of observable transactions than would have been the case if there had not been any transaction costs. The hypothesis is that the hidden transaction costs would negatively affect commercialisation or reduce the potential for market participation (MAKHURA, 2001).

Specification of Location and Transaction Costs

With regard to transaction costs, location specification has become an important concept in determining the level of transaction cost variances across regions, where the difference of experiences between small household farmers in high and in low potential areas occurs. Generally, the small household farmers in high potential areas have better experiences than those in low potential areas. The higher potential areas have more reliable access to production of inputs and markets and the lower costs and risks are associated with the switch to high value crop production. Nonetheless, the exception rests on the irrigated rice lowlands, where the drainage costs associated with growing non-rice crops tend to limit short-term movement between rice and other crops, particularly in the wet season (PINGALI et al., 2005). The other reason states that high potential areas generally have better transportation and communication infrastructure and hence, relatively lower search and information costs.

Moreover, infrastructure services affect transaction costs and affect market development (ESCOBAL, 2005). Transaction costs concerning market access and information tend to increase if road density is low (often the case in low potential areas). Poor road infrastructure also increases transportation time and cost. The getting price of farmers will be the net of a number of these costs if the incentive is not all reduced to come into commercial agriculture. Price and distance to a paved road (an indication of travel cost) both have a significantly negative effect on fertiliser use, due to the transactions costs related to the time taken to search for inputs (STRASBERG et al., 1999; PINGALI et al., 2005). Regarding the location-specific transaction costs, MINOT (1999) argues that transportation costs are basically the most tangible form of transaction costs, defined as the monetary and/or opportunity costs associated with carrying out a sale or a purchase.

Transaction Costs and Crop Choice

Pertaining to the crops-specific transaction costs aspect, PINGALI et al. (2005) explains that transaction costs also vary depending on the product. Not all agricultural products, only the high-value crops (e.g. vegetables) are typically associated with high transaction costs due to the perishable products. The high transaction costs occur due to poor infrastructures such as rural roads and lack of supportive infrastructure. On the other hand, intangible transaction costs occur when an asset-specific investment has been made or when the seller faces a monopolistic buying structure. The precise argument of transaction costs, related to the decline of market participation is elaborated by the study of STAAL et al. (as cited by MAKHURA, 2001) who emphasizes that a low proportion of products exchanged in the market reflects the existence of high transaction costs. A more elaborate concept of crop-specific transaction costs is given by JAYNE (1994) and OMAMO (1998). They show that high transportation costs induce farmers to grow food for home consumption rather than cash crops, even though the latter generate higher returns (where returns are calculated using market prices rather than farm-level opportunity costs).

2.2.3 Definition of Accessibility of Market

Accessibility is a main determinant, considered in the studies of land use and land cover change. In rural land use change studies, the accessibility situation is often described by simple measures of the distance to a location of interest (VERBURG et al. 2004). In this sense, DEICHMANN (1997) points out that accessibility can be defined as the ability to interact and contact with sites of economic or social opportunity (VERBURG et al., 2004). Therefore, different accessibility measures can be defined for different groups of participants based on their preferred sites and means of economic or social opportunity and their means of transport. For most agricultural practices, the market is an important destination for buying inputs (e.g. seeds and fertilizer), for selling agricultural products and for obtaining credit.

At the more conceptual level, rural markets, as part of rural infrastructures, were considered to play an important role in generating income. The development of transport infrastructure and the network and the availability of means of transport are important to integrate rural areas into the rest of the economy. An infrastructure investment changes the livelihood bases, its impact will be reflected in an improved access to services, in changes in the utilization of labour and other markets and in changes in marketing decisions.

To understand the concept of the accessibility of market, one needs first to clearly define what market accessibility is. In this study, the households went to the rural and urban markets through asphalt roads. These roads provide easy access to the surrounding lands regularly served by public transport, and agricultural products are sometimes picked up along these roads by such transport. Within this approach, the study of HAU and VON OPPEN (2002) tends to use time measurement to define the market access due to the fact that households use different modes of transport, so that time is more appropriate than the geographic distance, in spite of various measurement of accessibility with some different units, like simple distance measurement, time and monetary costs and a population potential measurement, as VERBURG et al., (2004) concludes that the advantage of using travel time as a measure of accessibility is the

easy comparison with household level data. In household studies, accessibility is often measured as the travel time to different destinations in the same units as spatial travel time measures. In this study, market access is defined by the time that each household takes to reach the market.

2.3 The Concept of Agriculture Land and Land Use

2.3.1 Household and Agriculture Land

For farmer households, farm land is a key factor for production along with labours, capital and other agricultural inputs. Nevertheless, land cannot be treated in the same way as other inputs of production due to their peculiarities (NURYARTONO, 2005). In contrast to capital and labour, land is characterised by its fixity in supply, which ultimately results in diminishing returns to other inputs (RANDALL and CASTLE, 1985 as cited by OLTMER, 2003). There are some reasons and advantages of access to land through individual ownership. DEINIGER and BINSWANGER (as quoted by NURYANTONO, 2005) mention the five advantages: (1) a land is an effective medium for generating or accumulating wealth and transferring it to the next generation; (2) land ownership serves as collateral for access to credit; (3) land ownership is a source of self-insurance and old-age social security: land can be sold, rent out or pawned for smoothing consumption in response to shock and life cycle stages; (4) land ownership is a source of security in the case of continued access to the same plot of land, offering the possibility of capitalizing on long-term investments and a source of local social capital; (5) land ownership is a source of social status and bargaining power.

2.3.2 Location-specific Agricultural Land Use

In many publications, the aggregate link between agricultural land use and location has been extensively discussed. For instance, VON THÜNEN (1828) argues that economic activity needs not to be spread evenly across space although land cannot be differentiated on the basis of location. The significance of von Thünen's work has widely been acknowledged by other researchers. For example, HITE in 1999 said, "If modern economics begins with Adam Smith, modern location economics begin with von Thünen, we should first look at von Thünen's work that for the most basic

analytical model of the interplay between markets, production, and geography" (p.1) (BURDINA, 2004). Furthermore, von Thünen describes that rural area surrounding cities specialize in different agricultural products. He further argues that the product they specialize in depends on the cost of transporting output to the market. Locations close to the city specialize in high transportation cost goods (e.g. milk and vegetables), while locations far from the destination specialize in less perishable, lower transport cost commodities (e.g. cereals and pulses) (SHIPLI and FAFCHAMPS, 2002).

Rural communities remote from cities tend to turn their trade into self-subsistence in agricultural and non-agricultural commodities produced using small-scale, artisan technology, as KRUGMAN (1991) points out. In short, he develops a model distinguishing between farmers located in concentric circles closer and those located remote from service and information centres (market places). Since the farmers are located far away from the centres, the total production costs, transaction costs to obtain inputs and services and information increase, yet the actual income from agricultural products decreases (price obtained at the market minus transaction costs) (NELL, 1998).

Another important concept considered by von Thünen is the issue of transport costs related to marketing costs and margins; for example, a horticultural farmer may need to shift his or her production area. Thus, the impact of urban expansion on agriculture may be an increase in overall costs. The farmgate price may increase as the costs of inputs are higher and transport costs from farm-gate to market increases because of the remote distance to the urban area (BURDINA, 2004).

The study of SHIPLI and FAFCHAMPS (2002) on the spatial division of labour in Nepal concludes that spatial effects are robust determinants of activity choice and market participation. For instance, a household located right next to a rural market would allocate 40% of its time to non-farm self-employment and 30% to non-farm wage employment compared to 0% for a household located one hour away from the market. Ignoring such spatial effects would undoubtedly bias poverty estimates. Further,

spatial effects are important for policy. This study also concludes that households located more than 5 hours away from towns and markets do not sell crops and consume fertilizers. Any successful efforts to promote agricultural innovation need to take these effects into account.

Von Thünen's method is extended by ALONSO (1964) for location choices of consumers. This prototype model of land use in economics has always been interpreted in the neoclassical economics tradition, because it conforms to the conditions of competitive markets. Thus, the real world is rather different than the isolated state that von Thünen used to develop his theory; in this respect, there are many distortions from the perfect competition envisaged. However, the basic principles he expounded are a very useful tool for analysing agricultural land use. Thus, with urban expansion, pre-urban areas will be under the greatest pressure. The effective impact of this is that producers will adopt intensive production methods (i.e. horticultural crops which provide higher returns). As distance from the centre increases, crop intensity is lower and arable crops prevail.

The strength of spatial economic land-use models is that the models give insights into the decision-making process as to where people convert the use of land (MAERTENS, 2003). Figure 2.2 shows the von Thünen Model for land rent and its use. Since the transport costs differ between crops, the land-use pattern will induce the concentric rings of different land use types around a central market. High value crops, which are more difficult to transport (e.g. vegetables), will be located closer to urban centres than more bulky ones with a lower value and lower transport costs (i.e. grains). The original von Thünen model assumes a featureless plain surrounding a central market (von Thünen, 1826). In addition, the relative location of market, i.e. the location with respect to roads, determines land rent. The model is further elaborated by adding land-rent features according to the work of Ricardo (MAERTENS, 2003). The natural land attributes also matter. The differences in geophysical characteristics bring about variability in natural land productivity. This determines potential agricultural yields and therefore influences land rent. By adding roads and Ricardian features, the original

von Thünen model has become more complex. However, the basic insight of the importance of location and transport costs in determining land rent and land use remains (MAERTENS, 2003; NELSON, 2002).

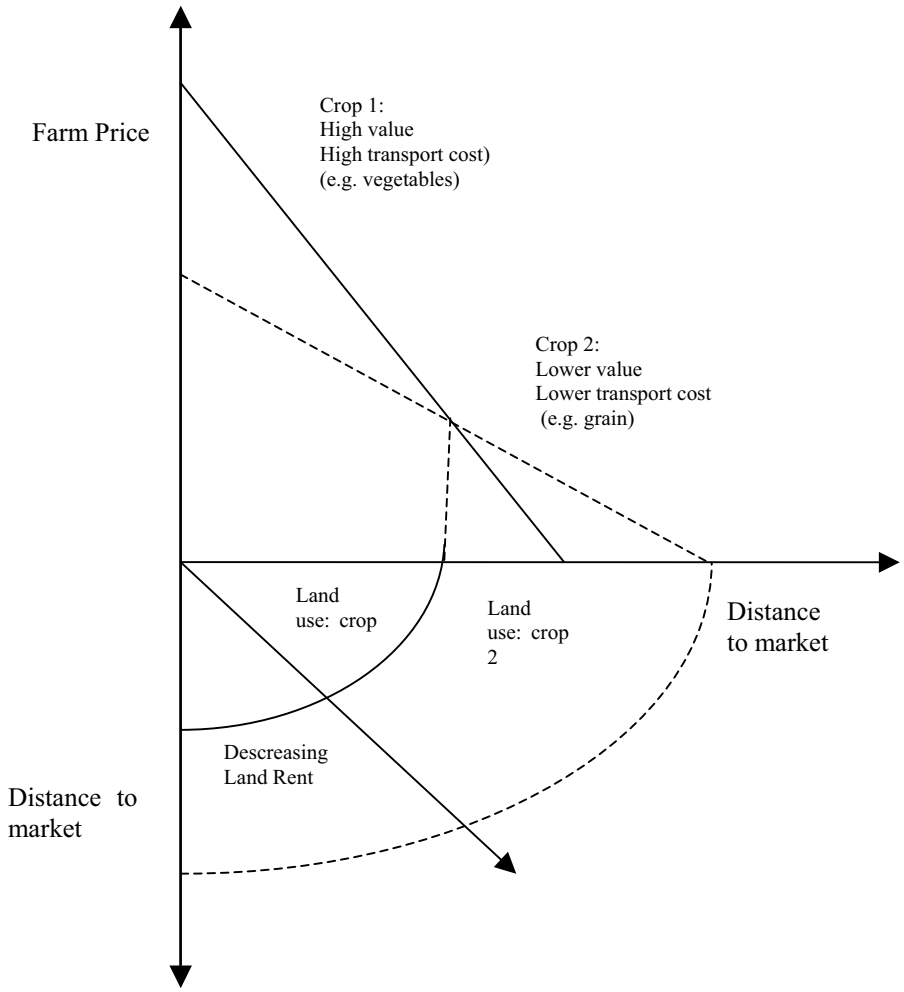

Figure 2.2: The Illustration of the von Thünen Land Rent Theory. Adapted from Nelson (2002) and Maertens (2003)

The von Thünen-Ricardo land-rent theory assumes that each piece of land would be devoted to the use for which it yields the highest rent in consideration of the land quality and the distance to the market. Land use models based on the von Thünen-Ricardo land rent theory are powerful but they require some strong simplifying

assumptions (CUONG, 2005; MAERTENS, 2003; MÜLLER, 2003). Firstly, the von Thünen land-rent model assumes that the landscape is a flat and uniform plain so that movement in all directions is equally comfortable (CUONG, 2005; IRWIN and GEOGHEGAN; 2001). It indicated that transportation costs in the model are a linear function of distance regardless of landscape heterogeneity and the means of transport (MÜLLER, 2003; CUONG, 2005). Secondly, perfect market and profit maximizing behaviour are implicitly assumed (NELSON and GEOGHEGAN, 2002). The classical literature on household models has shown that household utility maximization and profit maximization are the same only when the markets function perfectly, where there are no transaction costs, and production can be adequately characterized without regarding temporal effects (SINGH, et al, 1986). This assumption might be too simplistic for the case of rural areas in developing countries (MAERTENS, 2003). In these regions, markets (e.g. financial markets) are either missing or are imperfect, caused by high transaction costs, a lack of competition or information. In particular, the rural capital and labour market are often cited to be highly imperfect. Therefore, a land allocation decision of a farmer is often not a result of profit maximization behaviour (CUONG, 2005).

Thirdly, the model assumes that there is one central market where all output and input as well as labour are traded, so various land uses are expected to occupy a series of concentric rings surrounding the market location (CUONG, 2005; MÜLLER, 2003; BRIASSOULIS, 2000). However, in the forest margins of the tropical rural upland, land-uses are likely to be diffuse and not well shaped as in the theory (CUONG, 2005).

Fourthly, the von Thünen land-rent theory assumes that the market price of the agriculture products is stable and neither influenced by changing land-use nor by external product supply. This assumption does not hold respecting all products with an inelastic demand such as staple food crops (MAERTENS, 2003). The assumption is more reasonable in the case of export crops with prices determined by world market conditions and not much affected by local supply.

2.4 The Definition of the (Farm) Household

The household is commonly adopted as the basic unit of analysis when considering the economic situation of society. The farm household – or just household – is an important institutional and organizational basis for peasants when executing their daily activities. To understand the concept of the household, one needs first to be clear what the household is. Many definitions of the household that are subject to further debate have been advanced.

MANIG (1991) defines the household as a group of people who

- live together under a common roof,
- use a common kitchen,
- are provided for from a common household budget (income pooling unit), and
- contribute to the common budget from their own income.

According to its function of income generation and distribution, RÄDER (1992) defined the household as follows:

- the household is a functional unit of consumption, production and reproduction of its members. Its production means production for sale, exchange and subsistence, independent of the monetary or non-monetary value of these goods or services;
- the household unit should be considered as a heterogeneous combination of individuals, who interact with each other and whose dealings are oriented towards common as well as individual interests.
- the household and its members cannot be seen as isolated units, they have to be seen in relation to their surroundings, as a component of other small and bigger social groups (*biraderi*, village organizations, etc.).

In addition, KAHRS (1991) as quoted by DHARMAWAN (2001) conceptualized a household as:

> *"A household consists of an income generating and income utilizing unit. It is an organization of human beings that disposes resources and uses it for reproductive purposes and for generating income"*

Meanwhile, in agrarian societies in which there is only a low degree of labour division and the production process is oriented towards subsistence, there is absolutely no separation between farm household and farm in the member's consciousness (MANIG, 1993). Furthermore, according to MANIG (1991), there are six major functions of households that might be noted, namely:

- the allocation of available resources to satisfy needs,
- ensuring the pursuit of multiple goals,
- the production of services and goods (house production),
- the making of decisions in the utilization of income and consumption,
- the regulation of external social relations, and
- material and social reproduction and the social security of its members.

Another definition is expressed by ELLIS (1993). The household is understood as the sharing of the same abode or hearth. ELLIS (1993) limits the household as a social unit. As such this is evidently a sub-set of the family, through the extent to which families may be split up among separate households varies in different societies.

Households build their socio-economic structure in the community. Further, MANIG (1991) mentions some possibility of resource allocation within a farm-household as follows:

- in one's own household to produce goods and services (household production),
- on self-run farms in order to produce goods and services for the household's own needs and the market,
- outside the system household-farm in order to gain income, for other purposes (social, political, and cultural activities, leisure, etc.).

Moreover, in developing countries the concept of the household can be rather different from that applicable among OECD members. This is reflected in the UN in its guidelines for population and housing censuses, taken over into the draft

methodological recommendations for the World Programme of Agricultural Censuses scheduled for 2010. These describe a household as follows (UNECE, 2005):

> *"The concept of household is based on the arrangements made by persons, individually or in groups, for providing themselves with food or other essentials for living. A household may be either (a) a one-person household, that is to say, a person who makes provision for his or her own food or other essentials for living without combining with any other person to form part of a multi-person household, or (b) a multi-person household, that is to say, a group of two or more persons living together who make common provision for food or other essentials for living. The persons in the group may pool their incomes and may, to a greater or lesser extent, have a common budget; they may be related or unrelated persons or constitute a combination of persons both related and unrelated"* (UN, 1998).

2.5 Review of Empirical Evidence on Influence of Market Access on Land Use

This section reviews some empirical studies as comparative materials. Most of the research concerning agricultural land use has employed a variety of methods and levels. For example, a study of MAERTENS et al. (2002) endeavoured to explain agricultural land expansion in the area surrounding the Lore Lindu National Park. They found that the empirical analysis indicates that the elasticity of the cultivated area with respect to population is rather high in this area. This research also found that there are direct and indirect effects of exogenous changes. An improved agricultural technology, favourable land characteristics and lower transaction costs have a direct negative impact on agricultural expansion.

Integration into the market occurs when the gains are bigger than the associated transaction costs (YANG and BORLAND, 1991 in PALOMO et al., 2002). Rural households will participate in markets only when the transaction costs become sufficiently low and the gains from market opportunities are attractive. High transaction costs of reaching the market places and of accessing opportunities in those markets offset the potential gained from specialization and trade. PALOMO et al. (2000) found that a higher degree of integration into markets increases the per capita incomes of rural household in El Salvador. Important barriers relating to household

integration into markets are low educational levels, especially in the labour market. In contrast, MINTEN (1999) recommends that in a liberalized environment, the presence of infrastructure (i.e. roads and market sites) should increase the efficiency of marketing and production, as it reduces transaction costs. With his research in villages in Madagascar, he concludes that hard infrastructure such as roads becomes highly significant for the non-rice villages. His analyses also link the output market (e.g. price variation) to structural determinants. Hard infrastructure is an important determinant of producer price levels. Price levels decrease significantly as the distance to main roads increases and the quality of infrastructure decreases and they decrease relatively faster over shorter distances than over longer distances.

Different studies have documented the importance of road infrastructure in expanding rural productivity. GABAGAMBI and VON OPPEN (2001) recommend that access to roads, in terms of time and distance has a significant influence on aggregate productivity and on other variables. The influence is classified into direct (specialization) and indirect (intensification) effect. In case of villages in Tanzania, they conclude that an investment priority in road infrastructure is imperative for agricultural and rural development strategies. The strategies should be gender-sensitive in order not to accentuate the economic gap between men and women. The other benefits of rural roads are emphasized by JACOBY (2000) in his study. He shows that a rural road is not only making transport from and to agricultural markets cheaper, but also improves access to schools, health facilities and markets for consumer goods. A study of HAU and VON OPPEN (2002 and 2001) in Northern Thailand found that market access effects aggregate productivity of the farm and that better market access can promote a more efficient allocation and use of resources leading to increased productivity. They emphasize that improvements in infrastructure especially in roads and transport routes can improve productivity and in turn enhance household incomes.

MULLER and ZELLER (2002) examined the relationship between road network and land use in the highlands of Vietnam in 1990 and 2000. They estimated it using a multinomial logic regression for each of four land use categories and used lags for

some of the exogenous variables so as to address endogeneity. They explained that access to all year roads improved substantially in the last decade; thereby, facilitating market integration, access to infrastructure, input and public service. The investments in irrigation and infrastructure, along with improved market access to roads, markets and services, were successful in intensifying agricultural production.

The study of PANDEY and KHIEM (2002) also supports the important role of market access for arresting and reversing the Boserupian decline in labour productivity as population driven intensification of land use occurs. Both the land and labour productivity are found to be higher in areas with better access to the market. The improvement in productivity and income results mostly from an expansion in cash production. Improvement in the access to markets also reduces the need to intensify food production in the uplands.

The study of KHACHATRYAN and VON OPPEN (2004) concludes that the market access determinants have significant effects on total agricultural productivity. They have found that an increase of 10 percent of the existing road network would contribute to a 1.3 percent increase in aggregate productivity whereby specialization effect appears to be stronger than that of intensification (0.8 percent vs. 0.5 percent). The increase of 10 percent in the number of markets in a given area would improve aggregate productivity by 1.1 percent, which comprises 0.7 percent for specialization and 0.4 percent for intensification effects.

Concerning family land acquisition in the vicinity of Lore Lindu National Park, the study of NURYARTONO (2005) found that the ethnicity of the head of the households had a significant negative effect on family land holdings. This means that local people tend to bequeath their land to the extended family. Moreover, forest land acquisition by smallholders is significantly influenced by household ethnicity, distance to roads, social capital and poverty index.

2.6 Conceptual Framework and Hypotheses

The analysis of the influence of market access on land use of rural households is conceptualized in Figure 2. It is based on a conceptual framework by ZELLER and MINTEN (2000) used to evaluate the consequences of market liberation on household income and resource allocation.

The conceptual framework shows internal factors on the right side and external factors on the left side. The right hand side also shows the decision-making process of the household. According to its objectives, the household allocates the resources to activities subject to factors, which are external. These activities generate outcome, which will meet the objectives. The household's resources consist of physical capital (land, livestock, durables, and environmental quality), human capital (labour and education) and social capital (access to social networks and institutions). Other internal factors of the household influencing decision-making are the demographic structure (age, gender, dependency ratio) and the access to natural resources (forest, water and pasture). Furthermore, agricultural land use is defined by the allocation of land to different crops. The box for allocation of agricultural land also represents the crop shares and the intensity and productivity of crop production.

The external factors include the socio-economic and agro-ecological environment, the access to public services, financial markets, agricultural input and output markets and infrastructure. These components determine together with agricultural and rural development policies the transaction costs and farm-gate prices of rural producers and consumers.

Furthermore, this research will focus more heavily on agricultural input and output markets. Market access in this study is defined by two specific terms: hard infrastructure (e.g. time to paved roads) and soft infrastructure (e.g. information technology (from radio and TV)). In the study analysis, the market refers to the situation where households are able to buy food as well as sell and buy agricultural products. Moreover, this study analysis emphasizes that market access is defined by

the time that each household takes to reach the market. The rural markets as well as the city markets accessed by households exist. The study analyses also allow if many households identify the group of village small shops as a rural market. Our analysis considered agricultural input and output market in the research area.

According to MANIG (1991), resources are labour, land, capital, information, knowledge and rights, whereby the power of disposition the household has over these resources can be found in various combinations:

- the most important resource is labour, which is employed for household production (good and services);
- if the household has capital at its disposal then this can be used in the various economic sectors;
- the right of disposition and to use land makes it possible to work independently in the agricultural sector. However, it is also possible to lease land to others.

In this study household resources are classified as physical capital (land, livestock and other assets owned), human capital (labour, education, gender and age), and social capital (access to social networks and institutions). In addition, these studies differentiate explicitly the household member's access to social networks and institutions.

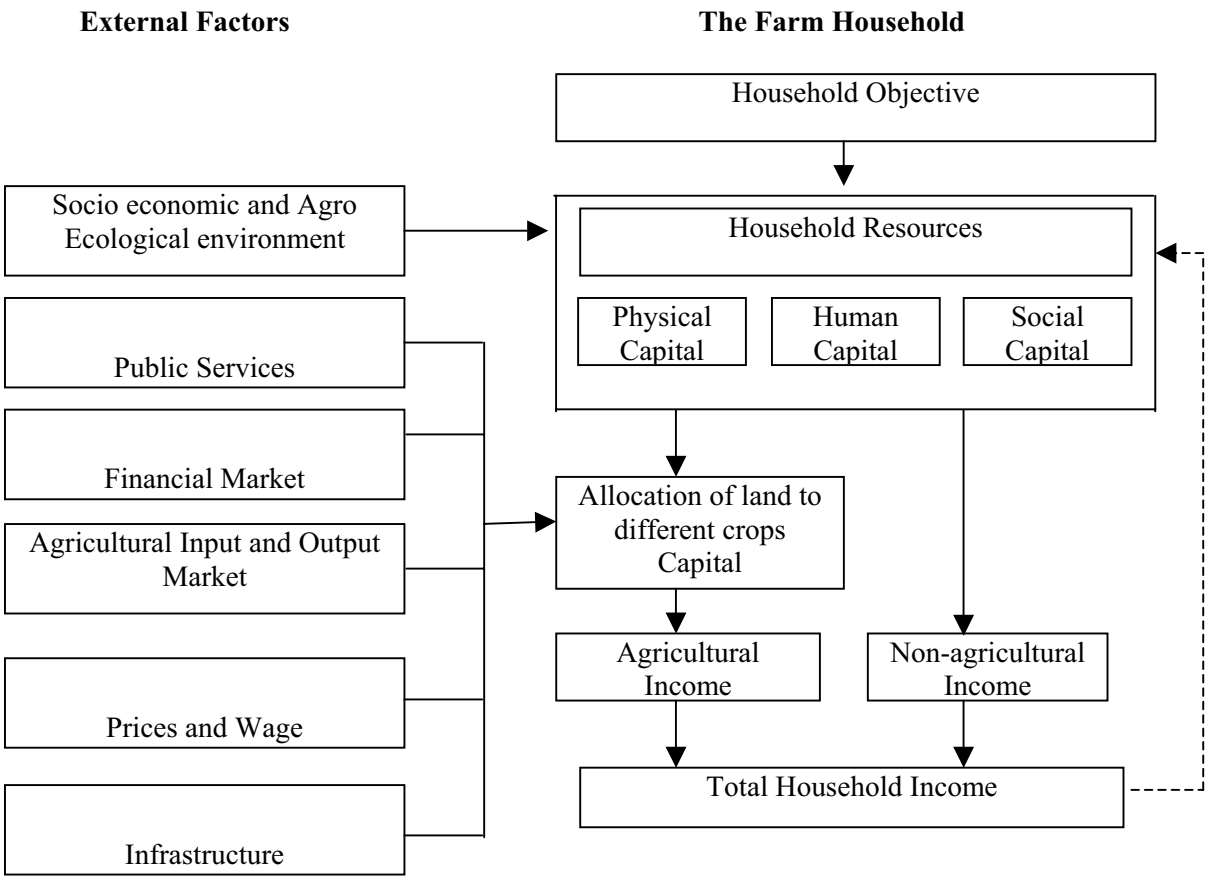

Figure 2.3: Conceptual Framework

Source: Adapted from ZELLER and MINTEN (2000, p.25)

The study tests the following hypotheses:

1. There is no considerable change with respect to land use (areas cultivated for certain crops), when comparing the situations of 2001 and 2004.
2. Better market access will increase the area of wet field rice, which will reduce the use of upland.
3. Better market access will increase the area cultivated with upland cash crops due to higher output prices.

3. Methodology

3.1 Sampling Frame and Selection of Households

Based on the general consensus in STORMA, all projects had concentrated on the same sub-set of villages in the research area. For the selection of these villages, the stratified random sampling method was chosen as the sampling frame (ZELLER et al., 2000). This section describes the main stages in the selection process and some important methodological approaches.

The research area consists of five sub-districts (*kecamatan*) with 117 villages (*desa)* in the vicinity of the Lore Lindu National Park as the population study. The report by ANZDEC (1997) provides information on the socio-economic characteristics for 115 of the 117 villages located in the research area of STORMA. These 115 villages were used to define the sampling frame. The method of stratified random sampling was mainly chosen, since: (1) it ensures the infrequent types of elements of the population included in the sample and (2) the higher efficiency, compared to the simple random samples (i.e. the same precision), can be achieved with a smaller sample (ZELLER et al., 2002).

Three important variables were developed as the main criteria to create the village strata. The first selected criterion distinguishes villages on the basis of their proximity and economic linkages with the park as defined by ANZDEC. In detail, two groups were differentiated:

- First group, consisting of 58 villages close to and affected by the Park, and
- second group, comprising the remaining 57 villages.

The second selection criterion was population density. The reason chosen was that it is closely correlated with the development of rural infrastructure and markets, recognizing that it will further determine access to markets, technology and information as well as other critical socioeconomic conditions. These factors directly or indirectly influence land use systems in the vicinity of the Lore Lindu National Park. In this case, groups were divided into:

- the first group: below or equal to the median population in all of the 115 villages, and
- the second group: above the median population in all of the 115 villages.

The third selection criterion was the ethnicity of the village population. It was hypothesized that the ethnic composition of the population strongly influenced practices of land cultivation as well as the use of forest and other resources. In this respect, three sub-groups were classified into:

- First group: >= 75% of the village population pertaining to an indigenous ethnicity.
- Second group: >= 75% of the village population regarding migrants.
- Third group: remaining villages

The criteria chosen reflect some hypotheses about the factors which influence stabilization and destabilization of the forest margin areas that will be investigated by each of the sub-projects. Furthermore, these criteria would result in 12 distinct strata, but only 10 of which were taken into account for further sampling on the basis of the variety of reasons described in ZELLER et al. (2002). As a whole, a sample size of 80 villages was considered sufficient to cover the diversity with respect to physio-

geographic, agro-ecological and socio-economic conditions of the 115 villages in the research area.

Due to the importance of close proximity of the research villages to the Park, villages close to the Park were sampled disproportionately more. Sampling sizes were adjusted for this disproportionate sampling in each stratum. They were calculated as follows:

$$W_1 = [(n_i/N) / (s_i/S)]$$

where n_i= number of element in the strata i, N= number of elements in the sampling frame, s_i= size of sample having elements belonging to strata I, S= total sample size
The sum of all sizes for each sample element has to be equalized into the sample size.

Table 3.1 presents an overview of the randomly selected villages for STORMA and their corresponding sampling weights.

Table 3.1 Sample Villages of STORMA and Their Sampling Weights

District	Village	Strata	Number of selected households	Sampling weight
Lore Utara	Watumaeta	6	20	0.53
	Wuasa	10	27	0.86
	Wanga	6	17	0.53
	Rompo	6	16	0.53
Palolo	Sintuwu	8	25	0.63
	Berdikari	5	21	2.54
Sigi Biromaru	Maranata	3	32	1.35
	Pandere	10	31	0.86
	Sidondo II	4	33	1.17
Kulawi	Bolapapu	9	32	0.68
	Lempelero	7	30	0.58
	Lawe	2	17	1.99

Source: Zeller et al. (2002) and Schwarze (2004)

3.2 Data Collection

As this study aims to analyze changes in land use over time, a set of panel data is preferred over two randomly selected cross sections. Within each of the above survey villages, a simple random sample of households based on a complete enumeration of all household residing in the village was undertaken in 2001 by SCHWARZE (2004). The data for the year 2001 was collected by project A4 of STORMA from December 2000 to March 2001. In the year 2004, a similar survey was conducted from March to July 2004. To link the data of the two periods, it is necessary to use the same approach for data collection. Therefore, the same households were interviewed to obtain panel data.

A group of eight enumerators were extensively trained in the classroom and in the field before conducting the survey. The objective and relevance of the survey were explained and each question of the questionnaire was discussed in detail regarding its intended purpose, measurement and reference period. The interview situation was trained using role-play.

The household survey was conducted using formal questionnaires. The questionnaires were pre-tested in Bora village for the 2001 household survey and Kalawara village for the 2004 household survey. The aim of the pre-test was to gain an understanding of the questionnaires through direct interviews with households conducted by the selected enumerators. The completion of the questionnaires was carried out after the pre-test in response to some input from the respondents and enumerators and the direct observations of senior field staff during the pre-test. Furthermore, an in-depth analysis was carried out to discover important information from the first and second household surveys.

For pooled data, 264 households were selected from the 2001 and 2004 surveys. There was attrition in the data set. The survey started with 299 households, but in 2004 the sample was reduced. The 264 households were selected from the two-period surveys,

since some households moved and some refused to cooperate with STORMA. It means that we missed several other observations beyond our control.

This study differentiated three household groups with respect to their market access using cluster analysis. Market access is defined by the time each household takes to reach the nearest market. In this study, we only considered the basic consumer market as well as agricultural input and output markets, which are accessed by households. The poverty groups were categorized using the poverty index developed by ZELLER (2002) employing principal component analysis (PCA) to select and eventually aggregate various indicators of poverty. This method was applied by ABU SHABAN (2001).

3.3 Data Entry and Cleaning

The data from the household surveys were entered twice by different enumerators at the University of Tadulako, Palu using SPSS software package. These two versions of the data were then compared with each other to ensure consistency. In the case of inconsistencies, questionnaires were checked again to identify the source of data entry error. The next step in data management was to clean all the entered data, consisting of the data for missing values, wild codes, inconsistencies and extreme values.

3.4 Methodology Applied in Descriptive Analyses

In the descriptive analyses, frequencies and cross-tabulation were used to characterize socio-economic aspects, assets, agricultural production and market condition and land use. In the case of comparing the mean of three or more groups of the same variables, Analysis of Variance (ANOVA) was applied. The partial analysis of variance (ANOVA), a general method for studying sample data relationship, was used to examine if the independent variable of market access was significantly associated with land use patterns. The ANOVA was based on an F-test underlying these assumptions (BLACK, 1999):

1. There is interval or ratio of the scaled variables,

2. each sample observation is randomly taken from the population,
3. the sampling distribution on the mean is approximately normal, and
4. the variances of the groups are homogeneous.

The results were presented by percentages, averages and standard deviations. However, the descriptive analysis is unable to give any insight into the impact of market access on land use patterns as it fails to control for other exogenous variables influencing land use, either at the household or higher levels as depicted in the conceptual framework. When the results of the ANOVA test were statistically significant, Post Hoc Scheffe multiple comparison were conducted to determine where differences between means existed. The Mann-Whitney test was used to test non-parametric equivalents for statistical significant differences among the groups in the descriptive analysis. This is based on comparing the rank order of the variable between the two groups. Furthermore, this study also applied the Kruskall-Wallis test which does not assume any type of underlying distribution. This is based on comparing the difference between median ranks (BURNS, 2000). Based on the Kruskall-Wallis test we can decide whether there is a difference across the groups, but this does not indicate that all groups are significantly different from each other. All descriptive analyses were undertaken using a SPSS software package.

3.5 Methodology Applied in Causal Analyses

This study focuses on panel data that offers the researcher more possibilities than purely cross sectional or time series data. A set of panel data is a combination of time series and cross sectional data. A regression analysis with both a spatial and temporal dimension is used in the panel data analysis. In general, for the variable y_{it} we have i=1,...,N individual observations for t=1,…,T time periods. T can be as small as 2 while N may refer to hundreds or thousands of individual units (GUJARATI, 2003, WOOLDRIDGE, 2002, WOOLDRIDGE, 2003, KITAZAWA, 2001).

In general, all regression models for panel data can be expressed as follows (HSIAO, 1995):

$$y_{it} = \alpha_{1t} + \sum_{k=2}^{k} \beta_{k1t} x_{k1t} + e_{1t}, \qquad i = 1,\ldots, N$$

$$k = 1,\ldots, T,$$

i = 1,…, N indicates cross sectional unit, and t =1,2,…T shows a series of time. Y_{it} is a dependent variable of household i in period t, and X_{it} is a value of k non-stochastic explanatory variable of i for t. In this model, β_{k1t} are unknown parameter of response parameter for each k non-stochastic explanatory variable of t for i. Stochastic variable (e_{it}) was assumed a zero value ($E(e_{it}) = 0$, and e_{it} has constant variant, with Var (e_{it}) = $E[e_{it}- E(e_{it})]^2 = (e_{it}) = \sigma^2$.

According to HSIAO (1995:1-2), the advantages of working with panel data are that the number of observations is much larger, which is likely to produce more reliable parameter estimates. At the same time, such data allow the researcher to specify and test more sophisticated models. They also alleviate the problem of multi-co linearity, when explanatory variables vary in two dimensions in which they are less likely to be highly correlated. To summarize, apart from controlling better for the two sources of endogeneity (reverse causality and non-observed effects), the panel data make this structure more desirable for this analysis (MATYAS and SEVESTRE, 1992).

Different techniques can be used for analysing a set of panel data. The first technique simply combines all the time-series and cross-sectional data and estimates the underlying model by utilising ordinary least squares. The second procedure involves the recognition that omitted variables may lead to changes in the cross-sectional and time series intercepts. The third technique improves the efficiency of the first least-squares estimation process by accounting for cross-sectional and time-series disturbances. The random-effects model is a variation of the generalised least-squares estimation process.

In terms of observable variables, a panel data model is possible to measure not only the effects of the observable variables on the dependent ones, but also those of relevant unobservable or non-measurable influences. The observable variables are incorporated into the model in the usual way. This means by which the unobservable variables are incorporated into the model depends upon whether a fixed-effect (FE) or random-effects (RE) model is used in estimation. In the random-effects model, the unobservable or non-measurable factors that differentiate cross-section units are assumed to be best characterized as randomly distributed variables (McPHERSON et al., 1998). Moreover, the advantages of random-effects are to accommodate heterogeneity (FREES, 2004).

The procedures of panel data estimation provide more robust estimates because they can account for the effect of unobserved variables and have the potential to more precisely measure the effect of changes in explanatory variables.

With respect to the category panel data in terms of N and T (periods), there are two panel types varying much in terms of N and T required them: micro panel data characteristically have a large N (and a small T), whereas macro ones data have a small N (and large T, or T = N) (LEE, 2002).

3.6 Model Estimation

3.6.1 The Influence of Market Access on Land Use

This study emphasizes the analysis of the influence of market access on land use of rural households using panel data. The study concentrates only on major crops in the research area, such as paddy rice, coffee and cocoa. This research employs the following model of panel data set estimation:

First: Share of households growing crops as dependent variables

$$SH_{it} = f(HHC_{it}, SC_{it}, CM_{it}, DISMARK_{it}) \quad (1)$$

Second: Households that grow crops as dependent variables

$$HHSC_{it} = f(HHC_{it}, SC_{it}, CM_{it}, DISMARK_{it}) \quad (2)$$

Where**:**

SH = share of households growing crops, *ie.* paddy rice, coffee, cocoa (%)

HHSC = household growing crops, *i.e.* paddy rice, coffee, cocoa
(0 = not growing, 1 = growing)

HHC = vector of socioeconomics characteristics of the household

SC = social capital

CM = access to credit (credit maximum) (IDR)

DISMARK= distance from house to market (minutes)

3.6.2 Impact of Households' Market Access on Fertilizer Use

As previously described in Chapter 1, better market access can lead to lower input prices and higher output prices at the farm-gate level and hence, influence positively productivity. The following model is used to find out the influence of market access on agricultural inputs, namely on fertilizer as a key input in Sulawesi agriculture. The volume of urea is used by household (kg) and household used fertilizer as dependent variables (dummy variable, 0/1).

$$UREA_{it} = f(HHC_{it}, SC_{it}, CM_{it}, DISMARK_{it}) \quad (3)$$

$$HHUREA_{it} = f(HHC_{it}, SC_{it}, CM_{it}, DISMARK_{it}) \quad (4)$$

Where**:**

UREA = total urea fertilizer used (kg)

HHUREA= household used fertilizer (0 = not used urea, 1 = used urea)

HHC = vector of socioeconomics characteristics of the household

SC = social capital

CM = access to credit (credit maximum) (IDR)

DISMARK= distance from house to market (minutes)

Data for households growing crops and households using fertilizer tend to be screened at the lower limit of zero. In this respect, some households may have some land for crop cultivation, while others may have no land. Logit models would be equal techniques for addressing probability questions. Although it is interesting to know the influences of market access on land use pattern, it is required for a model to be combined with the OLS. The appropriate tool, the Tobit model, uses maximum likelihood regression estimation (KMENTA, 1986; GUJARATI, 2003; TOBIN, 1958). For this study, two techniques are focused on the panel data estimation: Tobit Random Effect Estimation and Probit Random Effect Estimation.

The Censored Tobit Model

The dependent variable in Equation (1) and (3) represents a combination of discrete and continuous components; for this reason, it is censored at zero. The Tobit model has widely been used by some researchers in land use analysis. For instance, in a panel data context, the random effect of the Tobit model is employed by COXHEAD and BAYOUD (2004), EDMOND (2002) in their analysis of land use in upland rural areas in the Philippines and Vietnam.

The Tobit random effect model can be formulated to control unobserved household specific effects (WOOLDRIDGE, 2002; HSIAO, 2003; COXHEAD and BAYOU, 2004; EDMOND, 2002):

$$y^*_{it} = \alpha_i + x_{it}\beta + u_{it},\ i=1,\ldots,N;\ t=1\ldots..,T \qquad (5)$$

On the basis of this model, the explanatory variables are exogenous, conditional on the unobserved effects. The observed value y_{it} is equal to y^*_{it} if $y^*_{it} > 0$ and to zero when the data are censored. In this study, dependent variables (y_{it}) are the share of households growing crops (*i.e.* paddy rice, coffee, and cocoa), and x_{it} are explanatory

variables. Furthermore, it is assumed that the unobserved effect (α_i) is randomly distributed with density function g(α). The possibility function of the standard Tobit model for the censored data takes the following formulae (HSIAO, 2003, CHAVEZ, 2004):

$$\prod_{i=1}^{N} \int \left[\prod_{t=c_1} F(-x_{it}\beta - \alpha_i) \prod_{t=z_i} f(y_{it} - \alpha - x_{it}\beta_i) \right] g(\alpha_i)\, d\alpha_i \qquad (6)$$

where F (.) and f (.) are the distribution and density functions of the standard normal, respectively; the $c_i = \{t \mid y_{it} = 0\}$, and z_i denotes its complement. Maximizing the likelihood function in (6) with respect to unknown parameters yields consistent estimators.

The Probit Model

The panel Probit model with individual effects plays an important role in applied econometrics (LAINSNEY and LECHNER, 2002). Furthermore, in addition to estimating the censored Tobit Model in terms of explaining the amount of share of households growing crops and the fertilizer used by households, it is likely to estimate a model to explain the households cultivating land and using fertilizers. In this study, the random effect of the Probit model is applied to the determinants of households growing crops and using fertilizers (model function (2) and (4) above). The dependent variables in this analysis is a 0-1 dummy variable. The variables take on the value 1 if the household grows the crop and 0 if not. The random effect Probit model can be formulated as (WOOLDRIDGE, 2002, ARUMPALAM, 1996; GREENE, 2000):

$$P(y_{it} = 1 \mid x_i, c_i) = P(y_{it} = 1 \mid x_{it}, c_i) = \Phi(x_{it}\beta + c_i),\ t = 1,\ldots,T \qquad (7)$$

where c_i is the unobserved effect and x_i contains x_{it} for all t. The first equation implies that x_{it} is strictly exogenous, conditional on c_i. The second is the standard probit assumption about c_i. Besides, it is assumed that the outcomes are independent,

conditional on (x_i, c_i). The last assumption is that c_i and x_i are independent and c_i has a normal distribution [$c_i \mid x_i \sim$ Normal (0, σ^2_c)] (CHAVEZ, 2004).

Under the above assumptions, a conditional maximum likelihood approach is available in order to estimate β and σ^2_c. Given that the c_i are unobserved, they cannot appear in the likelihood function. It is necessary to integrate out c_i. Then, the formulas will appear like (8) since c_i has a N (0, σ^2_c) distribution (CHAVEZ, 2004).

$$F(y_1,\ldots,y_T \mid x_i;\ \theta) = \int_{-\infty}^{\infty} \left[\prod_{t=1}^{T} f(y_t \mid x_{it}, c;\ \beta)\right] (1/\sigma_c)\ \varphi\ (c/\sigma_c)\ dc \qquad (8)$$

where $f(y_t \mid x_t,\ c;\ \beta) = \Phi\ (x_t\beta + c)^{y_t} [1 - \Phi\ (x_t\beta + c)]^{1-y_t}$ and θ contains β and σ^2_c. Taking the log-likelihood of Equation (8) above gives the conditional log-likelihood for each *i*. The log-likelihood for the entire sample can be maximized respecting β and σ_c to obtain $\sqrt{N}$-consistent asymptotically normal estimators. Furthermore, WOOLDRIDGE (2002) states that this conditional MLE is characteristically called the random effects of the Probit estimator (CHAVEZ, 2004).

4. Overview of the Research Area

4.1 Introduction

This chapter gives an overview on the environmental situation and the social conditions of Indonesia particularly in Central Sulawesi and the research area around the Lore Lindu National Park. It focuses on site, geophysical and climatic conditions and the economic structure and land use conditions.

4.2 Central Sulawesi and the Lore Lindu National Park: An Overview

One of the largest provinces on the Sulawesi Island is Central Sulawesi. This province, with a size of 68,059.71 km^2, consists of eight districts (*kabupaten*) and one municipality (*kotamadya*). There are 81 sub-districts and 1440 villages. The province has 523,505 households with 2,195,711 inhabitants. Moreover, the poverty situation in Central Sulawesi shows that the percentage of poor people was 24.89 % in 2004 with the overall poor population of 486.300 people (MAKSUM. 2004).

Central Sulawesi was declared a province in 1964. It is located in the middle of Sulawesi Island, situated in the north of South Sulawesi, east of Kalimantan, west of Maluku, and south of the Philippines. Based on the local history, more than 500 years ago this area apparently made its ports a transit point for Portuguese and Spanish ships. It is located on the route of Sir Francis Drake's voyage round the world in his galleon The Golden Hind. In January 1580, he spent a month on one of the small islands of the eastern coast (BPS, 2000; MAPPATOBA, 2004).

Nowadays, the population density of Central Sulawesi province is 31 people per km^2 in 2004 (http://sulteng.bps.go.id/pop3.htm). Most of the households (74.1%) reported that farming is their main occupation. Here are the data on the population.

Figure 4.1: The Islands of Indonesia

Table 4.1: Population, Growth Rate of Population, Population Density and Number of Farm Household, Differentiated by District on Central Sulawesi Province

District	Population (2004)	Growth rate of population (2001-2004)	Population density (2004)	Number of farm households (2003)
Bangkep	150,880	1.37	44	31,517
Banggai	284,275	0.92	28	48,333
Morowali	165,542	0.59	11	32,022
Poso	275,974	0.71	16	54,046
Donggala	437,541	1.08	40	79,082
Parimo	347,842	1.95	51	65,885
Kota Palu	281,646	1.83	681	10,598
Toli-toli	190,579	1.97	43	32,984
Buol	108,635	2.17	24	18,200
Sulawesi Tengah	**2,242,914**	**1.83**	**31**	**372,667**

Source: Central Sulawesi Province Statistic Agency 2003 (BPS), KPU 2004

Our research area is located in the vicinity of the Lore Lindu National Park which covers two districts, Poso and Donggala. Poso has 283,378 inhabitants who reside in 242 villages. The population density in 2004 was 16 per km^2. There are 70,484 households and 80.8 % of whom reported that agriculture is their main source of income. The percentage of the poor households is relatively high (46.1%) compared to other districts. Donggala is the largest district in the province. In this district, the total population is 421,912 people living in 265 villages. The population density in 2004 was 40 per km^2. The total number of the households is 102,285 and 83.0% of whom are farm households. Compared to Poso, the share of the poor households in Donggala is slightly lower at 41.3%.

Approximately 117 villages are located on the margin of the park and more than 60 out of 117 villages are located close to the park. In Donggala, the park covers three sub-districts, namely Palolo, Kulawi and Sigi Biromaru. In Poso, the park also covers three sub-districts, namely Lore Utara, Lore Tengah and Lore Selatan. The boundaries

of the park are shown in Figure 4.1. The park hosts some of the world's most unique plant and animal species. However, deforestation for agriculture is threatening the integrity of the park. Moreover, a large part of the heterogeneous population, including migrants and indigenous Kaili people, live along the border of the Park. The high population density in this area constitutes a problem for forest protection. Two categories of people are dominant in the population of the research area. These are: indigenous people and immigrants. The latter category includes transmigrates from other regions in Indonesia as well as spontaneous migrants from other parts of Sulawesi. The majority of the research area population live as subsistence cultivators with supplementary earning from cash crops, such as of coffee, cacao and coconuts (SUNITO, 1999 as quoted by MAPPATOBA, 2004). There is an enclave around the Lindu Lake, which belongs to Kulawi. This sub-district covers most of the western side of the park. The villages vary considerably in terms of the composition of their population, some consisting almost entirely of indigenous Kaili people, while others are dominated by migrants and mixed population. The third district is Sigi Biromaru. This area extends into the Park from the north. Most villages are ethnically very diverse.

This area has been chosen as a focus site for a collaborative research project funded by the German Research Council. The project's interdisciplinary research is concerned with the stability of rainforest marginal areas. STORMA is jointly undertaken by scientists from the Universities of Göttingen and Kassel in Germany and the Institute Pertanian Bogor and Universitas Tadulako in Indonesia. The research is funded by the German Research Council (DFG) and supported by a number of other organizations in Indonesia and Germany.

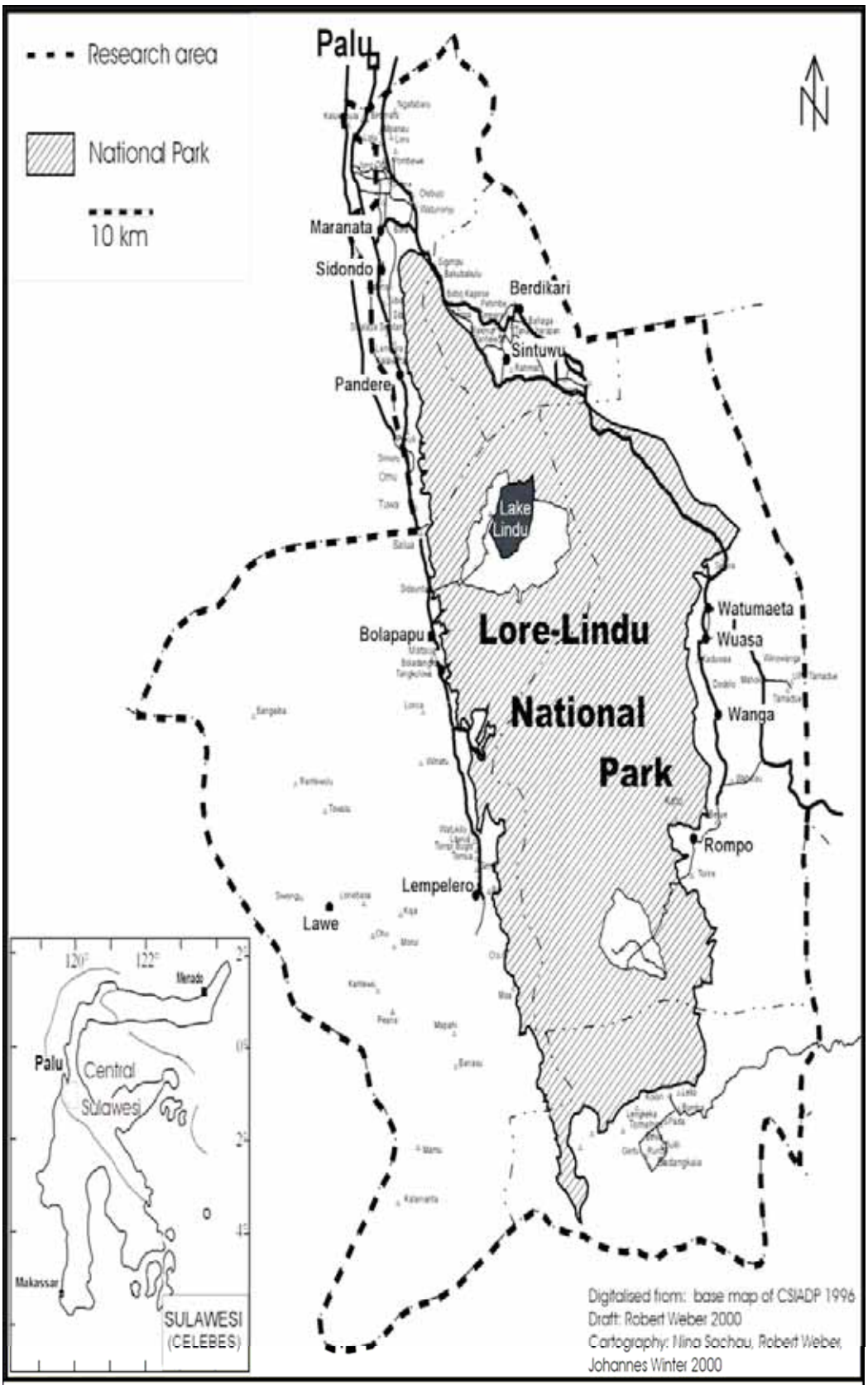

Figure 4.2: Map of Lore Lindu National Park

4.3 Geophysical and Climatic Conditions

In terms of the elevation of above sea level (ASL), in Central Sulawesi, areas can be categorized into: 0-1000 ASL (20.2%), 101-500 ASL (27.2%), 501-1.000 ASL (26, 7%), and above 1.000 MSL (25.9%). Based on the data, around 20% of the total area is categorised as fairly flat areas.

The climate of Central Sulawesi is characterized by two constant seasons and cool north-westerly and humid south-easterly winds. The humid south-easterly wind blows between April and September and generates much water. The cool north-westerly winds from South China blow between October and March and it is characterized by less rainfall. The climate zones of Sulawesi contribute to the distribution of vegetation. Using the ratio between dry and wet periods, Schmidt and Ferguson (cited by Mapatoba, 2004) classify most of this region into Zone A and only limited areas of Palu Valley and the surrounding into Zone E. Areas in the vicinity of Lore Lindu and Poso Lake are categorized as Zone B, dominated by natural rain forests. Air temperatures on the upland areas vary from 20^0 C to 30^0 C, while in the low land areas; it is between 22^0 C - 35^0 C. Humidity in the area ranges from 72% to 82%.

4.4 The Economic Structure and Land Use Condition

In general, the economic structure of Central Sulawesi is dominated by the agricultural sector. On average, this sector supplied the highest contributions to the GRDP (Gross Regional Domestic Product) with 44.3% in 2001 and 45.31 % in 2004. At a national level, the contribution of the agricultural sector to GDP (Gross Domestic Product) was 15.39% in 2004. This number implies that Central Sulawesi has a key role in the agricultural sector in which this province is the second biggest contributor to the GRDP in the service sector.

The contribution to employment in the agricultural sector in this province was 45% in 2000, either as small scale farmer or wage labour on plantations. According to the

developed definition of unemployment, Central Sulawesi had an unemployment rate of 7.63% in 2005.

The land use of the study area of Central Sulawesi Province can be described as mixed agriculture. Based on the Central Sulawesi Province Statistic Agency 2003, this region has 195,199.9 hectares of rice fields consisting of 121,796 hectares (62.40%) of irrigated rice fields, 31,969.6 hectares (16.38%) of non-irrigated fields and 41,433.5 hectares (21.23%) of the temporary non-cultivated. Rice is the main staple food as well as being a cash crop in the area.

The description of non-paddy land use areas includes upland, forest, settlement and non-cultivated land, as indicated in Figure 4 .3.

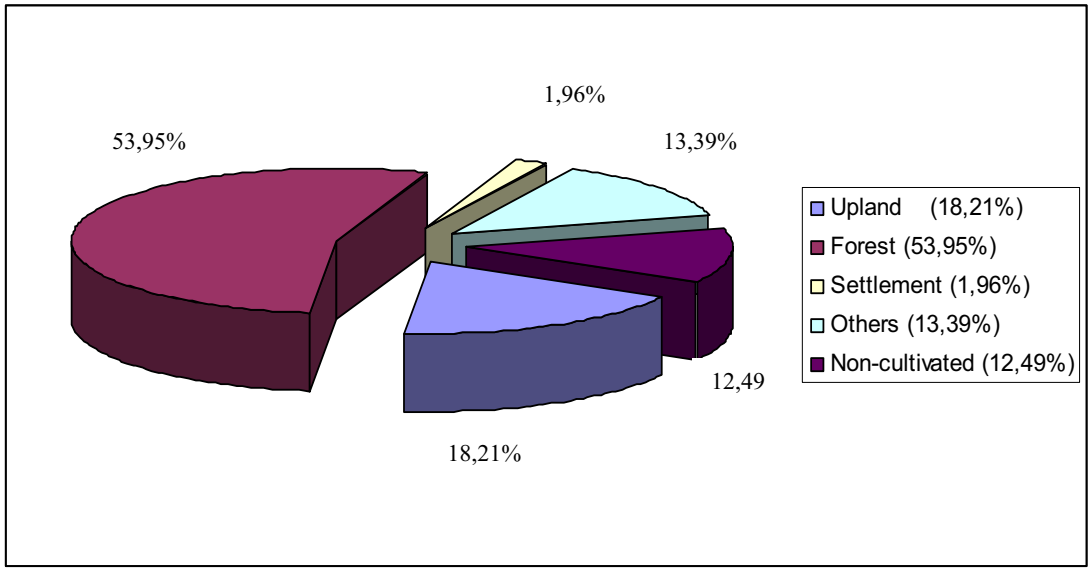

Figure 4.3: Size of Different Non-paddy Land Use Areas, Central Sulawesi Province Statistic Agency (2003).

Figure 4.3 shows that there are 1,203,460 hectares (18.21%) of upland, settlement cover 3,564,641.5 hectares (53.95%) of non-paddy land use area. Moreover, land which categorized other covers 884,792.9 hectares (13.39%) and non-cultivated 825,732.1 hectares (12.49%). The forestland in Central Sulawesi covers 3,564,641.5 hectares (53.95%) of non-paddy land use area.

5. Descriptive Analysis

5.1 Introduction

In the previous chapter, an overview of the study area, its geo-physical and climatic conditions and its economic structure and land use was described. The following chapter provides an overview of the characteristics of sample households in order to assess the variables for the model specification. The socio-economic characteristics are discussed beforehand. Subsequently, the accessibility of markets and market conditions as well as land use are presented to provide a more detailed explanation of the household activity.

5.2 Descriptive Analysis of the Determinant Factors of Land Use and Market Condition

This section is divided into seven subsections. The first provides the socio-economic characteristics of sample households. All of results presented are weighed results by applying the sampling weights presented in Chapter 3. As a characteristic of the computer package used the number of cases presented are also weighed counts. The

264 households interviewed represent the 263 weighed observations reported in the descriptive tables.

5.2.1 Socio-economic Characteristics of Sample Households

This section discusses the socio-economic characteristics of the sample households in the study area. Table 5.1 presents data on the average size and dependency ratio of the household, as well as the educational level of the household heads and land per capita. The average household size in all survey regions was 5.31 members in 2001 and 5.15 members in 2004, with a dependency ratio of 0.70 in 2001 and 0.80 in 2004 (dependent children per adult). The highest dependency ratio, which is defined to the number of individuals aged below 15 plus number of individual aged above 60 divided by the number of individuals aged 15 to 60 minus the number of individuals aged above 60, is particularly found in Palolo (on average 1.0 child per adult on 2004). The average age of the household head varied between 41 and 46 year in 2001 and between 44 and 49 years in 2004.

The average educational level of household heads was 3.75 and 3.72 years, which defined as average value of classification of schooling attendance level (see note on the below of Table 5.1), in 2001 and 2004 respectively. This was indicated that on average the household heads graduated from elementary school or at least attended junior high school. While the highest level of education was found in the Lore Utara, the lowest educational score was found in the Sigi Biromaru region. The land per capita showed that on average each household owned 0.36 hectares in 2001 and 0.45 hectares in 2004 in the research area. Land per capita in Kulawi (on average 0.56 hectares per capita in 2001 and 0.67 hectares per capita in 2004) is found to be higher than that in the other regions.

Table 5.1: Mean and Standard Deviations of Selected Socioeconomic Characteristics of Households, by Region

	Lore Utara N=71		Palolo N=44		Sigi Biromaru N=68		Kulawi N=80		All region N=263	
	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev
Household size										
2001	5.69	2.15	4.84	1.90	5.03	1.76	5.46	1.98	5.31	1.97
2004	5.63	2.10	4.74	2.10	5.02	1.71	5.04	1.88	5.15	1.95
Dependency ratio										
2001	0.62	0.46	0.86	0.76	0.71	0.59	0.68	0.71	0.70	0.63
2004	0.72	0.55	1.00	1.13	0.80	0.63	0.76	0.75	0.80	0.76
Age of household head										
2001	42.94	13.26	46.41	16.16	43.56	15,34	41,12	12,99	43,14	14,29
2004	45,54	13,30	49,78	16,09	46,35	15,51	44,31	13,92	46,09	14,32
Educational level of Household head*)										
2001	4,12	1,86	3,67	1,94	3,40	1,50	3,74	1,83	3,75	1,79
2004	4,14	1,85	3,58	1,96	3,37	1,49	3,74	1,83	3,72	1,79
Land per capita										
2001	0,36	0,31	0,21	0,18	0,28	0,29	0,51	0,57	0,36	0,40
2004	0,46	0,38	0,27	0,36	0,29	0,26	0,67	0,64	0.45	0.47

Source: Data from 2001 and 2004 STORMA A4 survey; N=264

**) The average value of a variable defined as follow: 1= never attended school; 2=did not graduate SD (a six-year primary school degree); 3= graduated SD; 4= attendance of SMP (junior high school-3 years of schooling); 5= graduated SMP; 6= attendance of SMU (senior high school- 3 years of schooling); 7=graduated SMU; 8= higher education (university)*

5.2.2 Social Capital

Social capital reflects the social relationships and networks among households. The degrees of intensity with which a household interacts influence the sharing of information, including information on markets and prices. Hence, one of the possibilities to channel information is through organisations in which the household is involved. On average, households were members of 2.86 different organisations in 2001 and 2.56 in 2004 (see table 5.2). Furthermore, the number of memberships was statistically and significantly higher in Lore Utara compared to all other sub districts in 2001 and 2004.

In addition to the membership in formal organisations, the ethnic affiliation could also be seen as social capital. Nevertheless, the influence of ethnicity is stronger than that of providing additional access to networks. Tradition is influenced by the ethnic group which the household belongs to (SCHWARZE, 2004). The indigenous ethnic groups are the households who were originated from Kaili, Kulawi and Lore. The non-indigenous ethnic groups are the household heads who came from Bugis, Minahasa, Toraja, Java and others. On average, the number of non-indigenous district household heads was 0.18 in 2001 and 0.17 in 2004. (see Table 5.2). In the districts of Lore Utara, Palolo and Sigi Biromaru, the number of the non-indigenous household heads was 0.0 in 2001, but there was a significant alteration in 2004, whereas the number of them was 0.02 in Lore Utara, 0.03 in Palolo and 0.05 in Sigi Biromaru. In contrast, the number of the non-indigenous household heads was 0.60 in 2001 and 0.49 in 2004.

Table 5.2: Membership in Organisations and Ethnicity by Sub District

District	Number of membership		Ethnicity	
	Mean	Std.dev	Mean	Std.dev
Lore Utara (N=71)				
2001	3.78	3.51	0.00	0.00
2004	3.46	3.24	0.02	0.16
Palolo (N=44)				
2001	2.54	2.37	0.00	0.00
2004	2.07	2.18	0.03	0.17
Sigi Biromaru (N=68)				
2001	2.73	2.49	0.00	0.00
2004	2.19	2.06	0.05	0.27
Kulawi (N=80)				
2001	2.34	2.26	0.60	0.49
2004	2.34	2.33	0.49	0.05
All Region (N=263)				
2001	2.86	2.77	0.18	0.38
2004	2.56	2.57	0.17	0.02

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

The shares of non-indigenous households are statistically and significantly different among the sub districts. In the sub district of Lore Utara, Palolo, and Sigi Biromaru, the share of the non-indigenous groups was 0 percent in 2001 and 2.7 percent, 3.0 percent and 5.3 percent in 2004 respectively (see Table 5.3). In contrast, in Kulawi, the number of the non-indigenous household heads was 60 percent in 2001 and 49.7 percent in 2004.

Table 5.3: Share of Non-Indigenous Households by Sub District

District	Indigenous ethnic groups		Non-Indigenous ethnic groups	
	2001	2004	2001	2004
Lore Utara (N=71)	100.0	97.3	0.00	2.7
Palolo (N=44)	100.0	97.0	0.00	3.0
Sigi Biromaru (N=68)	100.0	94.7	0.00	5.3
Kulawi (N=80)	40.0	50.8	60.0	49.2
All Region (N=263)	81.8	82.5	18.2	17.5

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

5.2.3 Access to Financial Market

This section focuses on the description of household's participation in informal and formal credit market in the research region. In general, the households received loans between IDR 705, 400 in 2001 and 1,7 million in 2004 (Table 5.4). The great change of the loan amount received was IDR 705.040 in 2001, but in 2004, the households were granted IDR 1.7 million. In Kulawi, the amount received was more than IDR 1.1 million in 2001 and IDR 2.8 million in 2004 and even was considered much higher than those in the other sub-districts. In 2004, on average the households used 2 percent of the loan they received for agriculture equipment, such as tractors for land preparation. Other than that, the households used the loan they received for non agricultural activities, such as for marriage ceremonies (3.4 percent) and for educational purposes is 11.6 percent.

Table 5.4: Average Loan Size Received (in IDR 1000), by Year

District	Loan received	
	Mean	Std.dev
Lore Utara (N=71)		
2001	636.05	1889.98
2004	1913.33	610.21
Palolo (N=44)		
2001	305.81	610.21
2004	897.81	2152.21
Sigi Biromaru (N=68)		
2001	531.04	1223.11
2004	718.30	172450
Kulawi (N=80)		
2001	1137.12	3793.2
2004	2866.88	9411.01
All Region (N=263)		
2001	705.04	3793.20
2004	1720.61	6042.91

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

As shown in the conceptual framework in Chapter 2, the financial market as an external factor might have an impact on the households which cultivate their farm land. Table 5.5 presents the households' accessibility to financial markets. Almost all households had received an informal and/or formal loan. The number of households which received a loan is 89.6 percent in 2001 and 90.3 percent in 2004.

Table 5.5: Share of Household Access to Financial Market by Sub District

District	Access to Financial Market		No-Access to Financial Market	
	2001	2004	2001	2004
Lore Utara (N=71)	90.2	92.8	9.8	7.2
Palolo (N=44)	95.0	92.0	5.0	8.0
Sigi Biromaru (N=68)	88.5	86.6	11.5	13.4
Kulawi (N=80)	86.9	90.4	13.1	9.6
All Region (N=263)	89.6	90.3	10.4	9.7

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

5.2.4 Road Infrastructure

There are only two main asphalt roads which connect the province capital of Palu with the research area (see MAERTENS, 2004). Table 5.6 presents the distance to the nearest asphalt road. Many of the villages were located along the tarmac road. In 2001, Sintuwu in Palolo and Rompo in Lore Lindu were connected by gravel roads, often closed after heavy rains (SCHWARZE, 2004). Table 5.6 reflects the situation of household, which requires them to walk from the homestead to the nearest tarmac road. In Kulawi, the distance to the next road was roughly 4.45 hours in 2001 and 3.04 hours in 2004 and is considered longer than that of the other villages. In contrast, in Palolo and Sigi Biromaru, almost all households lived extremely close to tarmac roads.

Table 5.6: Distance to Tarmac Road by Sub District 2001 – 2004 in Walking Time, hours

District	Maximum		Mean		Std.dev.	
	2001	2004	2001	2004	2001	2004
Lore Utara	5.0	1.0	0.23	0.03	0.78	0.16
Palolo	0.20	0.5	0.01	0.00	0.42	0.01
Sigi Biromaru	5.0	3.0	0.17	0.11	0.69	0.47
Kulawi	13.0	10.0	4.45	3.04	5.50	3.87
Total	13.0	10.0	1.46	0.96	3.65	2.54

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

5.2.5 Accessibility and Condition of Rural Market

This section provides a descriptive profile of rural market conditions and market access in the study area. As a proxy for market access, the travelling time to the next market is employed. Table 5.7 shows that market access varies considerably among the districts. In Lore Utara, households have very good access to markets. Here, on average, it takes approximately 3 minutes for a household to reach the next market. On the contrary, in Kulawi, it takes about 540 minutes for the average household to reach the market in 2001. Despite the improvements in the road network, the average travelling time was still 58.9 minutes (approximately one hour) in 2004.

Table 5.7: Distance to Market by Sub District 2001 – 2004 in Travelling Time, minutes

District	Minimum		Maximum		Mean		Std. Dev.	
	2001	2004	2001	2004	2001	2004	2001	2004
Lore Utara (N=71)	0	0	17	15	3.13	2.59	2.40	2.16
Palolo (N=44)	0	0	60	60	17.27	10.41	21.31	11.39
Sigi Biromaru (N=68)	0	0	60	60	10.27	7.57	12.16	9.29
Kulawi (N=80)	0	0	1200	540	330.31	179.8	390.61	172.95
TOTAL (N=263)	0	0	1200	540	106.60	58.95	260.52	124.20

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

Table 5.8 describes how often households participated in a market in the different districts. In Lore Utara, the district with the best access to markets, households visited the market 8.9 times per month. In Kulawi, the district with the largest distance to markets, households visited the market only 2.3 times per month.

Table 5.8: Number of Visits to Market per Month by Sub District 2004

	N	Minimum	Maximum	Mean	Std. dev.
Lore Utara	71	1	30	5.84	6.88
Palolo	44	1	4	2.67	1.16
Sigi Biromaru	68	0	10	1.74	1.67
Kulawi	80	0	32	3.89	4.52
TOTAL	263	0	32	3.65	4.69

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

Why did household members go to the market? Almost all of the households went to the market to buy food and sell agricultural outputs as Table 5.9 shows. In Kulawi the most important reason for going to the market was to sell the agricultural production, whereas in all other districts the households purchased food.

Table 5.9: Reasons for Going to Market (in percentage)

	Lore Utara		Palolo		Sigi Biromaru		Kulawi	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
For selling agr. Output	28.5	40.6	13.1	10.0	19.4	14.0	77.6	8.1
For buying agr. Input	-	2.3	-	-	2.7	4.9	1.1	-
For buying food etc.	71.5	54.8	86.9	80.1	75.1	67.7	21.3	91..9
Other	-	2.3	-	10.0	2.7	13.4	-	-

Source: Data from 2001 and 2004 STORMA A4 survey

Number of observations =264

In this study, the household respondents were asked about how they receive the price information on agricultural inputs and outputs. Table 5.10 describes such source of information. 51.9% of the households obtained the information from the traditional market traders/merchants, and 48% of whom obtained it from other sources such as rural agricultural shops, farm business partners, vendors and rural transportation drivers.

Table 5.10: Household Getting Information of Price

	N	Percentage
Trader in the Market	137	51.9
Others	127	48.1
Total	263	100.0

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

The interesting result was that the households bought the agricultural input from the same traders to whom they also sold their agricultural output. Table 5.11 presents the purchasing tendency of the households regarding traders. Only 250 households answered the question previously mentioned in Sigi Biromaru, but 12 households (17 percent) did not answer the question in Sigi Biromaru and 1 household (0.9 percent) in the district Kulawi. Nevertheless, most of the households tended to buy agricultural input and output from the same traders.

Table 5.11: Frequency of Household Buying Agricultural Products to The Same Trader by Sub District

District	Yes		No	
	N	%	N	%
Lore Utara (N=71)	12	17.5	58	82.5
Palolo (N=44)	2	5.0	42	95.0
Sigi Biromaru (N=68)	5	7.7	51	74.5
Kulawi (N=80)	18	22.0	62	77.1
All Region (N=263)	37	14.2	213	80.9

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

Regarding the question above, the reason of the households for purchasing agricultural input and output from the same traders could be seen in the following table 5.12. Only 37 households (14 percent) answered this question. Good access was the first reason, indicating that the households can easily reach the market.

Table 5.12: Household´s Reason for Buying Agricultural Products to the Same Trader

	Frequency
Complete choice	7
Cheap	6
Good access	16
Personal relationship	8
Total	37

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

In terms of the access to the agricultural market, several kinds of transport were used by the households. The question about the type of transport taken was not answered by all of the households. Only 249 households gave different answers. 40.7 percent went to the market on foot and 41.5 percent took public transport. 30 households drove their own cars and the rest took other types of transport (see Table 5.13).

Table 5.13: Type of Transportation Used by Households

	N	Percentage
On foot	107	40.7
By public transport	109	41.5
By private motorcycle	30	11.3
Others	3	1.2
Total	249	94.6

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

In the research area, most markets were held only at particular times, like Pasar Maranata, Pasar Bobo and Pasar Bolapapu. Only a few markets were permanent, namely Pasar Watumaeta, Pasar Wuasa, Pasar Wanga, Pasar Gimpu and Pasar

Tomua. Table 5.14 describes the characteristics of the village markets in the research area. Besides the regional markets, many households also travelled to the city markets, like Pasar Masomba and Pasar Inpres in Palu.

Table 5.14: Characteristics of Village Markets, in 2004

District	Name of market	Characteristic of market
Lore Utara	Watumaeta, Wanga, Wuasa; Rompo	Permanent, daily
Palolo	Rahmat, Sejahtera	Particular date
Sigi Biromaru	Bobo, Maranata, Pandere, Pakuli	Particular date
Kulawi	Gimpu, Tomua	Permanent-daily/particular date

Source: Data from 2001 and 2004 STORMA A4 survey; Note: Pasar = Market

Table 5.15 shows that in the research area most of the villages are accessible by car connecting these villages to the provincial capital city, Palu. Only one village, Lawe in the sub district of Kulawi is not accessible by car because the road available in the village is a walking track. The nearest road accessed by car can be reached on foot within 12 hours. Four villages of the village samples are reported to have a regular market and the rest do not.

Table 5.15: Characteristics of Market Access, in 2004

District	Village	Accessibility by car	Present of site market	The nearest market
Lore Utara	Watumaeta	Yes	Yes	
	Wuasa	Yes	Yes	
	Wanga	Yes	Yes	
	Rompo	Yes		Wanga
Palolo	Sintuwu	Yes		Rahmat
	Berdikari	Yes		Bahagia
Sigi Biromaru	Maranata	Yes	Yes	
	Pandere	Yes	Yes	
	Sidondo II	Yes		Bobo
Kulawi	Bolapapu	Yes	No	Bobo
	Lempelero	Yes	No	Tomua
	Lawe	No	No	Gimpu

Source: Data from 2001 and 2004 STORMA A4 survey; Note: Pasar = Market

Village markets are an important part of the rural infrastructure. The answers of households regarding their perceptions about the condition of the market in their village are presented in Table 5.16. Most households have a positive perception about the condition of the market. Only a few households felt that the condition of the village markets had been worsening since the last 4 years.

Table 5.16: Condition of Market by Region, in percent

	Lore Utara		Palolo		Sigi Biromaru		Kulawi	
	2001	2004	2001	2004	2001	2004	2001	2004
Dilapidated	-	-	-	-	13.8	12.5	15.8	10.5
Sound structure	57.8	56.7	59.3	51.0	60.8	43.5	61.9	66.0
Good condition	42.2	43.3	40.7	49.0	25.4	43.9	6.2	8.5
Very good condition	-	-	-	-	-	-	16.2	15.0

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

5.2.6 Land Possession and Land Use

In the vicinity of Lore Lindu National Park, land is the most important asset for rural households because their main incomes are derived from crop production. Table 5.17 presents data on the possession of land in 2001 and 2004. All area measurements are in hectares. On average for all regions, households possessed 1.88 hectares of land in 2001 and 2.15 hectares in 2004. This indicates that, on average, there was an increase in land possession by households. Households in Kulawi possessed the largest amount of land in the research area (e.g. 2.75 hectares of land in 2001 and 3.16 hectares in 2004). In contrast, the lowest score of the possession of land was found in Palolo. Meanwhile, the number of plots owned showed that the Kulawi households had on average 4.10 plots in 2001 and 4.73 plots in 2004. Commonly, all of the regions showed an increasing number of plot ownership for both survey periods.

Table 5.17: Possession and Use of Land in 2001 and 2004, in hectares

District	Owned *)		Number plot owned	
	Mean	Std.dev	Mean	Std.dev
Lore Utara (N=71)				
2001	1.98	1.89	3.32	2.27
2004	2.42	2.14	4.14	2.63
Palolo (N=44)				
2001	0.99	0.95	2.25	1.21
2004	1.05	1.37	2.50	1.99
Sigi Biromaru (N=68)				
2001	1.35	1.17	2.83	1.55
2004	1.43	1.38	3.25	1.82
Kulawi (N=80)				
2001	2.75	3.01	4.10	2.07
2004	3.16	3.09	4.73	2.49
All Region (N=263)				
2001	1.88	2.15	3.25	1.99
2004	2.15	2.35	3.81	2.42

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264
**) include rented plot*

Table 5.18 describes the area of cultivated land and the number of cultivated plots. The average area of cultivated land per household in the research area was 1.63 hectares and 1.44 hectares in 2001 and 2004, respectively. The table shows that there was a declining size of cultivated area, in Sigi Biromaru from 2.07 hectares in 2001 became 1.35 hectares in 2004 and also in Kulawi districts from 1.69 hectares in 2001 became 1.62 hectares in 2004. Nevertheless, the figure in Palolo region increased from 0.94 hectares in 2001 to 1.04 hectares in 2004. While the smallest cultivated land was found in Palolo, Kulawi showed the biggest figure of approximate hectares for both survey periods. Moreover, the number of the cultivated plots showed that in Lore Utara and Kulawi each of the households had roughly 3 plots cultivated for both survey periods. Generally, all of the regions showed a declining number of the cultivated plots for both survey periods.

Table 5.18: Area of Cultivated Land and Number of Area Cultivation Plots, in hectares

District	Land cultivated *)		Number plot cultivated	
	Mean	Std.dev	Mean	Std.dev
Lore Utara (N=71)				
2001	1.55	1.25	3.04	1.52
2004	1.59	1.32	2.50	1.56
Palolo (N=44)				
2001	0.94	0.73	2.11	1.13
2004	1.04	1.38	1.46	1.89
Sigi Biromaru (N=68)				
2001	2.07	7.06	2.65	1.51
2004	1.35	1.12	2.12	1.59
Kulawi (N=80)				
2001	1.69	1.36	3.10	1.48
2004	1.62	1.59	2.78	1.74
All Region (N=263)				
2001	1.63	3.74	2.80	1.48
2004	1.44	1.38	2.31	1.73

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264
**) include rented plot*

The analysis of land use focuses on the three most important crops grown in the research area: cocoa, coffee and irrigated rice. Cocoa is the most important crop in the research area in terms of area as well as in share of households growing this crop (Table 5.19). On average, households cultivated 0.63 hectares of cocoa in 2001 and 0.78 hectares in 2004. A strong decline in coffee cultivation can be observed. The average area cultivated decreased from 0.4 hectares in 2001 to 0.24 hectares in 2004. The share of households cultivating coffee dropped from 50 percent to 30 percent. Sigi Biromaru is the district with the smallest area for coffee plantation.

Table 5.19: Mean Area Cultivated, Share of Crops Cultivated and Percentage Share of Households Growing Crops, by Region

	Lore Utara (N=71)		Palolo (N=44)		Sigi Biromaru (N=68)		Kulawi (N=80)		Total (N=263)	
	2001	2004	2001	2004	2001	2004	2001	2004	2001	2004
Area of paddy rice cultivated (ha)	0.32	0.34	0.26	0.28	0.49	0.36	0.18	0.22	0.31	0.30
Area of coffee cultivated (ha)	0.67	0.29	0.41	0.05	0.09	0.00	0.61	0.49	0.45	0.24
Area of cocoa cultivated (ha)	0.69	0.81	0.23	0.36	0.57	0.58	0.83	1.14	0.63	0.78
HH grow paddy (%)	58.2	52.3	36.8	31.9	56.8	49.1	42.5	37.3	49.5	43.5
HH grow coffee (%)	69.3	34.8	34.9	7.8	6.4	0.0	80.1	65.7	50.4	30.6
HH grow cocoa (%)	79.7	78.6	81.9	82.8	40.7	35.1	89.8	89.9	73.0	71.4

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

5.2.7 Classifying Household Access to Market with Respect to Poverty

The households are classified according to their proximity to the market. Market access is defined as the time it takes for each household to reach the market. Travelling time was chosen as a measurement as households use different modes of transport, so that time measurement is more appropriate than the geographic distance (HAU, M and VON OPPEN, 2002). Using cluster analysis, this study differentiates three household groups with respect to their access to markets (see Table 5.20).

Table 5.20: Classification of Market Access 2001 and 2004

	All Households		Good Access		Medium Access		Low Access	
	2001	2004	2001	2004	2001	2004	2001	2004
Percent of households (%)	100	100	77	79	10	10	12	11
Minimum distance to market (minutes)	0	0	0	0	60	60	720	390
Maximum distance to market (minutes)	1200	540	60	35	210	180	1200	540
Mean distance to market (minutes)	114	61	8	6	112	94	907	435

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

Table 5.20 presents the number of household access to markets classified according to their accessibility. Household members reach the nearest market on average in 114 minutes in 2001 and in 61 minutes in 2004, but large differences are found in the research area on both survey periods. Seventy-seven percent of the households were categorized into having very good access to markets in 2001. A better condition was shown in year 2004, within which 79 percent of the households have access to markets.

The research area is characterized by strong differences on access to market. To give more details on this aspect of accessibility to markets, Figures 5.1 and Figure

5.2 illustrate graphically the percentage of household access to markets by district in 2001 and 2004.

Figure 5.1. Distance House to Market 2001 by district

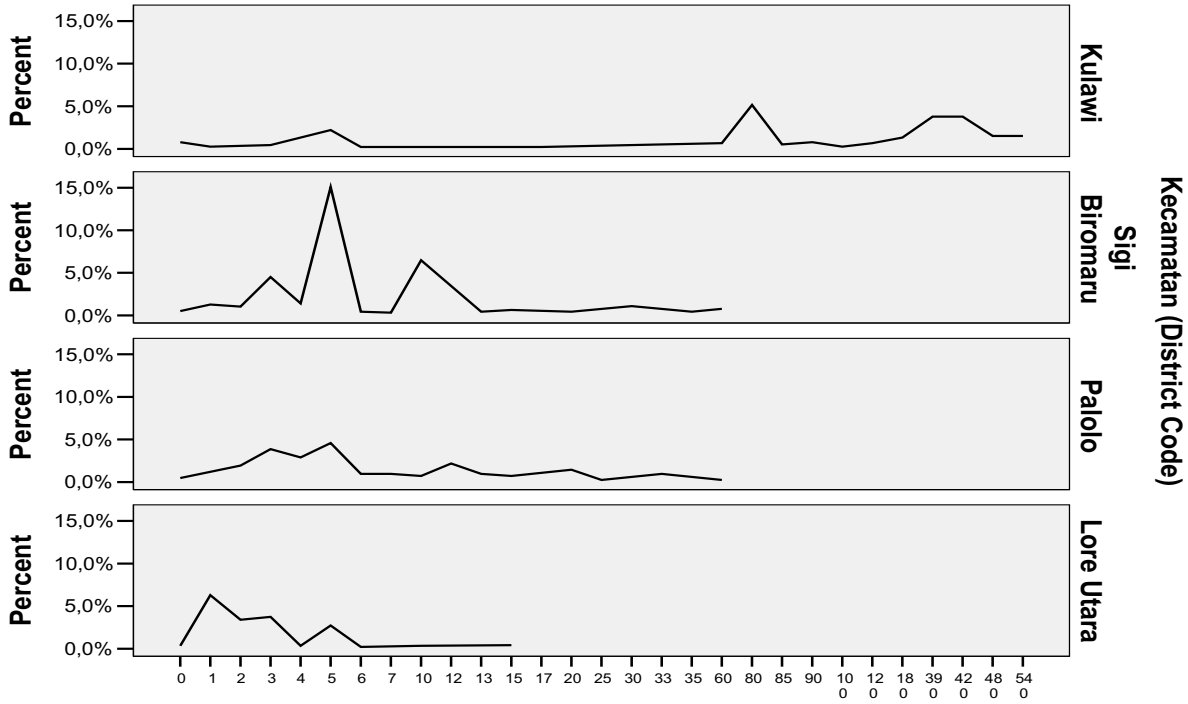

Figure 5.2. Distance house to market 2004

As described in the problem setting in Chapter 1, a reduction of rural poverty is a central policy objective in Indonesia, including the villages in the vicinity of the "Lore Lindu National Park" (LLNP) which is classified as one of the poorest regions in Indonesia. In this regard, this study will describe the accessibility of households categorized by poverty groups (see Table 5.21).

The poverty groups were categorized using the poverty index developed by ZELLER et al. (2005) who employs principal component analysis (PCA) to select and eventually aggregate various indicators of poverty and was calculated by SHABAN (2001) for 2001 and SCHWARZE (2005) for 2004.

Table 5.21: Access to Market by Poverty Group in Percent of Households

	Good Access		Medium Access		Low Access	
	2001	2004	2001	2004	2001	2004
Poorest (%)	54	62	16	11	30	27
Poor (%)	93	86	7	14	0	0
Less Poor (%)	86	94	14	6	0	0
All household	77	79	12	10	11	11

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

Applying a Kruskal-Wallis test reveals significant differences in market access according to poverty groups from both survey periods. Table 5.21 shows that 54 percent in 2001 and 62 percent in year 2004 poorest households were able to reach markets. The result shows that the percentage of the poorest and less poor group increased in the classification of good access to markets, but in contrast, the percentage of the poor group decreased to reach markets from year 2001 to 2004. In 2004, among the less-poor households 94 percent have a good market access, whereas this share is only 62 percent among the poorest households. There was an increasing number of more than 86 percent in 2001 among the less poor households that have a good access to markets. However, we see an increasing percentage of all the households among the poverty categories to reach markets. This could be due to the improvement of road in the research area, especially in remote villages, like the Kulawi district. Nevertheless, it is striking to see that the households with the lowest access to markets are all classified as poorest.

In order to further appreciate the households' access to the market, the following figures, Figure 5.3 and Figure 5.4 show graphically the distance to market on poverty group, by districts in 2001 and 2004.

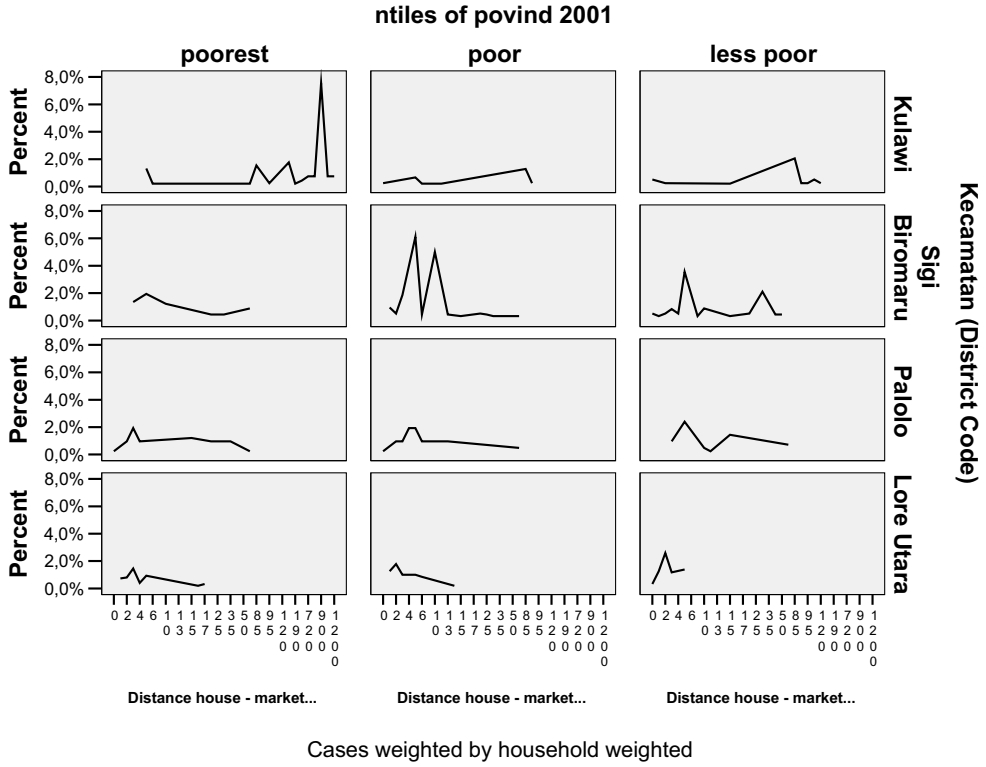

Figure 5.3: Distance House to Market on Poverty Group, by Districts in 2001

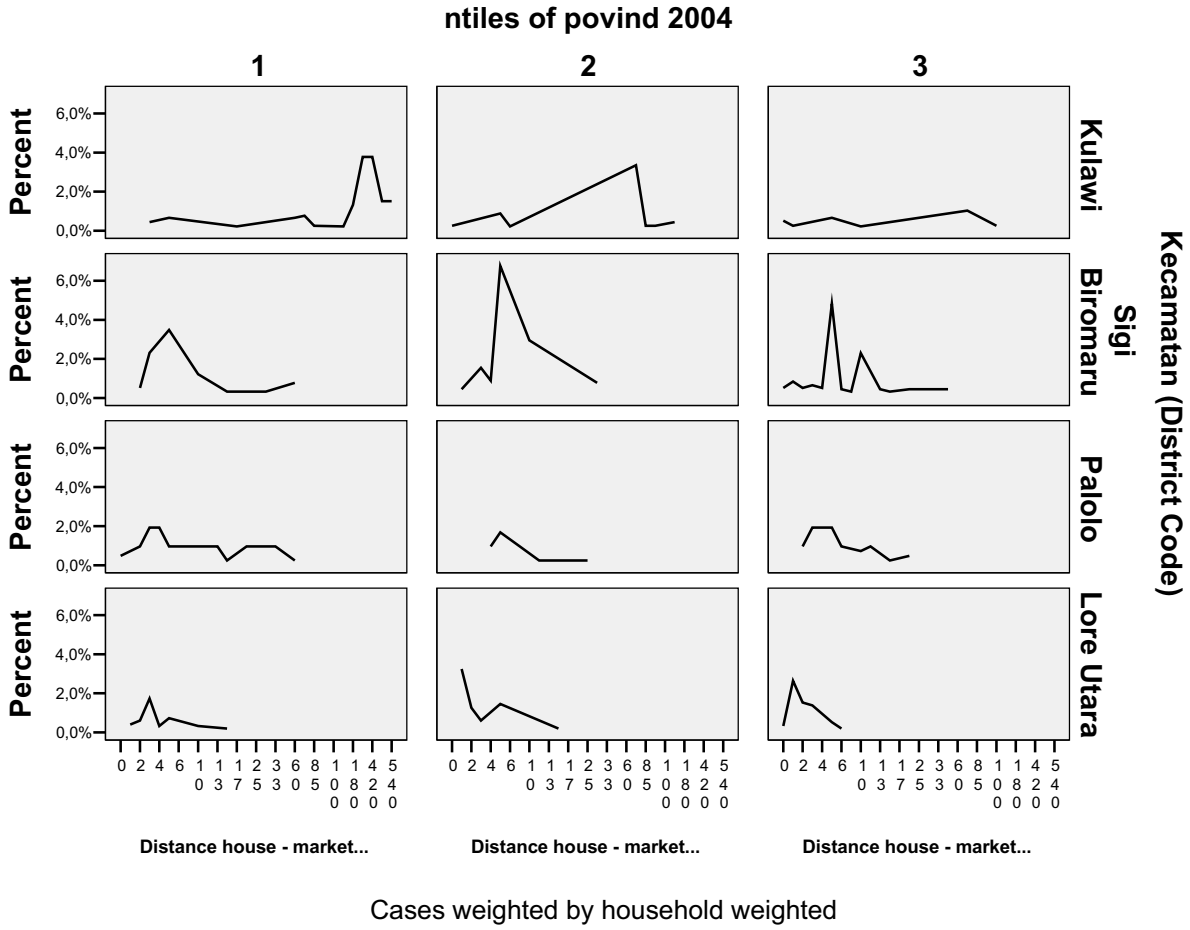

Figure 5.4: Distance House to Market on Poverty Group, by districts in 2004

5.3 Relationship between Households' Access to Markets and Land Use

Influence of market access on land use and households growing crops was examined using a partial ANOVA. In the research area, many different crops were produced. To simplify the analysis of crop pattern in relation to market access, these crops were grouped into three categories: rice, coffee and cocoa.

5.3.1 Share of Households Growing Crops

Table 5.22 reveals that the shares of households growing rice, coffee and cocoa significantly differ according to market access for both survey periods. Households with low market access are particularly involved in coffee and cocoa production,

whereas a large share of households with good and medium market access are cultivating paddy rice in 2001 and in 2004. The percentage of all households decreased cultivating cocoa from 2001 to 2004. Nevertheless, if compared with all of the classification of market access the result reveals that the households which cultivated cocoa tend to increase.

Table 5.22: Share of Paddy Rice, Coffee and Cocoa Conditional by Market Access

	All Household		Good Access		Medium Access		Low Access	
	2001	2004	2001	2004	2001	2004	2001	2004
Share of households growing paddy rice (%)	49	42	56	47	47	47	0	0
Share of households' coffee (%)	43	27	31	13	70	53	100	100
Share of households cocoa (%)	69	68	64	62	78	80	100	100

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations =264

5.3.2 Area of Paddy Rice, Coffee and Cocoa Conditional on Cultivating According to Market Access

Table 5.23 shows the area cultivated with these three crops when the household has decided to grow it. The area is significantly different with respect to market access in the case of cocoa for both survey periods. Households with low market access cultivate less area of cocoa than households with good access in both survey periods. This condition also appeared with respect to coffee. None of the households with low market access grow paddy rice cultivated on their land during the year 2001 and the year 2004.

Table 5.23: Area of Paddy Rice, Coffee and Cocoa Conditional on Cultivating According to Market Access

	All Household		Good Access		Medium Access		Low Access	
	2001	2004	2001	2004	2001	2004	2001	2004
Area of paddy rice cultivated (ha)	0.71	0.75	0.73	0.57	0.41	0.35	n.a	n.a
Area of coffee cultivated (ha)	0.91	0.75	1.03	0.79	0.89	0.88	0.65	0.64
Area of cocoa cultivated (ha)	0.90	1.16	1.01	1.28	0.87	0.98	0.45	0.70

Source: Data from 2001 and 2004 STORMA A4 survey
Note: Number of observation: paddy rice: 129 (2001), 106 (2004); coffee: 114 (2001), 69 (2004); cocoa: 182 (2001), 176 (2004)

5.4. Discussion

The research area is characterized by its inadequate access to markets for agricultural input and output. Recent research suggests that access to and participation in a certain market significantly influences farm productivity.

The description of socioeconomic characteristics shows that the average household members in all the surveyed regions were 5.31 and 5.15 people in 2001 and in 2004 respectively. Despite the declining number of the household members, the dependency ratio showed an increase (i.e. 0.70 in 2001 and 0.80 in 2004) in terms of the number of the dependent children per adult.

Characteristics of the research are displayed by strong differences on access to the markets. The traveling time was used as a proxy of accessibility of households to the markets. This measurement approach was opted for since households used different modes of transport and in this case the time needed for traveling was more appropriate to be used as a measurement tool than the geographic distance. In the Lore Utara region, households for both 2001 and 2004 survey periods have very good access to markets. In contrast, in the Kulawi region the average traveling time to market is more than 1200 minutes (around 20 hours) in 2001 and 540 minutes (around 9 hours) in 2004. However, for all of the regions we see an overall time

decline to reach markets. This could be due to the improvement of roads in the research area, especially in the Kulawi region. Formerly, households in Lawe village (in the Kulawi region) needed more than 20 hours to reach the nearest market, namely Pasar Gimpu. But nowadays there is a motorcycle way from Gimpu village to Lone Basa village; at least half of the travel time was needed to reach the market by motorcycle. The rest of trip was reachable using a horse or by walking. With respect to road infrastructure, ten of our sample villages were located along an asphalt road. One village was connected by gravel roads and one village was reachable only on foot and by horse. The result indicated that it is important to improve the roads as well as market access, e.g. through infrastructure development in the vicinity of Lore Lindu. The result supports the study of LEE et al. (2001). The study of LEE et al. (2001) shows that improvement of roads and market access often increase the intensity of agricultural input and the productivity of agriculture and at the same time reduces the risk associated with investments in agricultural production. In that way, a better access to the market can reduce the need for land expansion (REARDON et al. 2001). If the roads open up formerly inaccessible areas, immigration pressures can result in environment degradation (LEE et al. 2001).

Furthermore, the reason why households participate in the market was mainly to buy food and sell agricultural outputs. The third biggest percentage of participation was to buy agricultural inputs and the rest were for other purposes, such as sightseeing and comparing the prices of agricultural outputs and inputs. The result above indicates that to show household decisions regarding consumption, production, purchases and sales of particular crops or goods. This conforms to the OMAMO hypothesis (1998) that transaction costs will be differentiated by and dependent upon the household's sufficiency, i.e. whether they sustain deficiency or surplus on their crops production. Moreover, the high transaction costs will influence the commercialization pattern of the household. This implies that due to the net buyers of staples, who prefer buying less and producing more by themselves and the selling of cash crops, who prefer selling more and producing less for their own consumption. To most farmer households, transaction costs are associated with participating in an increasingly vertically coordinated market. Although, we also

considered the limitation of Omamo's approach that it only considers observable transaction costs incurred by transport.

Concerning market availability, there were not many village markets in the research area. Many households tried to reach a market outside their district. Many households travelled directly to the city market, like Pasar Masomba and Pasar Inpres in Palu. Some households have direct access to a city market because the city market is nearer than the rural market. Most of the households reached the village market near the homestead. In the research area, most markets were held only regularly on particular days of the week, like Pasar Maranata, Pasar Bobo and Pasar Bolapapu. Few markets were permanent, namely Pasar Watumaeta, Pasar Wuasa, Pasar Wanga, Pasar Gimpu and Pasar Tomua. The characteristics of the village markets were almost identical in the research area, namely permanent/daily or at a particular day of the week, most were a combination of both. The local trade system and the lack of market infrastructure in each village develop into a combination of permanent and particular day market. The consequences of this condition, which was shown with the low level of rural infrastructure leading to higher input prices and lower output prices at a farmgate level as well as higher transport and transaction costs for farmers procuring seeds and fertilizers. This phenomenon reflects to the study of de JANVRY et al. (1991) in which they point out the effect of 'missing markets', using a household model to represent a generic Africa household. The study showed that in the absence of a food market the households have to be self-sufficient in terms of food, which limits their ability to reallocate land and labour to cash crops. As a result, households paid the broad margin of product between low selling price and high buying price.

The Lore Lindu region is a geographically diverse region and features a lowland-upland dichotomy in the agricultural sector. The lowland sector is associated with paddy rice cultivation while perennial crops, mainly cocoa and coffee and some dryland seasonal crops, mainly upland rice and corn, are grown in the uplands (MAERTENS, 2003). Land use and cultivated crops are linked to each others. Thus, as crop production was the most important activity in the region, we focused on the

possession of land and land use. On average for all regions, households possess 1.88 hectares of land in 2001 and 2.15 hectares in 2004. This indicated that, on average, there was an increase in land possession. Households in Kulawi possessed the largest area of land in the research area (e.g. 2.75 hectares of land in 2001 and 3.16 hectares in 2004). In contrast, the lowest score of the possession of land was found in Palolo. Meanwhile, the number of plots owned showed that the Kulawi households had 4.10 plots in 2001 and 4.73 plots in 2004 on average. Commonly, all of the regions showed an increasing number of plot ownership for both survey periods. The changes in land ownership occurred between 2001 until 2004. There are several reasons in the changing of owned land property, namely due to land purchasing (46 %), heritage (19%), clearing of primary forest (11%), gifts (5%) and though marriage (3%). Seventy five of the households acquired a new plot, where the total of new plots is 107. Most of the new plots have higher soil fertility. On average the newly acquired land is 0.75 hectares from 2001 to 2004. Within the period of 2001 until 2004 there is a 40 percent change of landownership in 2003 and a 34% change of land ownership in 2002. Our results indicated that the analysis can be linked to the statement of VON THÜNEN, which stated that farmer households have perfect information and perfectly use this information to maximize profits. VON THÜNEN also describes that each piece of land will be devoted to the use in which it would yield the highest rent. Moreover, moving to Ricardian model of land use, it explains the existence of different land rents with differences in land quality that arise from a heterogeneous landscape. Land of better quality or higher soil fertility generates higher rents. Land with higher quality generates surpluses for farmers compared to farmers with land of lower quality (MÜLLER, 2003). Concerning the land use in the vicinity of Lore Lindu, MAERTENS (2003) also reported that the land use pattern in the research region is centered on villages rather than around roads and major markets, which relates to the history of the area. Villages might have a long history of establishment while roads were built more recently to connect villages. Furthermore, looking at the household land acquisition in the vicinity of the Lore Lindu National Park, NURYARTONO (2004) also reports that the process of land acquisition by purchase is related to the welfare status of the household and the household's ethnicity. The wealthier households and non

local/migrant people accumulate land through purchase from other households while the poorer households use their family labour to clear the forest land.

It is found that household members reach the nearest market approximately in 114 minutes in 2001 and in 61 minutes in 2004, but large differences exist in the research area on both survey periods. Seventy-seven percent of the households were categorized into having very good access to markets in 2001. A better condition was shown in year 2004, where 79 percent of the households have access to markets. This result indicates that the distance from house to market is important in determining to open up isolated area and improving the segmented market participant.

Moreover, we find that the percentage of the poorest and less poor groups increased in the classification of good access to the market, but in contrast, the percentage of the poor group decreased to reach markets from the year 2001 to 2004. In 2004 among the less poor households 94 percent have a good market access, whereas this share is only 62 percent among the poorest households. This condition was better than in 2001 that only 86 percent of the less poor households that have a good access to the markets. However, an increasing percentage is seen all households among the poverty categories to reach markets. This result indicates that improving market access could benefit rural activities of poorest and less poor groups to reduce transaction costs.

The application of ANOVA was able to give some general conclusions on the association between market access and land use. We may conclude that the result of ANOVA revealed that the share of households growing rice, coffee and cocoa significantly differs according to market access for both survey periods. Households with low market access are particularly involved in coffee and cocoa production, whereas a large share of households with good and medium market access is cultivating paddy rice in 2001 and in 2004. But, the area cultivated with cocoa is significantly different with respect to market access in both survey periods.

Households with low market access cultivate less area of cocoa than households with good access.

Based on the households growing crops, the result showed that the degree of market access tended to have a relationship with the share of households growing the crops which was highly significant in 2001 and 2004. The households' decisions on what to grow were much influenced by numerous factors, such as input and output market price, risk of production and market proximity (AHMED and HOSSAIN, 1990 in HUA and VON OPPEN, 2002). In our case, the good market access led the households to grow high value crops, such as cocoa.

At last, regarding the relationship between accessibility to market and decision to land use and on the basis of an economic viewpoint, the results of descriptive analysis above are able to explain widely that if the farmer households are generally poor and contribute inadequately to the mainstream market because of a low production and poor access to other options in getting a better livelihood. It is found, however, that these farmer households can survive economically when given a set of opportunities to transform from subsistence to commercial operators. When farmer households participate in the market, this might result in strong multiplier effects. If there are few farmer households participating in the market, this is caused by a number of constraints, some of which have to do with transaction cost barriers. The general view in the literature is that the presence of high transaction costs will affect the pattern and/or level of participation in the market (MAKHURA, 2001).

6. Econometric Analysis

6.1 Introduction

The objective of this chapter is to present the empirical result of the model formulated in Chapter 4. The model is designed to present the influences of market access on land use pattern and find the effects of market access on fertilizer use by households. The second part of this chapter explained the descriptive statistics of variables. The third part provides the result of econometrics of households growing crops. Finally, the fourth part presents the result of the econometrics model of households using fertilizers. This chapter ends with a discussion.

6.2 Descriptive Statistics of Variables

The description of variables in the model with the respective units of measurement and means value, standard deviation, minimum and maximum of variables are represented in Table 6.1 and Table 6.2.

The following Table 6.1 presents the descriptive statistics of all dependent variables used in the models. The dependent variables comprise several types, such as the share of households growing crops, in percentage (SHSW = share of households growing paddy rice; SHCF = share of households growing coffee; SHCC = share of households growing cocoa). The binary dependent variable is shown by the probability of households growing crops (1 = growing crops) (HHGROSW = the probability of households growing paddy rice; HHGROSW = the probability of households growing coffee; HHGROSW = the probability of households growing cocoa).

Table 6.1: Descriptive Statistics of the Dependent Variables

Variable	Mean	Std.Dev	Min	Max
SHSW (%)	23.53	33.12	0.00	100.00
SHCF (%)	17.12	28.27	0.00	100.00
SHCC (%)	40.28	37.89	0.00	100.00
HHGROSW (1=grow paddy rice)	0.46	0.49	0.00	1.00
HHGROCF (1=grow coffee)	0.36	0.48	0.00	1.00
HHGRCC (1=grow cocoa)	0.69	0.46	0.00	1.00
UREA (kg)	33.17	89.12	0.00	1200.00
HHUREA (1= used Urea)	0.29	0.45	0.00	1.00

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations = 528

Table 6.2 gives an overview of the descriptive statistics of the explanatory variables used in the models.

Table 6.2: Descriptive Statistics of the Independent Variables

Variable	Mean	Std.Dev	Min	Max
AGEHH (years)	45.38	14.43	20.00	86.00
ETNIC (1=non-indigenous)	0.19	0.39	0.00	1.00
EDHEAD (years)	3.83	1.85	1.00	8.00
HHSIZE	5.25	2.01	1.00	13.00
NUMSHIP	2.93	2.87	0.00	21.00
CREDMX (1000 IDR)	1247.29	4129.64	0.00	5000.00
DISMARK (minutes)	57.23	161.26	0.00	1200.00

Source: Data from 2001 and 2004 STORMA A4 survey
Number of observations = 528

The explanatory variables are divided into four key categories. First, human capital indicators (HHC) which include age of the household's head (AGEHH), education of head of household (EDHEAD) and household size (HHSIZE). The age of household AGEHH normally provides a proxy experience in farming. Further, these households will have stronger social network and will have established credibility within the network. This implies that older heads are more informed about the cultivated land. AGEHH was measured in number of years. The education of household heads, measured in schooling years has been used in all models as a proxy for education (EDHEAD) and the number of the household members as represented by a household size variable (HHSIZE). The size of the household represents the production and consumption units of the household. The more members in the household, the more labour to cultivate the land. Second, social capital (SC) indicators, which cover the number of organizations in which the household is involved, are taken into account. Social capital is the household member's access to social networks and institutions (NUMSHIP). In this case, the study focuses on the access to networks, based on a number of membership of households in various rural organizations and ethnicity of head household (ETNIC). The ethnicity of the household head (ETNIC) variable assumed the value of one if the head of household was non-indigenous and zero for indigenous head of

household. Third, access to credit (CM) is represented by a credit maximum (CREDMX). The credit maximum (CREDMX) variable is that the household received a loan which is informal loan or formal loan received by the head of households and their spouses. CREDMX was measured in IDR (Indonesian Rupiah). The category of formal loans includes credit from cooperatives, by credit programmes and also loans from the Bank Rakyat Indonesia. The category of informal loans includes loans from relatives and loans from traders. Fourth, household accessibility to reach a nearby market (DISMARK) is a key variable of interest in these estimates. DISMARK is measured in minutes.

6.3 Determinant of Household Growing Crops

In order to analyze the influences of market access on land use pattern, the model described in Equation (1) and (2) in Chapter 3 was employed. For this purpose, the random-effects Tobit and Probit regressions were estimated using the two survey observations from the unbalanced panel of STORMA rural households in the year 2001 and 2004. The Tobit and Probit models were used to determine the households growing crops and the influences of their variables, respectively. This study concentrates heavily on major crops (paddy rice, cocoa and coffee).

To accomplish this, Equation (9) using the Tobit random-effects estimator for share of households growing crops was estimated.

$$SH_{it} = c + \beta_1 AGEHH_{it} + \beta_2 EDHEAD_{it} + \beta_3 HHSIZE_{it} + \beta_4 ETNIC_{it} + \beta_5 NUMSHIP_{it} + \beta_6 CREDMX_{it} + \beta_7 DISMARK_{it} + \alpha_{it} + \varepsilon_{it} \quad (9)$$

In the Tobit regression, the dependent variable was the share of households growing crops; otherwise it was zero. Equation (10) using the Probit random-effects estimator for households that grow certain crops was estimated with the following independent variables.

$$HHGROW_{it} = c + \beta_1 AGEHH_{it} + \beta_2 EDHEAD_{it} + \beta_3 HHSIZE_{it} + \beta_4 ETNIC_{it} + \beta_5 NUMSHIP_{it} + \beta_6 CREDMX_{it} + \beta_7 DISMARK_{it} + \alpha_{it} + \varepsilon_{it} \quad (10)$$

The dependent variable in the Probit regression took on the value one, if the households had cultivated the respective crops and zero otherwise.

The vector of explanatory variable includes the coefficients for observable time-variant and time-invariant explanatory variables that affect the households growing crops. The unobserved heterogeneity was treated as a set of random variables, assumed to be orthogonal to the explanatory variables. This assumption provides the basis for using a random-effects estimator, allowing the estimation of coefficients for the observable time-invariant variables (CHAVEZ, 2004). The LIMDEP version 8 econometric software was used to run the sets of models.

6.3.1 Household Growing Paddy Rice

The results of estimation of random-effects Tobit estimator are shown in Table 6.3, with coefficients and a significance level of > 90% in bold. The coefficients in the table are the estimated absolute effects of one unit changes in the corresponding explanatory variables on share of household growing irrigated paddy.

Several variables are statistically significant for the determinant of the share of households growing paddy rice, namely the age of the household's head, education of household's head, ethnicity and distance from house to market. The age of the household's head variable was statistically significant. The positive sign and high significance of this variable mean that the share of households growing paddy rice rose as the age of the household's head increased. This indicates that an age factor has a key role in the success of paddy cultivation, since this factor is closely related to paddy cultivation experience. Besides, the longer farmers are involved in paddy cultivation, the more they have practical knowledge and intuition of observing natural phenomena.

Table 6.3: Share of Household Growing Irrigated Paddy

	Coeficient	t-value
Constant	**-40.309**	**-2.53**
AGEHH	**1.125**	**4.43**
EDHEAD	**3.146**	**1.69**
HHSIZE	- 2.605	-1.64
ETNIC	**-34.96**	**-3.96**
NUMSHIP	-2.605	1.392
CREDMX	1.918	-0.357
DISMARK	**-0.324**	**-3.03**
Sigma(v)	***54.543***	***13.98***
Sigma(u)	***16.610***	***2.15***
Log likelihood		-1405.034
Chi squared		57.80029
P-value		0.000

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

The educational variable of household head shows that the higher households attend a school, the higher they will get the share of households growing paddy rice. This denotes that the educational factor has a direct effect on farmers' understanding of paddy rice cultivation and the share of paddy rice cultivation.

Ethnic affiliation has a strong and statistically significant effect on the average share of households growing paddy rice crops. Belonging to a non-indigenous ethnicity decreased the share of households growing paddy rice. Land share for paddy cultivation is more popular among indigenous households in which most of them reside in a research area. Practically, paddy rice cultivation is intensive-labor; thus, paddy rice is cultivated by major ethnic who live in one area where a number of laborers are available.

Also, the distance from house to market was statistically significant. The negative sign and highly significant level of this variable indicates that the share of the households growing paddy rice increased as the distance to the market was closer.

Further, of the existing variables possibly affecting the share of household growing, household size has an insignificant effect, and this factor is marked “negative.” An interesting thing is that the negative sign means the more intensive paddy rice is cultivated, the fewer the number the household members is. Also, the paddy rice cultivation by farmers is not much affected by the amount of loans. This indicates that farmers have optimally cultivated the paddy rice crops in the research area.

Table 6.4: Factors Influencing the Decision to Grow Paddy Rice

Variables	Coeficient	t-value	Marginal Effect
Constant	**-1.089**	**-3.07**	
AGEHH	**0.027**	**4.73**	1.108
EDHEAD	0.045	1.03	0.158
HHSIZE	-0.042	-1.28	-0.202
ETNIC	**-0.725**	**-3.91**	-0.119
NUMSHIP	**0.059**	**2.02**	0.148
CREDMX	0.15D-04	1.09	0.017
DISMARK	**- 0.006**	**-2.45**	-0.478
Rho	***0.213***	***1.94***	
Goodness of fit diagnostics			
Pseudo R^2:Ben./Lerman:			0.592
Mc Fadden:			0.145
Veall/Zim.:			0.288
Rsqrd_ML:			0.182
Log Likelihood			-311.503
(degrees of freedom)			1
Pct. Correctly predicted			
Actual/Predicted			68.56

	0	1	total
0	189	95	284
1	71	173	244
total	260	268	528

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

Table 6.4 reports the results of the estimations using the random-effects Probit estimation procedure for households growing paddy rice crops. The dependent variable took on the value one, if the household cultivated the respective crops and zero otherwise. The Probit random-effect model was estimated by MLE using Limdep 8 software package. The percentage of correctly predicted observations was approximately 68 percent.

The estimate of the households that cultivated paddy rice shows that the age of household's head, ethnicity, number of memberships and distance from house to market had statistically significant effects on the probability that the household cultivated paddy rice.

Similar to the Tobit model, the age of household head variable has a positively significant relationship to the Probit model. This shows that the older farmers are, the more likely they will cultivate paddy rice crops. Probably, the contribution of household head experience in paddy cultivation is the silent factors.

Social capital plays an interesting role as the determinant of the probability of households growing paddy rice as shown by the variable of number of membership. The influence of social capital on households growing paddy rice might be explained by the importance of external factors in its decision of crop cultivation by the household. The attendance of members at several organisations' meetings might provide members with information, such as information about fertilizers and pesticides. Extension service is one of the more effective media of upgrading farmers' knowledge in crop cultivation and of sharing experience in paddy rice cultivation among farmers.

Being a non-indigenous ethnicity decreased the probability of households growing paddy rice by 0.72 percent. This result is in line with Tobit finding on the decision of household growing coffee. The negative sign of non-indigenous ethnicity illustrates indigenous residents are well-experienced in irrigated paddy rice cultivation. The decision of cultivating paddy rice crops is affected by crop culture process and marketing. Since farmers are well versed in marketing, risks of making decisions could be minimized. Meanwhile, walking distance from house to market has a significant negative effect on the households growing paddy rice. The farther the walking distance from homestead to the market, the less probable households would grow paddy rice as shown by variable of DISMARK.

The marginal effect displays the slope of probability function at sample mean. For example, the coefficient of marginal effect for the distance of homestead to market is -0.478. This means that one minute increase in the distance of homestead to the nearest market is a reduction of 0.478 percent in the likelihood that the households cultivate paddy rice. An increase of one year in the age of the household head is associated with only a 1.108 percent increase in the likelihood that the households cultivate paddy rice. An additional membership is associated with a 0.148 percent increase in the likelihood of households' paddy rice production.

6.3.2 Household Growing Coffee

Table 6.5 presents the results of the estimation of the share of households growing coffee. The result of the estimation shows that the household size, ethnicity and number of memberships in rural organizations and household's access to the market variables have a significant effect on the share of households growing coffee. The positive sign indicated that households growing coffee increase with the increasing amount of members of the household. While, ethnic affiliation has a strong and statistically significant effect on average share of households growing coffee crops.

An organization membership variable has a positive correlation although the significance level is low. This means that the more households participate actively in certain societal organizations, the more extensive coffee crops will be grown. The involvement variable effect on the share of coffee cultivation is much influenced by the amount of information that the households are involved in the organizations. In this case, the interactions among households enable them to share information and experience in coffee cultivation with one another and to wisely make a decision to grow coffee crops and share the lands.

Table 6.5: Share of Household Growing Coffee

	Coefficient	t-value
Constant	**-67.089**	**-3.79**
AGEHH	-0.087	-0.372
EDHEAD	1.242	0.63
HHSIZE	**4.895**	**2.91**
ETNIC	**15.504**	**2.07**
NUMSHIP	**2.311**	**1.81**
CREDMX	-0.001	-0.91
DISMARK	**0.104**	**5.11**
Sigma(v)	**45.432**	**12.771**
Sigma(u)	**38.231**	**5.762**
Log likelihood function		-1156.219
Chi squared		28.109
P-value		0.000

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

Finally, the study pointed out that the positive sign and high significant level of distance to market variable explain that the share of households growing coffee increases with an increase in the distance to markets. This result is incompatible with Tobit finding on the decision of household growing irrigated paddy rice crops.

While Table 6.6 presents the estimated determinants of probability of a household growing coffee using Probit random-effect model. The percentage of correctly predicted observations is about 71 percent. The pseudo R^2 varies between 0.674 and 0.128 percent across measure. Lastly, Table 6.6 also reports the probability of households growing coffee categories correctly predicted and the distribution of actual versus predicted probability of households growing coffee. This shows the models performed well, correctly predicting the household's growing crop decisions.

The estimation of the probability of a household growing coffee has several significant independent variables. The educational background of the household head, the household size, the number of membership, and the distance from homestead to the market have significant effects on whether the household decided to grow coffee. The positive sign of number of membership variable indicated that households growing coffee rose as the number of household members increased. This result is in line with Tobit finding on the decision of households growing coffee.

Finally, more access to the market boosts coffee cultivation. This is similar to the Tobit finding showing the positive effect of the decision of households growing coffee. This indicates that coffee cultivation is indirectly related to rural road infrastructures which are main access for farmers to markets.

Meanwhile, the marginal effect shows that an increasing number of the household members were 0.412 percent in the likelihood of households cultivating coffee. The households that had active members of several organizations were associated in a 0.103 percent likelihood that the household would cultivate coffee. Lastly, an increase of the travelling by one minute would lead to an increase of 0.698 percent in the likelihood that households cultivate coffee.

Table 6.6: Factors Influencing the Decision to Grow Coffee

Variables	Coeficient	t-value	Marginal effect
Constant	**-2.802**	**-4.91**	
AGEHH	0.006	0.95	0.179
EDHEAD	**0.098**	**1.77**	0.213
HHSIZE	**0.136**	**2.65**	0.412
ETNIC	0.297	1.43	0.031
NUMSHIP	**0.065**	**1.81**	0.103
CREDMX	-0.110D-04	-0.565	-0.008
DISMARK	**0.014**	**4.96**	0.698
Rho	***0.473***	***4.423***	
Goodness of fit diagnostics			
Pseudo R^2:Ben./Lerman:		0.674	
Mc Fadden:		0.128	
Veall/Zim.:		0.254	
Rsqrd_ML:		0.155	
Log likelihood		-301.681	
(degrees of freedom)		1	

Pct. Correctly predicted 71.780

Actual/Predicted	0	1	total
0	318	18	336
1	131	61	192
total	449	79	528

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

6.3.3 Household Growing Cocoa

Regarding the results of the random effect Tobit model (see Table 6.7), the estimation of the share of households growing cocoa shows that the age of the household's head, the household size and ethnicity were statistically significant.

Table 6.7: Share of Household Growing Cocoa

	Coefficient	t-value
Constant	17.652	1.612
AGEHH	**-0.3290**	**-1.929**
EDHEAD	-0.958	-0.690
HHSIZE	**3.983**	**3.148**
ETNIC	**29.007**	**4.965**
NUMSHIP	0.921	0.953
CREDMX	0.001	0.715
DISMARK	0.007	0.300
Sigma(v)	45.242	16.819
Sigma(u) 17.912	17.912	3.822
Log likelihood		-2029.838
Chi squared		46.768
P-value		0.000

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

Thus, the coefficient for the age of the head of a household is negative and significant, confirming that older households have a lower share of the households growing cocoa. The positive sign of household size variable indicated that the share of households growing cocoa increases with the increasing amount of members of the household. The case of influence of household size to share of household growing cocoa indicates that household tends to add the members of household as labour. On the other hand, cocoa has a high value in the economy. Thus, the adding of members of household can be possible because the relationship between relatives is closer. The households can adjure their relatives from other villages to cultivate together. This result shows that the households take advantage of the production factor (MANIG, 1991).

Meanwhile, several variables, such as the educational background of the household heads, the number of memberships and distance between homesteads to market, are

not statistically significant. The distance between homesteads to market had a positive sign, but these effects are not statistically significant.

Table 6.8: Factors Influencing the Decision to Grow Cocoa

Variables	Coeficient	t-value	Marginal effect
Constant	-0.497	-1.55	
AGEHH	-0.005	-1.03	-0.051
EDHEAD	-.0189	-0.43	-0.0159
HHSIZE	**0.161**	**4.23**	0.187
ETNIC	**0.667**	**3.55**	0.027
NUMSHIP	0.039	1.29	0.024
CREDMX	0.66D-05	0.32	0.002
DISMARK	**0.011**	**3.60**	0.214
Rho	0.161	1.32	
Goodness of fit diagnostics			
Pseudo R^2::Ben./Lerman:			0.630
Mc Fadden:			0.103
Veall/Zim.:			0.205
Rsqrd_ML:			0.120
Log likelihood			0.630
(degrees of freedom)			1
Pct. Correctly predicted			71.4

Actual/Predicted	0	1	total
0	40	122	162
1	29	337	366
total	69	459	528

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

Table 6.8 reveals that the decision to grow cocoa is influenced by the household size, ethnicity, and distance to the market. The variable of household size is a crucial factor in influencing the decision of share of households growing paddy. The household size had a positive sign and was significant. Holding other variables

constant, the household membership in a particular organization increases the probability of the household growing cocoa by only 0.16 percent.

A non-indigenous ethnicity increased the probability of the household growing cocoa by only 0.66 percent. This result suggests that an ethnic variable affects cocoa cultivation in which non-indigenous ethnic is more knowledgeable in cocoa cultivation and more sociable.

The condition of road infrastructure does matter for the decision of households growing cocoa. It is showed by walking distance from house to the market variable. Walking distance from house to the market has a significantly positive effect on the households growing cocoa. The farther the walking distance from homestead to the market, the more probable households would grow cocoa crops. This result is not in line with Tobit finding on the decision of household growing cocoa.

The interpretation of marginal effects for the decision of the households growing cocoa is discussed next. An increase of the number of household members by one induces a 0.187 percent higher chance of growing cocoa. This indicated that there is large effect to grow cocoa. The one minute travelling time from house to markets is associated with a 0.214 percent increase in the likelihood that the households cultivated cocoa.

The next section shifts the focus of determinant of the households using fertilizers in which market access was of great priority.

6.4 Factors Influencing Households Using Fertilizers

Better market access could lead to lower input prices and higher output prices at the farm-gate level and hence, positively influence productivity through increased input use. Hence, the effects of market access on the households' fertilizer use are investigated in this section.

In order to analyze the influence of market access on fertilizer use, the model described in Equation (3) and (4) of Chapter 3 was employed. The random-effect Tobit and Probit regressions were estimated using the two survey observations for the unbalanced panel of STORMA rural households in year 2001 and 2004.

In short, the model of the influence of market access to fertilizer households was used along with the Tobit random-effects estimator for household using urea as dependent variables.

$$UREA_{it} = c + \beta_1 AGEHH_{it} + \beta_2 EDHEAD_{it} + \beta_3 HHSIZE_{it} + \beta_4 ETNIC_{it} + \beta_5 NUMSHIP_{it} + \beta_6 CREDMX_{it} + \beta_7 DISMARK_{it} + \alpha_{it} + \varepsilon_{it} \quad (11)$$

Equation (12) was also used using the Probit random-effects estimator for households that used fertilizer as dependent variables.

$$HHURE_{it} = c + \beta_1 AGEHH_{it} + \beta_2 EDHEAD_{it} + \beta_3 HHSIZE_{it} + \beta_4 ETNIC_{it} + \beta_5 NUMSHIP_{it} + \beta_6 CREDMX_{it} + \beta_7 DISMARK_{it} + \alpha_{it} + \varepsilon_{it} \quad (12)$$

Table 6.9 reports the results of the estimation of the determinants of fertilizer used by the households on the basis of the estimator of Tobit random effect. Only two independent variables (number of membership and distance of market) were statistically significant. The number of membership has a significant positive effect on households using urea. A higher number of members in the rural organisation lead the household to increase the use of urea. In this case, the number of membership, as a proxy of social capital, plays an important role in the determinant of a household using urea. When households interact through the local organizations, their good relationship and networking presumably also provides information on the value and price of fertilizer. Furthermore, the empirical results of the Tobit random-effect analysis confirm that the distance to markets as a proxy of accessibility to markets also has a negative significant coefficient. The negative

sign and highly significant level of this variable indicates that the share of households using urea increases with the decreasing distance to the market.

Table 6.9: Determinant of the Households Using Urea

	Coefficient	t-value
Constant	**-148.956**	**-2.49**
AGEHH	1.418	1.63
EDHEAD	1.162	0.16
HHSIZE	-2.258	-0.338
ETNIC	12.324	0.445
NUMSHIP	**8.107**	**1.714**
CREDMAX	0.001	0.231
DISMARK	**-1.045**	**-2.144**
Sigma(v)	**176.172**	**14.045**
Sigma(u)	**79.841**	**2.959**
Log likelihood		-1236.350
Chi squared		47.809
P-value		0.000

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

The results from the estimations by using the Probit random effect model for panel data can be seen in table 6.10. We investigate how the vector explanatory variables influence the likelihood that a household used fertilizer for their crops. The dependent variable is a dummy variable with a value of 1, if the household used fertilizer and 0 otherwise.

The pseudo R^2 measures vary between 0.605 and 0.049 percent across measure as well as the table reports the urea used by household correctly predicted by model and the distribution of actual versus predicted household used fertilizer. Two variables are significant in determining the household's fertilizer use. The result shows that the variable of the number of membership and the distance from house to the market has a significant effect on how much fertilizer the households used.

The probability of household using fertilizer is considerably influenced by organizational membership. The positive sign of the membership indicates that the more households become a member of rural organization, the more probable they use fertilizers. This result is consistent with Tobit finding on the share of household using fertilizer.

The negative sign of the market access variable indicated that the more access households have to the market the less the probability that they use fertilizer. Some possibilities underscoring this result are that access to market is not a main factor encouraging households to use fertilizers, since cocoa and coffee cultivations require less fertilizer compared to paddy rice cultivation. Other possibilities are that better access to market does not guarantee that the use of fertilizers is reduced and that farmers have more knowledge about crop cultivation; in this regard, they focus not only on use of fertilizers, but also on good crop cultivation and management systems.

Although not statistically significant, the credit maximum variable had a positive influence in determining the household's fertilizer use and the negative sign indicates that the closer households are to receiving access to credit from formal or informal financial institutions the less total fertilizer is used by households. This fact relates to the condition of welfare. The possibility of getting access to the loans shows that money was not only used for agricultural input but also for other households that need it.

Table 6.10: Factors Influencing the Decision of Household that Use Urea

Variables	Coeficient	t-value	Marginal effect
Constant	-0.604	-1.64	
AGEHH	0.007	1.36	0.380
EDHEAD	0.002	0.05	0.009
HHSIZE	-0.0496	-1.29	-0.292
ETNIC	-0.034	-0.21	-0.007
NUMSHIP	**0.065**	**2.19**	0.199
CREDMAX	-0.66D-05	-0.421	-0.009
DISMARK	**-0.006**	**-2.10**	-0.582
Rho	*0.264*	*2.50*	
Goodness of fit diagnostics			
Pseudo R^2::Ben./Lerman:		0.605	
Mc Fadden:		0.049	
Veall/Zim.:		0.103	
Rsqrd_ML:		0.058	
Log likelihood		-297.34	
(degrees of freedom)		1	
Pct. Correctly predicted		71.023	

Actual/Predicted	0	1	total
0	365	12	377
1	141	10	151
total	506	22	528

Source: own calculation (Project A4 household survey 2001 and 2004), N=528
Note: Coefficients with a significance level greater than 90 percent are in bold

The interpretation of the marginal effect on the probability of households using fertilizer is that relatively an increase by one household member led to a 0.292 percent in which this percentage might lower the probability of the households using fertilizer. Moreover, a relative increase by being organization members led to a 0.199 percent might rise the probability of the households using fertilizers. Also,

the one minute longer travel time from house to the market was associated with a 0.582 percent reduction in the likelihood of the households using fertilizer.

6.5 Discussion

This section discusses the econometric findings. An accessibility indicator was calculated by all of the households who travelled to the nearest markets based on the time taken to get to the market. The interesting result of the market accessibility is that coffee and cocoa had different effects compared to paddy rice. The better market access increased the likelihood that the household grew paddy rice and decreased the probability of coffee and cocoa cultivation.

Nevertheless, the phenomena above took place since, in the case of paddy rice, the households did not sell the yields, but consumed the yields for their household needs instead. Further, they sold the yield only when the prices were sufficient. This is because the number of rice stocks is abundant if there is a large number of paddy rice crops harvested, for instance 53.3 percent of the paddy rice has been sold and 46.7 percent was self-consumed in 2004. On average the household could produce 1,534 kg and only 759 kg were sold to the nearest market in 2004 (self calculation). The rest of the yields is used to fulfill daily subsistence, especially in remote villages which have problems to access the rural markets to purchase consumption goods.

On the other hand, better market access decreased the likelihood of households growing coffee and cocoa. This statement is contrary with the study hypothesis which states that better market access will increase the area cultivated with upland cash crops due to higher output prices. In fact there is an indirect influence between accessibility to market with the households growing perennial crops. Many of the variables were not included in the estimation in the econometric model, although they may possibly influence the decision of household cultivated crops. For instance, in the case of cocoa, in general, the households sold the yields in different ways. For example, they self-transported their yields to the market or the buyers visited the households to purchase the yields. This shows that there is no direct

influence between the distance to market and the farm land capacity being cultivated. Furthermore, the availability of land might possibly be the reason why an indirect influence between accessibility to market with household growing perennial crops exists. The suitable land available for expanding cocoa is near the forest and far away from the road. In normal situations, the better the access to the market, the greater the possibility of households to grow cocoa and coffee, since the two crops had high economic values.

In terms of the farm land use, the households considered the farm land distance and houses in making decisions to grow cocoa and coffee crops. The increasing number of cocoa and coffee cultivation did not affect greater access to the market. There are possible explanations for the apparent contradiction between econometric findings with the study hypothesis. The land market condition also might influence the household's access to market with land use. NURYARTONO (2005) reported that the process of land acquisition by purchase is related to the welfare status of the household and the household's ethnicity. The wealthier households and non-local people have farm lands through purchasing them from indigenous, while the poorer indigenous households employ their family members to clear up the forest lands. Based on the personal interview with the Watumaeta village headman, we found that today the number of people that use land for cocoa plant through the clearing of the forest tends to decrease, but the migrant still has motivation to buy the land from the local people. Moreover, there are more possibilities to explain the contradiction between econometric finding with the study hypothesis, especially in terms of coffee and cocoa. Thus, it can be concluded that the farther the distances to the market, the less likely the crops would be cultivated. Nevertheless, the accessibility indicator should be considered as one of the essential aspects for the decision of households growing perennial crops with respect to market access, especially the possibility for clearing forest land.

In generally, the issue of market access and cultivated perennial and annual crops in the research area are still important problems and are still part of a long standing debate. The relative importance of crop income in the research area as reported by

(SCHWARZE, 2004) was 44 percent of the total household income, with 56 percent generating an important perennial crop. Since 1990, cocoa has been popular in the research area where smallholders have attempted to enlarge their land to cultivate cocoa crops; thus attracting people from outside Central Sulawesi to cultivate the crops the way the local people have done (NURYARTONO, 2005). Finally, it should be underlined in this study that it is common that the lowland sector is associated with food production such as paddy rice and the upland sector with cash crop production such as coffee and cocoa; this indicates that an improved market access induces a shift from food crop production to cash crop production. It also reflects food as a subsistence strategy in more isolated villages.

7. Conclusion and Suggestions for Policy Implication

Farmers living in remote areas in developing countries often lack adequate access to agricultural input and output markets, particularly restricted during rainy seasons when tracks and roads are impassable. Due to the changing price relations at the farmgate level and changing transaction costs, market access has a great effect on land use decisions. This is the case for many villages near “Lore Lindu National Park” (LLNP). For this reason, this study was conducted.

The study analyzes the influences of market access on land use and the households using fertilizers in the vicinity of Lore Lindu National Park, Central Sulawesi/Indonesia. The analysis of land use emphasizes the three major crops in the research area: wetland rice, cocoa and coffee. This study also aims to identify policy instruments and evaluate the consequences of development programs on the land use.

This chapter summarizes the major results related to the research questions presented in the first chapter. The first section presents the results in connection with the results of descriptive and causal analyses, and the last section draws on policy conclusions concerning the last research objectives.

7.1 Conclusion

On the basis of the research findings, there were various types of market access for the households among the districts. For instance, in Lore Utara, the households had extremely good access to markets. In spite of the improvements of the road network, the markets could be reached equivalent to one hour in 2004. In terms of the visit frequency in different districts, it was shown that in Lore Utara, the district with the best access to markets, the households visited the market 8.9 times per month, but in Kulawi, the district with the largest distance to markets, they just visited the market 2.3 times per month. Nevertheless, commonly, in the districts studied, the households visited the market 3.6 times per month. The research findings also show that there are three main reasons why the households went to the markets. The first was to buy food and sell agricultural outputs. The second was to buy agricultural inputs and the last was to observe and compare the prices of agricultural outputs and inputs.

Concerning the market characteristics, there were a few village markets in the research area. Many households tried to reach markets outside their area. They travelled directly to the city market, like Pasar Masomba and Pasar Inpres in Palu. However, most of the households reached a village market near the homestead. The characteristics of village markets were almost identical in the research area; namely permanent, non-permanent or both.

Related to the land ownership, in common, the households possessed 1.88 hectares of farm lands in 2001 and 2.15 hectares in 2004. This indicated that there was an increase of land ownership. The research findings indicate that there was a declining size of the cultivated lands in Sigi Biromaru from 2.07 hectares in 2001 to 1.35

hectares in 2004 and in Kulawi from 1.69 hectares in 2001 to 1.62 hectares in 2004. Household members reached the nearest market on average in 114 minutes in 2001 and in 61 minutes in 2004, but large differences exist in the research area in both survey period. Seventy-seven percent of the households were categorized into having very good access to market in 2001. A better condition was shown in year 2004, within which 79 percent of households have access to market.

Based on the 2001 and 2004 surveys on households´ access to market in which three classification of poverty were categorized into: less poor, poor, and poorest, it was surprising that 54% and 62% of the poorest households were able to reach market. Furthermore, on the basis of market access, the percentage of the poorest and less poor groups increased in which both groups were considered to have good market access from 2001 to 2004, but that of the poor group with good market access decreased. Based on the classifications of poverty, of the total number of the households, 77 percent could reach markets in 2001, and then in 2004, 79 percent were abe to reach the markets. For this reason, the households with the lowest access to markets were all classified as the poorest.

The econometric findings in this study augment several earlier ones. Using the two survey observations of a set of panel data for STORMA rural households, the econometric results have important implications for the understanding of the influences of the market access on land use pattern and determinant of the households using fertilizers. The Tobit and Probit model further provides evidence that several variables have a significant effect on the agricultural land use and the allocation of land by crop. These results may, in turn, affect the design of policies and projects directed at the development of upland agriculture and the conservation of forest and land resources in the vicinity of Lore Lindu National Park-Sulawesi.

The issue of market access influencing the decision of the households to cultivate agricultural land use becomes a central theme in this study. The econometric analysis shows that most of the market access variables significantly influence the households growing crops across the model of estimations. This study highlights the importance of market access on the households' decision to grow paddy rice,

coffee, and cocoa. Improving market accessibility encourages paddy rice production. By contrast, increasing market accessibility discourages the households' decision in the land production of coffee and cocoa. This unexpected result is likely to be caused by the fact that plots suitable for cocoa and coffee are close to the forest frontier area, i.e. in remote locations.

Another key factor affecting the decision of the households to cultivate the farm land associated with the market access is social capital. Ethnic affiliation has a statistically significant effect on the average share of the households growing paddy rice crops. The negative indication of the variable describes that the ownership of the non-indigenous ethnicity decreased the average share of the households growing paddy rice.

The final econometric model examines the factors influencing the household's use of fertilizer. Both estimation models show that the number of the organisations as proxy of social capital and distance from homestead to market was statistically significant. With respect to the probability of households' fertilizer use, the study points out that when households have greater access to the market, the probability of using fertilizer therefore decreases.

7.2 Suggestions for Policy Implications

On the basis of the conclusions above, it the small farmer households have financial difficulty, less access to, markets for agricultural input (i.e. fertilizers or pesticides) and outputs (e.g. agricultural products: paddy rice, cocoa, or coffee), and inadequate knowledge and technology in crop cultivation in the vicinity of Lore Lindu National Park. Therefore, such conditions need to be improved. Improved market access will stimulate investments in agricultural technology and fertilizer use, and hence improve agricultural productivity and incomes of rural households.

For this reason, the government may take actions to improve the rural hard infrastructure such as improving road quality and constructing new roads connecting the farmers' houses with their fields. On the whole, the improving of

market access would lead to a better integration of households in agricultural input and output, agricultural market, credit market, farm labour market. Coupled with stringent control of protect forest areas, the resulting increase in agricultural productivity and incomes may allow households to raise their income on the existing land and also diversify into non-farm income sources.

The local government in the study area should provide more attention to remote villages, such as Lawe and Lempelero in Kulawi because these are the poorest within this study area. More research among disciplines with respect to market accessibility analysis is required to improve agricultural production for the farmer households in the vicinity of Lore Lindu National Park; thereby, increasing household incomes and reducing the isolation of households as a source of poverty.

To find out the factors contributing to the limited market access on land use, further research should address the response of market access to rural environment and related aspects, like the income of household or rural labour. In other words, more research is needed to rigorously evaluate the accessibility of market using other approaches. For instance, the study of SCHWARZE (2004) states that in the research area the income derived from perennial crops, such as coffee and cocoa, is a major source of deforestation. This reflects that there is an open aspect to be analysed in the research area in a more complex and dynamic aspect. The policy measure to improve the access to markets can have a stabilising effect on the forest margin because forest land is mainly cleared for the cultivation of crops that have a high value in the economy, such as cocoa.

Viewed from the methodology employed, the limitation of this study is the insufficient panel data from only two periods and covering a fairly small number of households. Thus, with the limited data, more recent econometric methodologies could not be applied, such as panel data for error correction model. Obviously, for instance, the model could be improved, such as the dynamics modelling and simultaneous model, especially when land changing and land use dynamics is a great concern for the households and/or the measurement of accessibility to market

in more detailed varieties, such as time and monetary costs and a population potential measurement tools, not only appropriate with time distance. Moreover, the estimation of the systems for future research should consider a dynamic estimation. The model specification and estimation can also be extended to include off-farm and on-farm households.

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Appendix

Table A.1 Kruskal-Wallis test on differences in land use cultivated by sub district

Ranks

	Kecamatan	N	Mean Rank
Total area cultivated in hectare 2001	Lore Utara	95	165,28
	Palolo	39	120,82
	Sigi Biromaru	81	157,25
	Kulawi	101	167,67
	Total	316	
Total area cultivated in hectare 2004	Lore Utara	95	167,12
	Palolo	39	118,18
	Sigi Biromaru	81	161,88
	Kulawi	101	163,25
	Total	316	
Area of sawah plots cultivated (in hectare) 2001	Lore Utara	95	169,38
	Palolo	39	141,83
	Sigi Biromaru	81	182,09
	Kulawi	101	135,78
	Total	316	
Area of sawah plots cultivated (in hectare) 2004	Lore Utara	95	177,68
	Palolo	39	145,73
	Sigi Biromaru	81	162,02
	Kulawi	101	142,56
	Total	316	
Area of coffee cultivated (in hectare) 2001	Lore Utara	95	183,62
	Palolo	39	137,49
	Sigi Biromaru	81	88,39
	Kulawi	101	199,21
	Total	316	
Area of coffee cultivated (in hectare) 2004	Lore Utara	95	160,47
	Palolo	39	125,68
	Sigi Biromaru	81	109,00
	Kulawi	101	209,02
	Total	316	
Area of cocoa cultivated (in hectare) 2001	Lore Utara	95	164,09
	Palolo	39	207,67
	Sigi Biromaru	81	105,42
	Kulawi	101	176,83
	Total	316	
Area of cocoa cultivated (in hectare) 2004	Lore Utara	95	169,02
	Palolo	39	215,33
	Sigi Biromaru	81	97,51
	Kulawi	101	175,57
	Total	316	

Test Statistics[a,b]

	Total area cultivated in hectare 2001	Total area cultivated in hectare 2004	Area of sawah plots cultivated (in hectare) 2001	Area of sawah plots cultivated (in hectare) 2004	Area of coffee cultivated (in hectare) 2001	Area of coffee cultivated (in hectare) 2004	Area of cocoa cultivated (in hectare) 2001	Area of cocoa cultivated (in hectare) 2004
Chi-Square	8,192	8,853	16,501	10,132	86,703	88,422	43,886	57,469
df	3	3	3	3	3	3	3	3
Asymp. Sig.	,042	,031	,001	,017	,000	,000	,000	,000

a. Kruskal Wallis Test

b. Grouping Variable: Kecamatan

Table A.2 Kruskal-Wallis test on access to markets by poverty group in percent of households

Ranks

	ntiles of povind 2001	N	Mean Rank
TwoStep Cluster Number 2001	poorest	115	192,74
	poor	108	133,00
	less poor	93	145,77
	Total	316	

Test Statistics[a,b]

	TwoStep Cluster Number 2001
Chi-Square	47,730
df	2
Asymp. Sig.	,000

a. Kruskal Wallis Test

b. Grouping Variable: ntiles of povind 2001

Ranks

	ntiles of povind 2004	N	Mean Rank
TwoStep Cluster Number 2004	1	122	179,52
	2	96	154,46
	3	98	136,29
	Total	316	

Test Statistics[a,b]

	TwoStep Cluster Number 2004
Chi-Square	23,946
df	2
Asymp. Sig.	,000

a. Kruskal Wallis Test

b. Grouping Variable: ntiles of povind 2004

Table A.3 Mann-Whitney test on differences share of households growing by market access

Table A.3.1 Mann-Whitney test on differences share of households growing by market access 2001

Test Statistics[a] Market access group 1 and 2)

	Households growing paddy rice 2001	Hauseholds growing coffee 2001	Households growing cocoa 2001
Mann-Whitney U	5259,500	3705,000	4962,000
Wilcoxon W	6387,500	32866,000	34123,000
Z	-,895	-4,368	-1,700
Asymp. Sig. (2-tailed)	,371	,000	,089

a. Grouping Variable: TwoStep Cluster Number 2001

Test Statistics[a] Market access group 1 and 3)

	Households growing paddy rice 2001	Hauseholds growing coffee 2001	Households growing cocoa 2001
Mann-Whitney U	1554,000	1274,000	2310,000
Wilcoxon W	1960,000	30435,000	31471,000
Z	-5,396	-6,265	-3,502
Asymp. Sig. (2-tailed)	,000	,000	,000

a. Grouping Variable: TwoStep Cluster Number 2001

Test Statistics[a] Market access group 2 and 3)

	Households growing paddy rice 2001	Hauseholds growing coffee 2001	Households growing cocoa 2001
Mann-Whitney U	350,000	476,000	532,000
Wilcoxon W	756,000	1604,000	1660,000
Z	-4,278	-3,040	-2,452
Asymp. Sig. (2-tailed)	,000	,002	,014

a. Grouping Variable: TwoStep Cluster Number 2001

Table A.3.2 Mann-Whitney test on differences share of households growing by market access 2004

Test Statistics [a] Market access group 1 and 3)

	Households growing paddy rice 2004	Hauseholds growing coffee 2004	Hauseholds growing cocoa 2004
Mann-Whitney U	1890,000	560,000	2352,000
Wilcoxon W	2296,000	31188,000	32980,000
Z	-4,620	-9,724	-3,538
Asymp. Sig. (2-tailed)	,000	,000	,000

a. Grouping Variable: TwoStep Cluster Number 2004

Test Statistics [a] Market access group 1 and2)

	Households growing paddy rice 2004	Hauseholds growing coffee 2004	Hauseholds growing cocoa 2004
Mann-Whitney U	5013,000	3166,500	4432,000
Wilcoxon W	35641,000	33794,500	35060,000
Z	-,119	-5,396	-1,608
Asymp. Sig. (2-tailed)	,906	,000	,108

a. Grouping Variable: TwoStep Cluster Number 2004

Test Statistics [a] Market access group 1 and 3)

	Households growing paddy rice 2004	Hauseholds growing coffee 2004	Hauseholds growing cocoa 2004
Mann-Whitney U	308,000	308,000	462,000
Wilcoxon W	714,000	1169,000	1323,000
Z	-4,201	-4,201	-2,468
Asymp. Sig. (2-tailed)	,000	,000	,014

a. Grouping Variable: TwoStep Cluster Number 2004

Table A.4. : ANOVA test for Share of paddy rice, coffee and cocoa conditional by market access

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Households growing paddy rice 2001	Between Groups	7,600	2	3,800	16,990	,000
	Within Groups	58,150	260	,224		
	Total	65,749	262			
Hauseholds growing coffee 2001	Between Groups	13,992	2	6,996	35,935	,000
	Within Groups	50,620	260	,195		
	Total	64,612	262			
Households growing cocoa 2001	Between Groups	3,508	2	1,754	8,715	,000
	Within Groups	52,328	260	,201		
	Total	55,836	262			

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Households growing paddy rice 2004	Between Groups	5,432	2	2,716	12,055	,000
	Within Groups	58,583	260	,225		
	Total	64,016	262			
Hauseholds growing coffee 2004	Between Groups	20,691	2	10,346	88,335	,000
	Within Groups	30,450	260	,117		
	Total	51,142	262			
Hauseholds growing cocoa 2004	Between Groups	4,049	2	2,024	9,818	,000
	Within Groups	53,612	260	,206		
	Total	57,661	262			

Table A.5.1: ANOVA test for area of paddy rice, coffee and cocoa conditional on cultivating according to market access

ANOVA

Area of sawah plots cultivated (in hectare) 2001

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,224	1	,224	,661	,418
Within Groups	42,723	126	,339		
Total	42,947	127			

ANOVA

arsw4

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,096	1	,096	,315	,576
Within Groups	31,628	104	,304		
Total	31,723	105			

ANOVA

Area of coffee cultivated (in hectare) 2004

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,612	2	,306	,840	,436
Within Groups	23,662	65	,364		
Total	24,274	67			

ANOVA

Area of cocoa cultivated (in hectare) 2001

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6,945	2	3,472	3,976	,020
Within Groups	155,441	178	,873		
Total	162,386	180			

ANOVA

Area of cocoa cultivated (in hectare) 2004

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8,185	2	4,092	3,138	,046
Within Groups	224,273	172	1,304		
Total	232,458	174			

CURRICULUM VITAE

1. PERSONAL DATA

1. N a m e	: Adhitya Wardhono
2. Place/Date of Birth	: Surakarta, Indonesia/September 5th 1971
3. Sex	: Male
4. Marital Status	: Married, one child
5. Nationality	: Indonesian
6. Email	: a_wardhono@yahoo.com
7. Occupation	: Teaching Staff and Researcher at the Department of Economic and Development Studies, Faculty of Economics–University of Jember, Indonesia.

2. EDUCATION

- Bachelor in Economics (BSc.Ec) at Department of Economics and Development Studies - Faculty of Economics, University of Jember
- Post Graduate Program in Economics, Master of Science in Economics (MSc. Ec), University of Gadjah Mada Yogyakarta-Indonesia
- Post Graduate Program, Master of Cooperation Economics (*Dipl. Kooperationoekonom*), Institute of Cooperation in Developing Countries, Economics Faculty - Philipps University Marburg-Germany, November 2002, Germany.
- Since : 2003 PhD. student in agricultural economics at the Institute of Rural Development, Georg-August-University of Goettingen.

3. WORK EXPERIENCES

- Lecturer at Department Economics and Development Studies, Faculty of Economics University of Jember, 1998-now.
- East Java Regional Researcher of World Bank for "Monitoring The Regional Implementation of Indonesia's Structural Reforms And Deregulation Program", Indonesia, 1999 collaborated with SMERU Jakarta-Indonesia.

4. ACHIEVEMENTS AND AWARDS

- *2003*
  DAAD Scholarship
  Recipient of monthly scholarship from Government of Germany
- *2000-2002*
  Landesregierung Hessen-Germany Scholarship
  Recipient of monthly scholarship from Landesregierung Hessen Germany
- *1998*
  The Best Graduate, Cum Laude, on Master Program the University of Gadjah Mada Awarded by the University of Gadjah Mada, May1998.

- *1994*
  The Best Graduate, the University of Jember.
  Awarded by the President of the University of Jember, July 1994.
- *1994*
  The Best Graduate in Economics and Development Studies
  Awarded on the Commencement Day by the Dean of the Department of Economics University of Jember, July 1994.
- *1993-1994*
  Scholarship to be appointed as Lecturer and Researcher
  Recipient of monthly scholarship from the Ministry of Education – Indonesia.

Goettingen, November 2006 *Adhitya Wardhono*