Addis Ababa University
School of Graduate Studies

Price Response of Rural Households in Ethiopia: Case of Bako, Yetmen, Tiyo/Eteya

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A Master's Thesis Submitted to the School of Graduate Studies
Addis Ababa University
In Partial Fulfillment of the Requirements for the Degree of Masters of Science in Economics (Economic Policy Analysis)

Addis Ababa
October, 2007

Declaration

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been dully acknowledged.

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ACKNOWLEDGEMENT

I would like to extend my heart felt gratitude and special thanks for my advisor Dr. Mulat Demeke for his invaluable support in his technical, professional as well as material support to accomplish my thesis. With out his unreserved support the thesis wouldn't have this shape.

I also want to thank my mom for her moral encouragement in perusing my Msc study. It is worth mentioning my friends Workamaw and Zelealem who have provided me their office considering the limitations that I have. Also my friend Ibrahim deserves valuable thanks for he has been there during the whole research period.

Finally I would like to thank African Economic Research Consortium for the financial support to complete this thesis.

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ABSTRACT

The study is conducted to assess price response of Ethiopian farm households. For this purpose, a sample of 217 households selected from food crop growing areas is used. The households are modeled using the non-separable farm household framework for the reason that the households are assumed to face incomplete labor market. The SNQ profit function is estimated to capture the production side of the households where as AIDS function for consumption side. Elasticities are derived from this function and utilized in calculating non-separable household model price elaticities. In addition, to examine the implication of market imperfection, the separable farm household price elasticities are calculated for comparison purpose.

The findings show that price response of agricultural production activities are negatively affected by the rise in price of agricultural goods under non-separable framework unlike the separable one. On the other hand, change of fertilizer price in downward direction has positive impact on production and input use. So, the rise in price of agricultural goods is not the right incentive for increasing production. Hence, a more appropriate incentive for production would be a reduction in the price of fertilizer than a rise in price of agricultural goods. The possible policy implication which could be inferred form the analysis is that governments need to have the discretion to provide support in input use, particularly fertilizer, in the form of subsidy so as to initiate rural households to produce more.

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Most people in developing countries rely on income generated from agricultural sector. Being part of developing countries, Ethiopian economy is characterized by dominance of agricultural activity, providing livelihood for over 80% of the population. However, its performance has been declining in the last three or four decades.

Under the monarchial regime, a larger portion of the agricultural land was owned by the government and the church. Private land ownership was prevalent in central and southern parts of the country and land tenancy system was also common in these areas. The system changed after the military takeover which introduced a socialist policy with centralized planned system.

The Derge government nationalized rural land, abolished tenancy, ordered all commercial farms to remain under the government control, redistributed lands, and maintained a highly overvalued currency (Rashid et. al., 2006). Moreover, the government controlled input and output markets limiting the movement of agricultural products within the country and also forced farmers to deliver some portion of their total produce to the government. Prices were set by the government along the restrictive movement of the goods that are traded in the market. Such preventive measures act against the peasant farmers eroding away their incentive to produce more.

Besides, the diminishing farm size, degradation of soil quality, inadequate and variable rainfall, poor infrastructure account for the poor performance of the sector (Abebe, 2002). The rapid population growth also aggravated the diminishing soil quality as a result of using shorter fallow periods to produce more agricultural goods in order to meet the demand of the increased population (Abrar et. al., 2004). In this period, the growth of agriculture showed a downward trend.

In contrast, the sector has shown little revival after the downfall of the Derge government. In the years 1992/93 to 1996/97, agriculture grew with an average of 5% per year (Croppenstedt et. al., 2003). The growth is partly the result of the reforms that are implemented for the whole economy in general and the agricultural sector in particular. Policies that focus on the economy as a whole are like the liberalization of the economy, devaluation of the currency, accepting and putting into effect the Structural Adjustment Program (SAP), and measures that insure the macroeconomic stability.

The reforms for the agricultural sector are like the withdrawal of the forced grain delivery system, letting the market fix the prices, deregulation of input and output markets, allowing free grain movement in the country, extension programs, and credit facilities for the farmer and providing price support for export items. Abrar et. al. (2004) argued that the free market system of getting prices right gave farmers a driving force that led them to produce more. That is households' positive supply response is due to price incentives. In contrast to this, Croppenstedt et. al. (2003) indicated that good performance of the agricultural production is attributed to good weather conditions and increased area of cultivation in the period.

Though the government gives more emphasis for the agriculture by designing Agricultural Development Led Industrialization (ADLI), the growth of agriculture is still lagging behind the growth of the population. Increasing land size has been the major solution for expanding agricultural output which is no longer a solution for the parts of the country which produce food crops. The solution should divert to increasing yield level and giving incentive for the households to produce more (Mulat and Bekele, 2003). The price incentive can be one possible instrument to increase the production level and the income of rural households. Therefore the need for understanding the behavior of agricultural households with respect to price policy cannot be overemphasized.

1.2 Statement of the Problem

Currently, in Ethiopia policies are designed to enhance the development of the economy in general and the agricultural sector in particular. The usual problem faced from policies introduced in the sector is to predict the resultant effect on the targeted population (Singh et al., 1986). Such a problem arises from the fact that households are heterogeneous in their endowments and preferences and hence respond differently (Kuiper and Ruben, 2005).

In addition, households are not only consumers or but also they are producers and consumers of agricultural goods. That is, households operate in semi-commercialized farms where they produce mainly for consumption and sell the remaining produce in the markets. Unfortunately, markets are mostly imperfect and even some are non-existent. Policies introduced in this environment may go in different direction or affect the sector in a lesser extent than the

intended one. As the sector is the one that cannot be ignored by the government, appropriate and the responsive policies should be designed.

Alemayehu (1997) analyzed the impact of forced grain delivery system and rationed consumer goods procurement procedure on the households' activity. On the other hand, Abrar et. al. (2004) also analyzed the price response of households in the production of food crops by taking only the production side. Kuiper and Ruben (2005) also investigated the impact of policies like technology improvement, infrastructure development and off-farm employment on the poverty reduction, within-village income inequality and resource degradation.

In this study, unlike the previous studies, empirically investigates the households' behavioral response for price changes taking the dual behavior of households into consideration. The evaluation will be undertaken by estimating elasticities that show the direction and extent of response of households' for prices under market imperfection.

1.3 Objective of the Study

Taking into account household behavior as profit and utility maximizer, the general objective of the study is to identify or measure price response of rural households under imperfect market scenario.

The specific objectives are:-

- To examine the price response of households in terms of production consumption and input use decisions under market imperfection.

- To see the implication of market imperfection on households decision response to price changes.
- based on the analysis to come up with plausible policy implication that would maximize a better incentive scheme for the rural farm household.

1.4 Significance of the study

As agriculture is a pillar of the Ethiopian economy where the livelihood of the poor depends, the bid for progress is indeed a must. To have radical change in the sector suitable policies are required for the farm household. As Maria bond (1983) stated there is also a need to determine policies which suit best in stimulating agricultural productions. Policies are injected to the rural household in hope of development and growth. In the mean while, governments complain that households are not responsive to policies (De Janvery et al, 1991). Hence in this study, identification of the direction of price responses will be a benchmark for policy makers in designing incentives for rural farm households. And also, the paper will be an empirical input for the stock of knowledge in this area.

1.5 Scope and Limitation of the study

The study will basically focus on the response of rural farm households for price changes. So, the study will not cover other agricultural polices like promoting off farm employment, improvement of mechanical and other technical supports. In addition, the paper will only focus on imperfection of labor market taking aside imperfections on the credit and insurance markets. Add to this, it does not address risks that prevail in rural areas.

1.6 Organization of the Study

The paper is organized in such a way that, in chapter one a brief introduction of the study focus is provided. In the next chapter the theoretical foundation of household modeling is discussed and also the relevant empirical studies are reviewed. Chapter three discusses the theoretical modeling for the study as well as the empirical specification. In chapter four, a brief discussion on the estimation procedure and estimation results is done. Finally, the last chapter concludes and raises some policy implications based on the findings of the study.

CHAPTER TWO

2. LITRATURE REVIEW

2.1 Theoretical Review

Analyzing the behavior of the rural household is vital for addressing problems within the rural farmer through appropriate policies. The policies should be effective in improving consumption and production behavior, health and educational status and also reducing poverty and income inequality.

The rural household is characterized by operating in semi-commercialized farms producing and consuming agricultural goods at the same time. Thus, as Singh et. al. (1986) have indicated the agricultural household model is a model that provides a framework for analyzing household behaviors by integrating consumption, production and labor supply decisions.

The usual way of evaluating policy response, especially price change, is using the consumers demand theory, that is, through substitution and income effect. In the rural households, the income effect includes the profit effect which arises from households' main income source of selling agricultural goods. The profit effect is the resultant of the households being not only consumers but also producers of agricultural products (Sadoulate and de Janvery 1995; Singh et. al. 1986). Accordingly, the model incorporates this additional feature of the household in studying the behavioral price response.

The unitary farm household model (FHM) shows the behavior of the household in relation to production and consumption decisions considering the household as one decision making unit.

The unitary FHM assumes that all household members jointly make decisions to maximize their collective utility and satisfy their common preference pooling resources together (Maitra and Ray, 2003).

In choosing production and consumption strategies, the FHM has two broad classes on the basis of market structure. The first is the separable model which explains the households' behavior when markets for goods and labor are well developed and work for the entire households. In a competitive market, the market clears with the price band of zero in which the household faces fixed and identical buying and selling prices. In theory, the condition of no price band does not have any limitation for estimation whether the household is both a producer and a consumer. It will maximize profit as a producer in the first step, and then it will allocate the income obtained from the profit so as to maximize utility as a consumer. This two-step process of maximization is recursive, and then it is separable (Singh et. al. 1986).

In a sense, the model assumes that all markets exist and clears implying utility maximizing farmer applies a production strategy which is independent of the consumption decision (Vance and Geoghegan 2004; Strauss 1986) but the production decision has implication on the amount of consumption decision through profit effect (Singh et. al, 1986). Empirically, the household is taken as a pure profit maximizing agent and able to drive the level of input use for desired level of production without the feedback effect of the consumption choices.

The other strand of the FHM is the non-separable model which explains household behavior under market failure. A market fails when the cost of a transaction through market exchange creates disutility greater than the utility gain than it creates, with the result that the market is

not used for transaction (de Janvery et. al, 1991). As utility is defined over individuals with differing preferences, the market fail not for all but for some households whose utility gain is less than the disutility. Therefore, it results in differing degree of participation where some are net sellers, others are net buyers and the remaining stay self-sufficient in their produced outputs and labor use. Market failure with high transaction costs of exchanges in a market often induce households to run for self-sufficiency creating high price bands (Omano, 1998).

Under market imperfections, policy analysis assuming the existence of perfect markets may badly misstate the impact of policy changes on producer behavior and household welfare (Lofgren and Robinson, 1999). Empirical estimations which do not explicitly incorporate the interdependence of production and consumption decision will give biased estimators even if the production and utility parameters are known because the shadow price will be treated wrongly as constant (Singh et al. 1986). Unlike the separable model, the non-separable one incorporates the simultaneous decision making process which is non-recursive.

In the non-separable case, when households do not participate in markets, consumption and production depends on the price of consumer goods as well as household preference (Strauss 1986; de Janavry et. al. 1991). Price is no longer given in the market rather it is endogenously determined within the household by personal internal valuation. Hence, the endogenous price cannot be the same over the households. The different level of market prices due to some factors is the major contributor of heterogeneous market participation where in some households sell a portion of their total output, some are in deficit of the agricultural goods and purchase the deficit amount from markets while the others are self sufficient in their production and do not participate in the market.

The non-separability condition also arise when the households are no longer price takers in the market, the goods that are exchanged in the market are imperfect substitutes with the goods produced and consumed on the farm, the presence of gap between sale and purchase price and the presence of constraints on the amount that can be exchanged in the market (Lofgren and Robinson, 1999). In addition information asymmetry, risk of yield and price, high selling and buying costs that create price band between the selling and buying price of goods and labor are possible causes of non-recursive decision making process (de Janvry et. al, 1991). Moreover, households are characterized by differential asset positions that influence their supply and demand for goods and labor. For example, households demand for labor is based on land size and fixed capital while their supply of labor depends on the level of the household educational level and skill.

Due to underdevelopment of markets in developing countries, the non-separable model will be the convenient way of modeling rural households (Vance and Geoghegan, 2004). For example, the labor markets to which they relate are typically characterized by large transaction costs that make effective wage received when selling labor and effective wages paid when hiring labor diverge, creating wide idiosyncratic price bands around the market wage. The consequence of these two features is that farm households are differentially integrated into labor markets, with some selling labor services, others hiring labor, yet others opting for labor self-sufficiency (Sadoulet et. al.,1996). Graphically, the idea is illustrated by Sadoulet and de Janvry (1995).

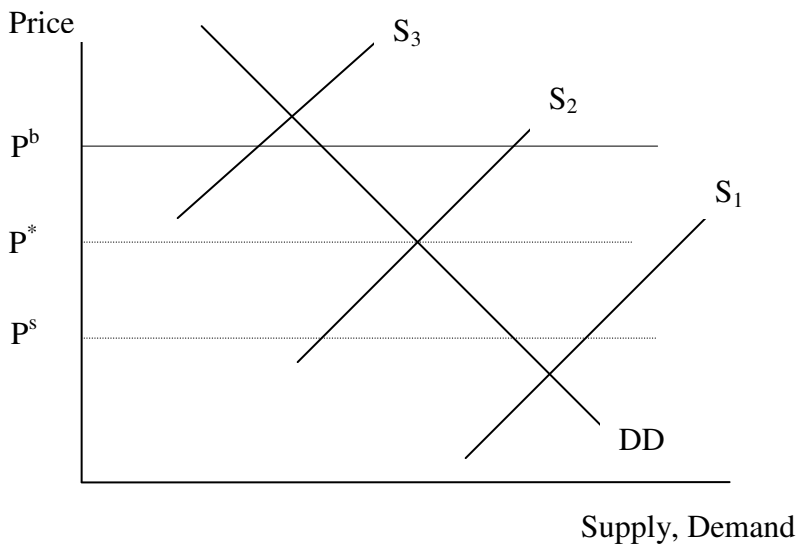

Figure 2.1: Market participation regime of households.

In this illustration, it is assumed that labor market is imperfect due to variable transaction costs. In addition, assume that there are three households with the same demand for labor curve of DD and consumer characteristics of C_i, i=1, 2, 3. These households also have supply of labor curve S_1, S_2 and S_3 respectively for the first, second and the third household which depend on the individual characteristics of z_i. These households face effective selling price which is the market price less the variable transaction cost and buying price which is the market price plus variable transaction cost. The household with supply curve of S_1 is expected to participate in the labor market as a seller until its internal valuation of labor equals the market price level. On the other hand, the household with the supply curve of S_3 participate in the market as a buyer until its shadow price equals the market price. Unlike the two, the household with the supply curve of S_2 stay in self-sufficiency as its shadow price (P^*) is in between of the selling and buying price of labor. Because of the existence of transaction costs,

there is non-zero price band where households do not participate in the market remaining in autarky.

Therefore, market imperfection due to transaction costs that widen the price band of selling and buying prices has important implication in price response of households. Such costs induce the household to remain self-sufficient no matter how much incentives are given to them. Moreover, individual characteristics and resource endowment of households also create heterogeneous integration in the market.

Theoretically, Alemayehu (1997) has predicted the responses of Ethiopian farm households which were under the restrictive policies of the previous military regime. In that period the economy of the country was commanded by the central government. The restrictive policies that were introduced in the agriculture sector were the compulsory grain delivery system and restricted supply of fertilizers to the farm households. Under the compulsory grain delivery system, households were forced to deliver some proportion of their total produce to the government with prices set by the government. In addition, purchase of modern consumer goods is rationed restricting their demand. These restrictions induced households to internally value goods and labor and hence the prices of such goods are endogenous to the household.

The researcher employed direct way of evaluating welfare effects of rationing, compulsory grain delivery, prices and income. This was done with the introduction of new procedure of analysis that can directly characterize the effect of these policies. In comparative static analysis, he found that compulsory grain delivery system is likely to force households to switch crop production. In addition, the policy made the supply and own consumptions of

these crops less responsive to their internal prices. Moreover, the policy reduced the welfare of the households' dipping the income received from the crop which is affected by the forced delivery. In general, the policy has implication on the reduced amount of the marketed surplus as well in the growth of crop production.

The other policy in the Derge regime was rationing of fertilizers. Even though there was excess demand for fertilizers, the households were given a restricted amount for cultivation of their crops. In here, the comparative statistic also indicates, the adoption of such policy reduced own price responsiveness of output supplies and labor demand on part of the households. Hence, it had negative impact on the production and productivity of the households in increasing crop output. Add to this, restriction on the purchase of manufactured consumption goods reduced own price elasticities for convertible rationed goods – are goods which are possible to resell the excess and purchase the deficit amount in the market.

Other studies also have analyzed household behavior focusing on the imperfection of markets. For instance, Key et. al. (2000) examined transaction costs of two types which create heterogeneous market participation regimes. The costs are labeled as fixed and proportional which were included in analyzing the behavior of households towards policies. Likewise, Glauben et. al. (2003) analyzed tax-induced response of households in the presence of transaction costs. The same researchers also studied the behavior of households not only under fixed and proportional transaction costs but also under non-proportional transaction costs and of their heterogeneity. Under this scenario, most of the households' responses happened to be ambiguous which arises from the imperfection of the markets. The theoretical result is presented in the following summarized table (Henning and Henningsen, 2006).

Table 2.1: Theoretical effects of exogenous price effects.

		Non separable model			
		$\mathbf{P_c}$	$\mathbf{P_a}$	$\mathbf{P_v}$	$\mathbf{P_m}$
Farm	$\mathbf{X_c}$	?	?	?	?
	$\mathbf{X_a}$	?	?	?	?
	$\mathbf{/X_v/}$	?	?	?	?
	$\mathbf{/X_L/}$	?	?	?	?
Consumption	$\mathbf{C_m}$	(+)	(+)	(-)	?
	$\mathbf{C_a}$	(+)	?	(-)	?
	$\mathbf{C_L}$	?	?	?	?
Labor market	$\mathbf{X_{LSn}}$	(-)	(-)	(+)	?
	$\mathbf{X_L^S}$	(-)	(-)	(+)	?
	$\mathbf{X_L^h}$	(+)	(+)	(-)	?
	$\mathbf{P^*}$	(+)	(+)	(-)	?

Where; X_a and X_c are agricultural goods produced partly for consumption and for market only, respectively. X_v is variable input and X_L is labor input use on the farm. C_i ,i = m,a,L are consumption levels of market goods, agricultural goods and leisure respectively. X_L^s and X_L^h are household's labor off-farm supply and level of hired labor respectively. At last X_{Lsn} is net labor supply and P^* is shadow price of labor of the households. The empirical findings will be discussed in the next section.

2.2 Empirical Evidence

Besides theoretical foundations, different researchers have dealt with empirical justifications in explaining household behavior. Some focus on explaining factors that influence households to behave in the way they are observed. Others identify the strategy that households follow in their decision making process that is, whether it is recursive of non-recursive and the remaining studies examine the response of households for policies under the prevailing decision making process.

2.2.1 Empirical Evidence from the Rest of the World

Various studies are conducted to investigate household behavior in the different part of the world. From the earliest, Lau et. al (1981) has investigated the behavior of households with respect to policies like price change, levy of taxes and change in household size. That is, the effects of such policies on the supply of output and labor, the demand for factors and on expenditure. In the study, markets are assumed to exist and clear for all households. Therefore, the decision of the households is recursive and hence separable farm household model is used. The empirical findings indicate that increase of the output price leads to increase in output supply but the increase in expenditure is small. The justification given for this small change is that aggregate expenditure depends not only on profits but also on the imputed value of maximum leisure of households, which is not affected by the output price.

In addition, wage floor policy was used as another possible policy incentive for the households which gave rise in wage for almost half of the population. This policy resulted in decline of output supply and labor demand at large. Moreover, the labor supply has declined slightly and

leisure increased by small amount. Along with these changes, aggregate consumption of non-agricultural goods declined by small amount while the marketed surplus increased significantly (Lau et. al, 1986).

In the same study, a policy simulation exercise focusing on reducing the size of the household has reduced consumption level of agricultural commodities, increased aggregate leisure consumption, decreased aggregate labor supply and increased marketed surplus. This policy change has no effect on the production side due to the separable nature of production and consumption decision. Therefore, the decrease in number of dependents has no effect on aggregate output supply, factor demands, profits or full expenditures.

De Janvry et. al.(1991) also examined the behavior of households under missing markets. So, the study is based on the simultaneous decision-making of production and consumption levels. The model specification is the non-separable type in which households do not participate in goods and labor markets. In this study, the researchers analyzed the responses of households under perfect and imperfect market scenario.

The empirical finding of the non-separable and the separable model elasticities are tested against different policies. Increase in the price of cash crops increased its supply but the presence of imperfection in the market reduced the extent to which the supply would have increased. This is due to the absence of markets that limit resource reallocation towards the more profitable one. Households cannot reduce producing food items and increase the production of cash crops for the reason that there is no food market. Hence, land allocation for food has only slightly decreased and labor allocation to the farm has decreased due to income

increase which increased leisure consumption. The demand for manufactured goods has increased inline with the increase in income. The rise in price of manufactured goods decreased real income which would induce households to produce more of cash crops. In contrast to the expectation, the result indicated decline in production of cash crops due to reallocation of land for food (de Janvry et. al., 1991).

Henning and Henningsen (2007) also investigated the price response of households under imperfect labor market both theoretically and empirically. The researchers argue that non-separability is due to transaction costs that can be fixed, proportional or non-proportional unlike Vakis et. al (2003) who take only fixed and proportional transaction costs. In addition, they argue heterogeneity in on-farm and off-farm labor markets will create non-separability even if households are participating in the market. So, the study analyzed the responses of households in non-separable framework for different labor market participation regimes as well responses under separability framework. That is, the study also assessed whether the degree of market imperfection has impact on farm price responses by comparing price elasticities across labor market regimes.

In Henning and Henningsen (2007) theoretical analysis, most of elasticities are found to be ambiguous in determining the direction of responses for the non-separable specification. Accordingly, the empirical results show mixed results. For instance, for perfect labor markets crop output and farm labor input show a clear positive response with respect to increased crop prices. However, the extent of response to price changes of agricultural goods declines for moderately incomplete labor markets and even it becomes negative for missing labor markets. So, the study concludes that the degree of labor market imperfection has a significant

influence on price responses of consumer goods, crop products and farm labor input. Such difference in price elasticities is due to high cross-price elasticities or high shadow price elasticities.

2.2.1 Empirical Evidences in Ethiopia

Kuiper and Ruben (2005) evaluated the role of heterogeneous household endowments for policies that aim in reduction of poverty and within-village income inequality and soil degradation. The analysis was based on census data from one of the villages of Northern Ethiopia region in Tigray. The study assumes that household labor and livestock endowments are non-tradable but the products of livestock are traded locally without price band. Where as, crop outputs are assumed to be traded outside the village with a price band. Therefore, households in the region follow non-recursive decision-making process as the result of non-availability of local market for labor and crop outputs.

The simulation is carried out by introducing policies in individual terms and joint form for the purpose of achievement of the above mentioned objectives. From the policies, technology improvement through reducing the price of fertilizers reach only certain individuals as households are in shortage of cash. Most households could not be the beneficiaries of reduced prices as the majority were poor. On the other hand, policies that promote migration and cash for work programs are found to be much effective in reducing poverty. Especially, cash for work program is effective in reducing income inequality. These policies have the ability to reach the very poor in a better way than the previous one. Moreover, policies tested in a combined form have significant impact than the single policies. For example, the combined

policy of cash for work program with reduction of price bands has a greater output in reducing poverty along with reduction of income inequality within the village.

Alemayehu S. (1997), in addition to the theoretical explanation, investigated the response of households who were under forced grain delivery system and rationing of fertilizers and manufactured goods. For the purpose, the dynamic farm household model is employed under rational expectations and risk neutrality. The model is used to characterize acreage demand elasticities with respect to the grain delivery amount rate, market price of the crop, and the revenue collected from related crops. The estimated elasticities showed that the long-run demand for Teff[1] relates negatively to the expansion of the compulsory grain delivery system. The households' response to the price of Teff is positive which is consistent to the theoretical findings. However, there is low long-run own price elasticity which is partly the result of the policy of compulsory grain delivery system. Again, there is negative relation of acreage demand for Teff with respect to revenue from other annual crops. In general, the long-run and current acreage allocations to a crop respond positively to the crop's market price and negatively to the corresponding grain delivery amount and the revenue from competing crops.

Abrar et. al. (2004) assessed the responsiveness of peasant farmers to price and non-price factors for Ethiopia. The study considers production side only. To model the production side, the study utilized Symmetric Normalized Quadratic (SNQ) profit function. The finding of the study showed that the households respond positively and significantly to price incentives.

[1] Endemic crop produced in Ethiopia.

Kuiper and Ruben (2005) studied policies that aim in poverty reduction, income inequality and soil degradation with in the frame work of farm household model. While, Alemayehu (1997) analyzed the impact of compulsory delivery system and rationed fertilizer supply and manufactured consumer goods on rural farm household. Abrar et. al. (2004) estimated price elasticities for different crops taking only the production side into consideration. In this study, the dual behavior of households will be taken into consideration. That is, households act simultaneously as a consumer and producer of agricultural goods. With this, the price response of households in terms of production and input use will be analyzed. Consequently, the extent of the market imperfection impact on price responses will be dealt by looking at the difference between elasticities under market imperfections and complete markets.

CHAPTER THREE

3. DATA AND METHODOLOGY

3.1 Data Source, Type and Description

The data source for this study is taken from Ethiopian rural household survey conducted by Ethiopian Economic Policy Research Institute and Ethiopian Economic Association in collaboration with the World Bank in 2006/07. The survey was undertaken in three selected sites for assessing the role of production, consumption and marketing factors in the recent food price rises in the country.

The sample size is a total of 217[2] households which are drawn from the three sites that is 77 from Bako, 70 from Tiyo/Etya and 70 from Yetmen. The sites are selected for the reason that they are producers of the major food crops, namely teff, maize and wheat in the country. Accordingly, one peasant association is selected from each district. Odda Harro Peasant Association form Bako Tibe District, West Shoa Zone, Gondie Peasant Association form Tiyo District, Arsi Zone and Yetmen Peasant Association from Enemay District, East Gojjam Zone. Bako is known for production of maize, Tiyo/Eteya for wheat and Yetemen for teff. The sites are surplus producing areas (Abebe, 2002).

[2] The final sample size for the analysis consists of 184 observations as the households with zero output level, incompleteness in report of labor or input use and negative profit level, which lead to negative shadow price of labor, are excluded.

3.2 Model Specification

3.2.1 Theoretical Model Specification

In this study, the household model is used to identify the crucial behaviors of households towards agricultural price policies. As discussed in the previous chapter, the model is able to explain the characteristics of rural households who are producers and consumers at the same time. The model can be used in two ways depending on the strategy households' use in maximizing profit and utility which is again dependent on the functioning of the market.

The recursive decision making process will be adopted by the households if the assumption of well functioning markets for outputs and inputs and perfect substitutability of hired labor and family labor in production process holds. Under this condition the separable household model is suitable one and the decision making process is assumed to hold in two stages. At the initial stage, the households maximize their level of production deciding on the level of input use. In this initial stage, there is no consideration of consumption levels for decision making process. At the second stage, the household decide on the level of consumption depending on the income of the household and the prices in the market.

On the other hand, if the above assumptions do not hold, households will rely on the non-recursive decision-making process. The prevalence of imperfect markets, imperfect substitutability of family labor and hired labor, risk, constraints in the credit and insurance market and information asymmetry will break the two stage decision making of the households. So, the households decide simultaneously on the level of production and

consumption considering important factors. In this case, the non-separable household model is expected to explain households' behavior.

The reality of market incompleteness in developing countries results in non-recursive decision-making process. The same fact holds true for the rural markets of Ethiopian farm households that lead households to choose the later strategy. Hence, some variables are determined internally by the household valuation instead of being determined exogenously. That is, the endogenous variables arise for the markets that are imperfect where the household make internal adjustment to maximize its utility and profit. Thus, in this study the non-separable household model will be used in analyzing the household behavior as labor market is assumed to be non-existent.

THE MODEL

The underlying assumptions of non-separable household model are the following. The household:

- is taken as a single decision making unit. That is, the household members pool resources and make decision acting as one individual.
- produce food crops. The household may produce for market only or for consumption or both. Therefore, the household is supplier of agricultural goods.
- heavily rely on family labor and may use other traditional group work programs in the production process.
- do participate in markets whichever available but the labor market is assumed to be non-existent. So, households are in autarky in the labor.
- buy manufactured goods from market.

In addition, credit and insurance market constraints and problem of risk are ignored.

According to Singh et al (1986), the household is assumed to maximize utility level under constraints of production technology, time and budget. The household maximization of utility level is expressed in general form as:

$$\max_{x,c} U(\mathbf{c}) \quad \text{……..…….…….(3.1)}$$

Subject to

$$G(\mathbf{x}, r) = 0 \quad \text{……..……... (3.2)}$$

$$T_L - X_L - C_L \geq 0\text{……..….... (3.3)}$$

$$P_m C_m \leq P_a (X_a - C_a) - Pv /Xv/ - P_L^* /X_L/ + E\text{…..…….. (3.4)}$$

Where;

c is vector of consumption goods constitution C_a, C_m and C_L.

C_a is consumption of agricultural goods (food crops).

C_m is consumption of manufactured goods (non-food items).

C_L is consumption of leisure[3].

x is vector of production goods that is X_a, X_L, and X_v.

X_a is output level of food crops (agricultural goods).

[3] The time other than on-farm labor hour is taken as leisure time.

X_v is the level of variable input which is mainly the chemical fertilizers and it is negative is sign ($X_v < 0$).

X_L is on farm labor hour and it is negative in sign ($X_L < 0$).

r is cultivated land size.

T_L is the total time endowment of the household[4].

P_a is market price of food crops.

P_m is price of manufactured goods (non-food items).

P_v is price of variable input (fertilizer).

P_L^* is the endogenous price of labor.

E is exogenous income ($E > 0$) or payment ($E < 0$).

Equation (3.1) is a utility function having the usual characteristics of the function being quasi-concave and monotonically increasing. Households increase their level of utility consuming a vector of good **c** constituting leisure (C_l), manufactured (C_m) and agricultural goods (C_a).

Equation (3.2) is a concave production function. The sampled households produce food crops using variable inputs of labor and chemical fertilizer. In addition to these variable inputs, the households use land which is taken as quasi-fixed factor as its size cannot be changed within short time.

Equation (3.3) is the time constraint that total labor hour available should equal or be greater than the total labor hour used either in on-farm work or in leisure (Strauss 1986).

[4] In calculation of total time endowment of the household, it is assumed that each household member between age of 10 and 14, between age of 15 and 65 and greater than 65 has 3 hours, 8 hours and 5 hours per day respectively either for on-farm activity or leisure.

Equation (3.4) is the budget constraint. Households purchase manufactured goods (C_m) from the market with the price of (P_m) and sell marketed surplus of ($X_a - C_a$) agricultural good with prices of P_a. Moreover, the households purchase fertilizer from the market at a price of P_v. There is also exogenous transfer of E that can be positive in value or negative depending on the household receives transfer or makes a payment respectively.

Assuming that there exists interior solution for the above four equations, the optimal values for the decision problems is obtained by differentiating the Lagrangian function with the respective variables. The Lagrangian has the following form.

$$L = U(c) + \lambda\,(P_c X_c + P_a (X_a - C_a) + Pv\, Xv + P_L^{*} X_L - P_m C_m + E) + \varphi\, G(X, r) + \mu\, (T_L - X_L - C_L) = 0 \quad \ldots\ldots (3.5)$$

$\lambda, \varphi, \mu > 0$ $\qquad X_L, X_v < 0$ $\qquad C_m, C_a, C_L, X_a > 0$

Where; λ, φ and μ are Lagrangian multipliers associated with the budget constraint, production function and the time constraint respectively. Then differentiating the Lagrangian function with the variables gives us:

$$\frac{\partial U(c_i)}{\partial c_i} - \lambda P_i = 0 \qquad i = m, a, L \quad \ldots\ldots (3.6)$$

$$\frac{\varphi \partial G(.)}{\partial X_i} + \lambda P_i = 0 \qquad i = a, v, L \quad \ldots\ldots (3.7)$$

$$0 = P_c X_c + P_a (X_a - C_a) + Pv\, Xv + P_L^{*} X_L - P_m C_m + E \quad \ldots\ldots (3.8)$$

$$G(x, r) = 0 \quad \ldots\ldots (3.9)$$

$$T_L - X_L - C_L = 0 \quad \ldots\ldots (3.10)$$

Therefore, solving these derivative equations will give the optimal quantities of the decision problems of production and consumption. The solutions of equation (3.7) and (3.9) give optimal values of inputs use and output levels. That is, the input demand level and output supply as follows:

$$X_i = (P_{i=a,\, v,\, L}, r), \quad i=a,v,L \quad \ldots\ldots (3.11)$$

Similarly, the solution of equation (3.6) and (3.8) gives the consumption levels that maximize utility of the household. The consumer demand is:

$$C_i = (P_{i=a,\, m,\, L}, Y), \quad i= a, m, L \quad \ldots\ldots (3.12)$$

Where Y is the full income and it is given as:

$$Y = P_a C_a + P_m C_m + P_L^* C_L \quad \ldots\ldots (3.13)$$

Having the optimal quantities of the variables, the comparative statistic gives the households' response towards price policy. According to De Janvry et. al. (1991) and Strauss (1986), the effect of change in exogenous prices on households' consumption and production decision in non-separable household model is in two directions. That is, the change affects the household

behavior directly and indirectly. For this let define A = $C_{i=m, a, L}$, $X_{i=a, v, L}$ which are variables that explain the consumption and production levels. Then,

$$\frac{\partial A}{\partial P_j} = \frac{\partial A}{\partial P_j}\Big|_{P_L^* = cons\ \tan t} + \frac{\partial A}{\partial P_L^*}\frac{dP_L^*}{dP_j} \quad , j=m,a,v \quad \ldots\ldots (3.14)$$

Where, P_j is exogenous price. The first expression on the right hand side is the direct effect of the price change on the level of A. The second expression on the same side is the indirect effect of exogenous price on the level of A through endogenous price (P_L^*) change.

$\frac{dP^*}{dP_j}$ is the internal adjustment of the household in response to the change in exogenous price.

As De Janvry et.al (1991) did, applying the implicit function theorem on the budget constraint to get the internal adjustment of exogenous price change will give us:

$$\frac{dP_L^*}{dP_j} = \frac{\frac{\partial X_L}{\partial P_j} - \frac{\partial C_L}{\partial P_j}}{\frac{\partial X_L}{\partial P_L^*} - \frac{\partial C_L}{\partial P_L^*}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.15)^5$$

The numerator shows change in time allocation for on-farm and leisure consumption level due to the exogenous price where as the denominator is the change in allocation of on-farm and leisure time due to shadow prices changes.

[5] The derivation is found in Appendix (1).

Based on the equations (3.14) to (3.15) the theoretical price responses can be derived for the various important variables. As well for identifying the implication of market imperfection on household response direction, the indirect price effect (in equation 3.14) should be ignored. This will help in comparing the separable model results with that of the non-separable one.

3.2.2 Empirical Specification

The household is in face of making decision on the production level, consumption and labor allocation. To model the production technology the symmetric normalized quadratic function (SNQ) will be employed. The function sometimes is called symmetric generalized Mac Fadden function (Diewert and Wales 1987, 1992). Accordingly, the profit function is specified in SNQ functional form. The function is advantageous for the following reasons. First, it has flexible functional form which does not impose many restrictions on the production technology set unlike non-flexible functional forms as the Cobb- Douglas form. Second, the SNQ profit function is operational even when profit is negative, which is an important feature when applying the profit function for describing a production process with many restricted outputs. Third, convexity can be imposed globally on the normalized quadratic function without loss of flexibility (Jensen et.al.2004, Diewert and Wales 1987).

Kohli (1993) discuss the difficulty of imposing curvature condition on functions. That is, if it is tried to impose curvature condition globally, the flexibility of the functional form may be destroyed in the process. For example, imposing global convexity in the Translog function seriously restricts the substitution possibilities allowed by the curvature condition becoming Cobb-Douglas over certain areas. As well, curvature conditions imposed globally on the Generalized Leontief jeopardizes the flexibility ruling out complementarities between goods

or factors. In contrast to this, global curvature condition can be imposed on SNQ function without endangering the flexibility of the function.

Hence, following the root of Diewert and Wales (1987), kohli (1993) and Henning and Henningsen (2007) the SNQ profit function is specified as follows,

$$\pi(P_n, r_n) = \left(\begin{array}{l} \sum_{i=a,v,L} \alpha_i P_{in} + \frac{1}{2} w^{-1} \sum_{i=a,v,L} \sum_{j=a,v,L} \beta_{ij} P_{in} P_{jn} \\ + \sum_{i=a,v,L} \sum_{j=g} \delta_{ij} P_{in} P_{jn} + \frac{1}{2} w \sum_{i=g} \sum_{j=g} \gamma_{ij} R_{in} R_{jn} \end{array} \right) \quad \ldots\ldots. (3.16)$$

π is the profit function and the variable w = $\sum_{i=a,v} \theta_i P_{in}$ is the factor used to normalize price that $\theta_i = \frac{\sum_n P_{in} / X_{in} /}{\sum_n \sum_{j \varepsilon a,v} P_{jn} / X_{jn} /}$; i= a, v, L is the weight of individual prices. P_n and X_{in} are indices of prices and quantity of netputs respectively and r_n is the quasi-fixed factor that is land. The restrictions that need to be imposed is $\sum_{j=c,a,v} \beta_{ij} \bar{P}_j = 0$; i= a, v, L where $\bar{P}_j$ are mean prices of the goods (Henning and Henningsen, 2007). The netput equations are simply the derivation of the profit function with the respective prices of the netputs.

Likewise, consumption decision of the household is specified using an Almost Ideal Demand System (AIDS). According to Deaton and Muellbauer (1980), the model gives an arbitrary first order approximation that can be used to test the restrictions of homogeneity and

symmetry through linear restrictions on fixed parameters. Moreover, it satisfies the axioms of choice and it is easy to estimate. Blanciforti and Green (1983) also indicate that the AIDS is more suitable for modeling food items as income elasticities from this function become more inelastic for necessities as the budget share decreases. The specification is:

$$w_{in} = \alpha_i + \sum_{j=m,a,L} \gamma_{ij} \log P_{jn} + \beta_i \log \frac{Y_n}{P} \quad ; \qquad \text{i= m, a, L} \ldots\ldots\ldots \text{(3.17)}$$

$$\log P = \alpha_o + \sum_{j=m,a,L} \alpha_i \log P_{in} + \frac{1}{2} \sum_{i=m,a,L} \sum_{j=m,a,L} \gamma_{ij} \log P_{in} \log P_{jn} \quad \ldots\ldots\ldots \text{(3.18)}$$

Where, $w_{in} = \frac{P_{in} C_{in}}{Y_n}$; i= m, a, L are expenditure shares and Y_n is full income. The other, log P is translog consumer price index with the consumer price P_{in}. The restrictions that are imposed are:

Adding up:

$$; \sum_{i=m,a,L} \alpha_i = 1 \qquad \sum_{i=m,a,L} \beta_i = 0 \text{ and } \sum_{i=m,a,L} \gamma_{ij} = 0$$

Homogeneity:

$$\sum_{j=m,a,L} \gamma_{ij} = 0$$

Symmetry:

$$\gamma_{ij} = \gamma_{ji} \text{ for all i, j= m, a, L.}$$

The adding up restriction imposes the budget share to sum to unity. Homogeneity restriction insures that households do not exhibit money illusion. It is based on the assumption of

proportional change in all prices and expenditures do not affect the quantities purchased. The last restriction, symmetry represents consistency of the household choice (Kumar, 2006).

CHAPTER FOUR

4. ANALYSIS OF EMPERICAL RESULTS

4.1 Discussion on the Nature of Production

In the previous chapter, it is indicated that the data used for this study is the rural household survey conducted in three sites namely, Bako, Yetmen and Tiyo/Eteya. The households in these areas operate in a semi-commercialized farm that households produce partly for consumption and partly for sell. These sites are known for production of major food crops in excess of their consumption for the country. A brief description of the data in production in these sites (both in terms of acreage and in total) as well as land allocation will be discussed.

As can be seen in table 4.1 there are variety of crops produced in the sites but one type being the dominant crop in the respective areas. Bako is the major maize producing area with an average production level of 1547.68 kg. The yield level of maize is 1292.47 kg per hectare. In Bako there is also production of sorghum and teff with an average production level of 431.56 kg and 200kg of white teff and 192.75kg of black/mixed teff. The land which is allocated for maize is 0.59 hectare greater than that of sorghum. But the land allocated for teff that is white teff and black/mixed teff in total is 0.08 hectare that is greater than the land size of maize. Even though the land allocated for maize and teff production is almost equal, the yield level of maize is much higher indicating the area is a major maize growing area. In addition, the number of households who produce maize is larger than the number of households producing the other major food crops. Moreover, in Bako there is small amount of production of pepper which is a cash crop.

On the other hand, Yetmen is the major producer of white teff having an average production level of 1737.64kg. Unlike Bako production of maize is lower when compared to the production of the other major crop in the country that is, wheat. The land allocated for cultivation of white teff is 1.62 hectare with yield level of 1109.41kg per hectare.

Tiyo/Eteya is known region for the production of wheat in the country. The average production of wheat is 2972.71kg covering an average land size of 1.31 hectare. Yield level of the cultivated land is around 2207.53kg per hectare. In Tiyo/Eteya there is production of barley, maize, sorghum, horse beans and peas. Potatoes production is a bit higher next to the production of wheat with an average production level of 1753.46kg by cultivating relatively small land area around 0.28 hectare on average. Following the production of wheat, the number of households that participate in production of barley and horse beans are more than the number of households who produce potatoes.

Table 4.1 Crop Diversification in the Three Sites

	Tiyo/Eteya		Yetmen		Bako	
	N	Mean	N	Mean	N	Mean
White teff						
Output (in kg)	5	170	70	1737.64	22	200
Yield (in kg/ha)	5	880	70	1109.41	22	345.08
Land (in ha)	5	0.19	70	1.61	23	0.67
Black/mixed teff						
Output (in kg)	11	247.73	7	390	20	192.75
Yield (in kg/ha)	11	1218.18	7	908.06	20	293
Land (in ha)	11	0.22	7	0.4	22	0.73
Barley (gebis)						
Output (in kg)	48	467.6				
Yield (in kg/ha)	48	1657.22				
Land (in ha)	48	0.32				
Wheat (durrah)						
Output (in kg)	70	2972.71	41	443.78		
Yield (in kg/ha)	70	2207.53	41	1053.53		
Land (in ha)	70	1.37	41	0.43		
Maize						
Output (in kg)	32	344.38	19	162.63	75	1547.68
Yield (in kg/ha)	32	1445.63	19	776.84	75	1292.47
Land (in ha)	32	0.25	19	0.27	75	1.32
Sorghum						
Output (in kg)	28	425.89			61	431.56
Yield (in kg/ha)	28	1835.71			61	728.29
Land (in ha)	28	0.23			62	0.63
Horse beans						
Output (in kg)	49	391.33				
Yield (in kg/ha)	48	1438.89				
Land (in ha)	48	0.29				
Potatoes						
Output (in kg)	26	1753.46				
Yield (in kg/ha)	26	7966.92				
Land (in ha)	29	0.28				
Peas						
Output (in kg)	32	340				
Yield (in kg/ha)	32	1670.42				
Land (in ha)	32	0.26				
Vetch (Guaya))						
Output (in kg)			45	334.11		
Yield (in kg/ha)			45	1196.44		
Land (in ha)			45	0.32		
Nigger seed Nueg)						
Output (in kg)			29	129.48	15	128
Yield (in kg/ha)			29	589.12	15	226.67
Land (in ha)			29	0.23	16	0.62
Pepper						
Output (in kg)					13	105.08
Yield (in kg/ha)					13	330.36
Land (in ha)					23	0.64

As it has been seen in the previous paragraphs and table 4.1 these three sites are the major producers of food crops. But the production level for the major crops in each of these three sites has shown decline in the production level when compared with the production level in 1999/00[6]. Table A1, in the appendix, reveal that the production of maize in Bako has declined by 2316.94 kg on average. The decline is questionable because the same numbers of households are producing maize in both years. Similarly, the amount of land that is allocated for maize production is almost the same with land allocated in 1999/00, which is a bit higher by 0.05 hectare.

Conversely, the production of the major crops white teff in Yetmen and wheat in Tiyo/Eteya has shown a slight rise in production level in 2006/07 than that of 1999/00. This could be due to the factors that the land allocated for the production except in Tiyo/Eteya and the numbers of households that participate in the production activity have increased. Still the production rise is demandable for the country to be food surplus instead of food deficit. Facts show that there is a trend of rise in prices in recent years especially within the years 2004/05 to 2006/07. How the households respond to this price rise is an empirical question and it will be dealt in the next section.

[6] The rural household data collected by the Department of Economics with collaboration of USAID.

4.2 Discussion on the Estimation Procedure and Estimation Results

Since rural households make non-recursive decision making process, the constructed household model will be estimated in non-separable framework. When households are in face of market failure, price of the good, which the market is imperfect, will be determined endogenously. Therefore, the linkage of the production decision and the consumption decision is through the endogenous price (De Janvery et. al., 1991). In this study, the labor market in the three sites is assumed to be non-existent that causes the price of labor to be determined endogenously. Therefore, at first shadow price of labor needs to be estimated. For this purpose, the profit function is re-constructed assuming that labor has constant returns to scale and the price of labor is endogenous to the household (Henning and Henningsen, 2007).

$$\pi(P_n, r_n, X_L) = X_{Ln}\pi^L(P_n, r_n)$$

$$= X_{Ln}\left(\begin{array}{l}\sum_{i=a,v}\alpha_i P_{in} + \frac{1}{2}w^{-1}\sum_{i=a,v}\sum_{j=a,v}\beta_{ij}P_{in}P_{jn} \\ + \sum_{i=a,v}\sum_{j=g}\delta_{ij}P_{in}P_{jn} + \frac{1}{2}w\sum_{i=g}\sum_{j=g}\gamma_{ij}R_{in}R_{jn}\end{array}\right) \quad \text{..... (4.1)}$$

π^L is profit per unit of labor and the other variables definition is the same as they are in previous chapter. The output variable is measured as total output produced in kilogram. The different crop types are aggregated by dividing the value of output produced by the average price level. Moreover, prices are computed from the total output sale of each household dividing it by the output amount sold in the market (Abrar, 2004). For prices that are not

available for the household is taken form prices collected in the market in the respective areas. The labor variable is the total labor hour spent on the farm activity. The variable input that is, chemical fertilizer is expressed in kilogram and its price level is calculated from total expenditure for the input by the amount applied.

To estimate the specified equations, the R- software (R Development Core Team, 2005) with MicEcon (Henningsen and Toomet, 2007) and System fit (Hamann and Henningsen, 2007) add-on packages is utilized. The micEcon is easy way to estimate the SNQ profit function and AIDS function. The package is advantageous that it creates a way for the functions to be estimated in consistency with theories. Moreover, the package is helpful in calculating elasticities for both the profit function as well as the demand function. Systemfit, the second package, is used for estimating equations using instrumental variable (IV), two-stage least square (2SLS) and three-stage least square estimation procedure (3SLS).

Thus, the first step is to estimate equation 4.1. The estimated result for this equation is reported in table 4.2. The function is already convex in its first estimation. So, there is no need to impose convexity. After estimating the function, the shadow price of labor is obtained from the fitted values of the profit. That is, the derivation of the profit function (equation 4.1) with respect to on-farm labor hour will give the shadow price. The shadow price is given as:

$$P_{Ln}^{*} = \frac{\partial \pi(P_n, r_n, X_{Ln})}{\partial X_{Ln}} = \pi^{L}(P_n, r_n) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2)$$

Table 4.2: Estimation Result of Equation 4.1

	Coeff.	t-value
$\bullet_{a}$	1238.85	2.903131
$\bullet_{v}$	-195.31	-1.463177
$\bullet_{aa}$	126.88	1.630586
$\bullet_{av}$	-126.88	-1.630586
$\bullet_{va}$	-126.88	-1.630586
$\bullet_{vv}$	126.88	1.630586
$\bullet_{ag}$	777.10	3.238248
$\bullet_{vg}$	-199.57	-2.448169
γ_{gg}	-230.45	-2.682956

R-squared values of the netput equations:

qOutput	Qinput
0.01172282	0.46579068

Now the SNQ profit function can be re-estimated taking labor as a variable input with the shadow price of labor. In re-estimating the profit function, there is problem of endogenity created due to the shadow price of labor. Hence, to solve this problem age of the household head and number of dependents are used as possible instruments. So, equation (3.16) is estimated with labor as a variable input. Once again the estimated profit function is found to be convex in prices. The estimation result is given under table 4.3.

Table 4.3: Estimation result of Equation 3.16

	Coeff.	t-value
α_a	3354.116379	7.98936198
α_v	2.235522	0.02077861
α_L	-1318.462431	-7.54154666
β_{aa}	1543.915808	7.17195943
β_{av}	-606.679880	-7.11787560
β_{aL}	-937.235929	-7.08162528
β_{va}	-606.679880	-7.11787560
β_{vv}	238.865089	6.80879570
β_{vL}	367.814791	7.18429245
β_{La}	-937.235929	-7.08162528
β_{Lv}	367.814791	7.18429245
β_{LL}	569.421137	6.91265182
δ_{ag}	-615.782523	-2.91774804
δ_{vg}	-448.603651	-7.96421976
δ_{Lg}	-433.104606	-3.89556464
γ_{gg}	372.471433	3.81608876

R-squared values of the netput equations:

qOutput	Qinput	qlabor
-0.03500807	0.45617501	0.36303380

After estimating the profit functions, the third step is to estimate the demand function. The Almost Ideal Demand System function is estimated using iterative least square method for its ability to correct coefficient of covariance matrix (Blundell and Robin, 1999). In estimating the AIDS function, endogeneity problem is introduced due to the inclusion of shadow price of labor and full income which is also derived from the other variables in the function. Therefore, number of dependents and age of the household head are used as instruments. Hence, the function is estimated using 2SLS estimation procedure. The estimation result of the demand function is given below in table 4.4.

Table 4.4: Estimation Result of the Almost Ideal Demand System

	i= a Coeff.	i= L Coeff.	i= m Coeff.
α_i	-0.25122438	1.32284076	-0.07161639
β_i	0.034458161	-0.042116457	0.007658297
γ_{ia}	0.0412661415	-0.04161824	0.0003520984
γ_{iL}	-0.0416182399	0.06368776	-0.0220695205
γ_{im}	0.0003520984	-0.02206952	0.0217174221

For this study, we are not interested on the coefficients rather on elasticities of both production and consumption side. The price elasticites on the production side are given under table 4.5.

Table 4.5: Price Elasticities on Production Side

	pOutput	pInput	pLabor
qOutput	1.0879455	-0.2848921	-0.8030535
	(10.480325)	(-4.826563)	(-14.10706)
Qinput	0.7165381	-0.2738893	-0.4426488
	(4.826563)	(-2.694131)	(-6.30519)
qLabor	1.0071627	-0.2207270	-0.7864356
	(14.107061)	(-6.305190)	(-16.54957)

As we can see from the above table, the household respond positively in production, labor and input use with respect to the rise in price of the agricultural crops. If the price were to increase by 1 percent, the production level increases by 1 percent and the input use by 0.7 percent. If this case holds true, the rise in prices seems favorable for the production level to rise. In contrast, the rise in the price of chemical fertilizers deepens the production of crops as well as the use of modern inputs which enhance the yield level. But these households are not only

producers but also consumers. Therefore, the consumption behavior of the households should be incorporated in the calculation of elasticities.

According to Green and Alston (1990) elasticities in AIDS can be expressed as $\eta_i = 1 + \beta_i / w_i$ for income elasticity and $\eta_{ij}^{*} = -\delta_{ij} + w_j + \gamma_{ij} / w_i$ for compensated elasticities. The uncompensated elasticities are computed from $\eta_{ii} = -\delta_{ij} - \beta_i + \gamma_{ij} / w_i$, and $\eta_{ij} = \gamma_{ij} / w_i - \beta_i w_j / w_i$. Under table 4.6, both the Marshallian (uncompensated) and the Hecksian (compensated) demand elasticities are given.

Table 4.6: Price and Income Elasticities of the AIDS Model

	pAgric	pLabor	pMfd
Marshallian (uncompensated) Price Elasticities			
C_a	-0.67245799	-0.5882585	0.008148415
C_L	-0.05572318	-0.8650533	-0.027981172
C_m	0.02670037	-0.7358634	-0.474660479
Hicksian (compensated) Price Elasticities			
C_a	-0.50156866	0.4412368	0.06033183
C_L	0.07371695	-0.0852621	0.01154515
C_m	0.18821080	0.2371302	-0.42534104
Expenditure Elasticities			
Y_n	1.2525681	0.9487577	1.1838235

In line with the objective of the study, there is a need to analyze the price response of households in the presence of market imperfection within the framework of non-separable farm household model. To do so, calculation of elasticities is done considering the indirect impact of exogenous prices based on equation (3.14)[7].

Table 4.7: The non- separable household model elasticities

	P_a	P_v	P_m
X_a	-0.89	-1.09	0.32

[7] Detail derivation on the elasticities is provided in appendix (1)

X_v	-0.36	-0.09	0.176
X_L	-0.88	0.41	0.32
C_m	2.69	-0.96	-0.57
C_a	-2.6	-1.17	-0.16
C_L	1.39	-0.55	0.02
P_L^*	2.46	-0.80	-0.4

The second objective is to see the implication of market imperfection on the households' decision making process. This will be captured by deriving the elasticities under separable or recursive decision making process. This will leave out the indirect effect of the exogenous price on the endogenous price[8].

Table 4.8: The separable household model elasticities

	P_a	P_v	P_L	P_m
X_a	1.09	-0.28	-0.8	0.00
X_v	0.72	-0.27	-0.44	0.00
X_L	1.01	-0.22	-0.79	0.00
C_m	2.1	-0.77	0.24	-0.47
C_a	1.52	-0.82	0.44	0.02
C_L	1.61	-0.62	-0.09	-0.02
P_L^*	0.00	0.00	1.00	0.00

Households under market imperfection respond negatively to price changes in their level of production, input use and labor use on the farm. A one percent increase in agricultural good price decreases level of production by 0.89 percent and input use by 0.36, which is contrary to the separable model. In the separable (recursive) decision-making process, the increase in one percent in the price of agricultural goods result in increase in level of production and input use

[8] The elasticity derivations are provided in appendix (1).

by 1.09 percent and 0.72 percent respectively. The discrepancy is created due to imperfection of the labor market that forces households to respond in unexpected way. In the non-separable model the increase in the price of agricultural good increases consumption of leisure by 1.39 percent that decreases on farm labor hour. Again, the decrease in labor hour allocation for on farm activity has implication on reduced level of production and variable input use.

Variable input price increase under the non-separable model decreases level of production by 1.09 percent. However, the rise in price of manufactured goods motivates the households to produce more by increasing labor and variable input use. This is due to the reduced level of real income of the households and household run for maintaining their status quo (at least their initial level of consumption).

CHAPTER FIVE

5. CONCLUSION AND POLICY IMPLICATION

5.1 Conclusion

Ethiopia basically relies on the performance of the agrarian economy. The growth of the sector at large contributes to the growth of the economy. For this reason, the understanding of the rural environment is crucial. Almost 80% of the Ethiopian population is settled in the rural parts of the country and most are farmers. This means the investigation of the perspective of the farm household behavior is important. These households dwell on the production of agricultural goods. One point which needs to be given more emphasis is that most households are both consumers and producers of these goods at the same time.

The dual behavior of households should be considered in analyzing the response of households for any policy measure. In this paper, the response of households for price change is analyzed under the condition of market imperfection. The market imperfection is also an important issue in investigating the price response of households as it may distort the expected change. Such irregular response is due to the internal valuation of prices that is labor price is found to be endogenous particularly in this study. So the study basically used non-separable household model that households make simultaneous decision on level of production and consumption.

Empirically, the SNQ profit function is used to capture the production side and AIDS function to model the demand side. From the SNQ function production side price elasticities are derived while the AIDS gives us elasiticities from the consumption side. These two groups of elasticities are used in computing price response elasticties in non-separable household model framework. In addition, price response elasticities are also calculated for the separable

household model which is used to compare the result with the non-separable one so as to see the implication of market imperfection.

The elasticities reveal that households respond inversely in production level for price change of agricultural goods in the non-separable case unlike the separable one. Under the imperfect market scenario, negative relation of price and production is some what unexpected result.

One possible explanation behind for such unexpected result could be the fact that households are also consumers where they sell what is produced and buy other agricultural output form the market. Thus, the rise in price would not be an appropriate incentive for the farmers to produce more. Add to this, when farmers are engaged in production, initially they invest their income to buy inputs. If prices that prevail in the market are found to be high, when compared with prices in the harvest time, the farmers choose lower price both in the harvest or selling time and input buying time for the reason that the farmers tend to be risk-averse. The farmers' risk-averse behavior is tied with the fact that in rural areas social protection is so weak or in extreme case non-existent. Where as, farmers would not face any risk with the prevalence of lower price in the market.

On the other hand, this unexpected result could also be due to market imperfection. If we really look at market imperfection, it has significant impact on the responses of households which are supposed to favor production. However, upward movement of fertilizer price reduces production of agricultural goods in both case of separability and non-separability. That is, if the prices of inputs are lower, the households will have the incentive to produce more whether there is market imperfection or not.

5.2 Policy Implication

The policy implication that could be inferred from the findings of the study is summarized as follows.

Rise in the price of agricultural goods is expected to deepen the production of the same goods and the use of modern fertilizers as well. This negative impact is the result of incomplete labor market faced by the households. The manifestation is that, the response of households when they are assumed to be participating in perfect markets is positive for both production and input use. So, rise in price of crop products is not in favor of increasing production and input use that expel the manipulation of agricultural goods price as an incentive.

On the other hand, to meet the objective of rise in production and input use manipulation of fertilizer price is convenient. Reducing the price of fertilizer will have positive response in the use of fertilizers. More use of fertilizer also induces households to have a better yield increasing production level in total. The reduction in the price could be in the form of giving subsidy for the farmers that reduces the effective price paid by the farmers as they are cash constrained.

It is discussed that market imperfection has significant impact on household decision of resource allocation. Therefore, efforts that tend to solve the problem of market imperfection particularly in rural areas also need to be given emphasis. For instance, the introduction of

cash for work programs can help the farmer in alleviating cash constraint problem which has implication on input use and then production.

Finally, further studies on the factors that account for market imperfections are promptly required in order to make comprehensive and effective measures in the effort to remove market imperfections. Among these credit market constraints, price and production risk and market access are notable.

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Appendix 1

The derivation of change in shadow price with respect to change in exogenous price will follow the following procedure in accordance with de Janvry et. al. (1991) and Henning and Henningsen (2006). Take the time constraint equation and apply the implicit function theorem,

$T - X_L - C_L = 0$ ……………………………………….. (1)

$$\frac{-\partial X_L}{\partial P_j} - \frac{\partial X_L}{\partial P_L^*}\frac{dP_L^*}{dP_j} + \frac{\partial C_L}{\partial P_j} + \frac{\partial C_L}{\partial P_L^*}\frac{dP_L^*}{dP_j} = 0 \quad \text{………… (2)}$$

$$\frac{-\partial X_L}{\partial P_j} + \frac{\partial C_L}{\partial P_j} = \frac{\partial X_L}{\partial P_L^*}\frac{dP_L^*}{dP_j} - \frac{\partial C_L}{\partial P_L^*}\frac{dP_L^*}{dP_L} \quad \text{……………….. (3)}$$

$$\frac{dP^*}{dP_j} = -\frac{\dfrac{\partial X_L}{\partial P_j} - \dfrac{\partial C_L}{\partial P_j}}{\dfrac{\partial X_L}{\partial P_L^*} - \dfrac{\partial C_L^H}{\partial P_L^*}} \quad \text{…………………………………….(4)}$$

Shadow price elasticities with respect to exogenous price are given as:

$$\Omega_j = \frac{dP_L^*}{dP_j}\frac{P_j}{P_L^*} \quad \text{where j = a, v, m …………………….(5)}$$

Using equation (4), equation (5) could be re-written as:

$$\Omega_j = \frac{-\frac{\partial X_L}{\partial P_j} + \left.\frac{\partial C_L}{\partial P_j}\right|_{Y=\text{constant}} + \frac{\partial C_L}{\partial Y}\frac{\partial Y}{\partial P_j}}{\frac{\partial X_L}{\partial P_L^*} - \frac{\partial C_L^H}{\partial P_L^*}} \frac{P_j}{P_L^*} \qquad \text{.............................. (6)}$$

$\frac{\partial Y}{\partial P_j} = C_j$ from the budget constraint and $\left.\frac{\partial C_L}{\partial P_j}\right|_{Y=\text{constant}} = \frac{\partial C_L^H}{\partial P_j} - \frac{\partial C_L}{\partial Y}\frac{\partial Y}{\partial P_j}$

Where C_L^H is the hicksian demand.

Therefore:

$$\Omega_j = \frac{-\frac{\partial X_L}{\partial P_j} + \frac{\partial C_L^H}{\partial P_j} + \frac{\partial C_L}{\partial Y}\left(\frac{\partial Y}{\partial P_j} - C_j\right)}{\frac{\partial X_L}{\partial P_L^*} - \frac{\partial C_L^H}{\partial P_L^*}} \frac{P_j}{P_L^*} \qquad \text{.. (7)}$$

$$= \frac{-\left(\frac{\partial X_L}{\partial P_j}\frac{P_j}{X_L}\right)X_L + \left(\frac{\partial C_L^H}{\partial P_J}\frac{P_j}{C_L}\right)C_L + \left(\frac{\partial C_L}{\partial Y}\frac{Y}{C_L}\right)\left(\frac{\partial Y}{\partial P_j} - C_j\right)\frac{P_j}{Y}C_L}{\left(\frac{\partial X_L}{\partial P_L^*}\frac{P_L^*}{X_L}\right)X_L - \left(\frac{\partial C_L^H}{\partial P_L^*}\frac{P_L^*}{C_L}\right)C_L} \qquad \text{......... (8)}$$

$$\Omega_i = \frac{-\delta_{Lj}X_L + \omega_{Lj}^H C_L + \theta_L\left(\frac{\partial Y}{\partial P_j} - C_j\right)\frac{P_j}{Y}C_L}{\delta_{LL}X_L - \omega_{LL}^H C_L} \qquad \text{..........................(9)}$$

The definitions of the traditional elasticities are:

i) Traditional production side elasticities

$$\delta_{ij} = \frac{\partial X_i}{\partial P_j}\frac{P_j}{X_i}$$ price elasticity of good i with respect to price of good j.

ii) Traditional consumption side elasticities

$\omega_{ij} = \frac{\partial C_i}{\partial P_j}\frac{P_j}{C_i}$ Marshallian Price elasticity of good i with respect to price of good j

$\omega_{ij}^{H} = \frac{\partial C_i^{H}}{\partial P_j}\frac{P_j}{C_i}$ Hicksian price elasticity of good i with respect to price of good j

iii) Income elasticities

$\theta_i = \frac{\partial C_i}{\partial Y}\frac{Y}{C_i}$ income elasticity of good i

Definitions of farm household elasticities are given as:

i) Farm household elasticities on the production side

$\delta_{ij}^{FH} = \frac{\partial X_i}{\partial P_j}\frac{P_j}{X_i}$ price elasticity of good i with respect to price of good j in farm household model (FHM)

ii) Farm household elasticities on the consumption side

$\omega_{ij}^{FH} = \frac{\partial C_i}{\partial P_j}\frac{P_j}{C_i}$ price elasticity of good i with respect to price of good j

Price elasticities for the separable household model:

i) Price elasticities on production side

In the separable household model, consumption decision does not affect production decision. Thus, the separable elasticities in the production side are the same as the traditional price elasticities.

$$\delta_{ij}^{SFH} = \delta_{ij} = \frac{\partial X_i}{\partial P_j}\frac{P_j}{X_i} \quad \text{for i, j =a, v, L} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

The price of manufactured goods does not have any effect on production since manufactured goods are consumption goods. Therefore,

$$\delta_{im}^{SFH} = 0 \quad \text{where i = a, v, L} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

ii)Price elasticities on consumption side

The separable farm household model consumption price elasticites will not have the indirect exogenous price effect through endogenous price. In addition, income change occurs due to change in farm activities.

$$\omega_{ij}^{SFH} = \left.\frac{\partial C_i}{\partial P_j}\right|_{Y=constant} \frac{P_j}{C_i} + \frac{\partial C_i}{\partial Y}\frac{\partial Y}{\partial P_j}\frac{P_j}{C_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$= \left(\frac{\partial C_i^H}{\partial P_i} - \frac{\partial C_i}{\partial Y}C_j\right)\frac{P_j}{C_i} + \frac{\partial C_i}{\partial Y}\frac{\partial Y}{\partial P_j}\frac{P_j}{C_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

$$= \frac{\partial C_i^H}{\partial P_j}\frac{P_j}{C_i} + \frac{\partial C_i}{\partial Y}\frac{Y}{C_i}\left(\frac{\partial Y}{\partial P_j} - C_j\right)\frac{P_j}{Y} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

$$= \omega_{ij}^{H} + \theta_i \left(\frac{\partial Y}{\partial P_j} - C_j \right) \frac{P_j}{Y} \quad \text{..... (15)}$$

Then the elasticities with respect to each price is given as:

$$\omega_{iv}^{SFH} = \omega_{iv}^{H} + \theta_i \left(\frac{\partial Y}{\partial P_v} - C_v \right) \frac{P_j}{Y} \quad , \qquad \text{i = a, m, L ..... (16)}$$

Setting the values which are zero,

$$\omega_{iv}^{SFH} = \theta_i \frac{P_j X_j}{Y} \quad \text{..... (17)}$$

$$\omega_{ia}^{SFH} = \omega_{ia}^{H} + \theta_i \frac{P_a \left(X_a - C_a \right)}{Y} \quad \text{..... (18)}$$

$$\omega_{im}^{SFH} = \omega_{im}^{H} + \theta_i \left(\frac{\partial Y}{\partial P_m} - C_m \right) \frac{P_m}{Y} \quad \text{..... (19)}$$

but $\frac{\partial Y}{\partial P_m} = 0$

$$\omega_{im}^{SFH} = \omega_{im}^{H} - \theta_i \frac{P_m C_m}{Y} \quad \text{..... (20)}$$

$$\omega_{iL}^{SFH} = \omega_{iL}^{H} + \theta_i \left(\frac{\partial Y}{\partial P_L} - C_L \right) \frac{P_L}{Y} \quad \text{..... (21)}$$

$$\omega_{iL}^{SFH} = \omega_{iL}^{H} - \theta_i \frac{P_L C_L}{Y} \quad \text{..... (22)}$$

In all equations (16) to (21) i= a, m, L

Price Elasticities under non-separable household model

i) Price elasticities on the production side

Under non-separable household model framework, the price response constitute the direct and indirect price effect of exogenous price change. The direct effect is the same as the separable elasticities.

$$\delta_{ij}^{NFH} = \frac{\partial X_i}{\partial P_j}_{P_L^*=cons\tan t} + \frac{\partial X_i}{\partial P_L^*}\frac{P_L^*}{X_i}\frac{\partial P_L^*}{\partial P_j}\frac{P_j}{P_L} \quad \text{……..(23)}$$

$$= \delta_{ij}^{SFH} + \delta_{iL}\Omega_j \quad \text{for i = a, v, L and j =a, v, L}$$

For a change of manufactured goods price the elasticity is:

$$\delta_{im}^{NFH} = \delta_{im}^{SFH} + \delta_{iL}\Omega m \quad \text{……..(24)}$$

$$= \delta_{iL}\Omega_m \quad \text{, i = a, v, L because } \delta_{im}^{SFH} = 0$$

ii)Price elasticities on consumption side

$$\omega_{ij}^{NFH} = \frac{\partial C_i}{\partial P_j}_{P_L^*=cons\tan t}\frac{P_j}{C_i} + \frac{\partial C_i}{\partial P_L^*}\frac{\partial P_L^*}{\partial P_j}\frac{P_j}{C_i} \quad \text{……..(25)}$$

And $\frac{\partial C_i}{\partial P_L^*}_{Y=cons\tan t} + \frac{\partial C_i}{\partial Y}\frac{\partial Y}{\partial P_L^*}$

$$\omega_{ij}^{NFH} = \frac{\partial C_i}{\partial P_j}_{P_L^*=cons\tan t}\frac{P_j}{C_i} + \frac{\partial C_i^H}{\partial P_L^*}\frac{P_L^*}{C_i}\frac{\partial P_L^*}{\partial P_j}\frac{P_j}{P_L^*} \quad \text{……..(26)}$$

$$= \omega_{ij}^{SFH} + \omega_{iL}^H\Omega_j \quad \text{i = a, m, L and j = a, m, L……..(27)}$$

Appendix 2

Table A1: Production level in Bako

	2006/07		1999/00	
	N	Mean	N	Mean
White teff				
Output (in kg)	22	200	10	345
Yield (in kg/ha)	22	345.08	10	646.67
Land (in ha)	23	0.67	10	0.53
Black/mixed teff				
Output (in kg)	20	192.75	40	353.75
Yield (in kg/ha)	20	293	40	555.25
Land (in ha)	22	0.73	41	0.6
Maize				
Output (in kg)	75	1547.68	75	3864.67
Yield (in kg/ha)	75	1292.47	75	2554.43
Land (in ha)	75	1.32	76	1.37
Sorghum				
Output (in kg)	61	431.56	14	402.14
Yield (in kg/ha)	61	728.29	14	775.24
Land (in ha)	62	0.63	14	0.48
Nueg				
Output (in kg)	15	128	17	285.29
Yield (in kg/ha)	15	226.67	17	400
Land (in ha)	16	0.62	18	0.65
Horse beans				
Output (in kg)			5	270
Yield (in kg/ha)			5	560
Land (in ha)			6	0.46
Pepper				
Output (in kg)	13	105.08	45	99.44
Yield (in kg/ha)	13	330.36	45	250.44
Land (in ha)	23	0.64	45	0.41
Note: output, yield and land figures were not reported if number of households reporting crop growing is less than 3				

Table A2: Production level in Yetmen

	2006/07		1999/00	
	N	Mean	N	Mean
White teff				
Output (in kg)	70	1737.64	60	1402.55
Yield (in kg/ha)	70	1109.41	60	1189.49
Land (in ha)	70	1.61	61	1.2
Black/mixed teff				
Output (in kg)	7	390		
Yield (in kg/ha)	7	908.06		
Land (in ha)	7	0.4		
Wheat				
Output (in kg)	41	443.78	21	480
Yield (in kg/ha)	41	1053.53	21	1278.73
Land (in ha)	41	0.43	21	0.39
Maize				
Output (in kg)	19	162.63		
Yield (in kg/ha)	19	776.84		
Land (in ha)	19	0.27		
Vetch (Guaya))				
Output (in kg)	45	334.11	19	331.58
Yield (in kg/ha)	45	1196.44	19	1148.07
Land (in ha)	45	0.32	33	0.32
Nigger seed (Nueg)				
Output (in kg)	29	129.48		
Yield (in kg/ha)	29	589.12		
Land (in ha)	29	0.23		
Note: output, yield and land figures were not reported if number of households reporting crop growing is less than 3				

Table A3: Production level in Tiyo/Eteya

	2006/07		1999/00	
	N	Mean	N	Mean
White teff				
Output (in kg)	5	170		
Yield (in kg/ha)	5	880		
Land (in ha)	5	0.19		
Black/mixed teff				
Output (in kg)	11	247.73	17	240
Yield (in kg/ha)	11	1218.18	17	680
Land (in ha)	11	0.22	17	0.37
Barley (gebis)				
Output (in kg)	48	467.6	34	329.41
Yield (in kg/ha)	48	1657.22	34	965.57
Land (in ha)	48	0.32	35	0.38
Wheat (durrah)				
Output (in kg)	70	2972.71	62	2001.61
Yield (in kg/ha)	70	2207.53	62	1426.1
Land (in ha)	70	1.37	63	1.5
Maize				
Output (in kg)	32	344.38	19	444.74
Yield (in kg/ha)	32	1445.63	19	1301.75
Land (in ha)	32	0.25	20	0.33
Sorghum				
Output (in kg)	28	425.89	22	415
Yield (in kg/ha)	28	1835.71	22	1469.09
Land (in ha)	28	0.23	22	0.28
Horse beans				
Output (in kg)	49	391.33	46	279.57
Yield (in kg/ha)	48	1438.89	46	981.52
Land (in ha)	48	0.29	46	0.33
Potatoes				
Output (in kg)	26	1753.46	5	1780
Yield (in kg/ha)	26	7966.92	5	6160
Land (in ha)	29	0.28	5	0.19
Lentils				
Output (in kg)			4	125
Yield (in kg/ha)			4	900
Land (in ha)			4	0.16
Peas				
Output (in kg)	32	340	15	181.67
Yield (in kg/ha)	32	1670.42	15	686.67
Land (in ha)	32	0.26	16	0.27

Note: output, yield and land figures were not reported if number of households reporting crop growing is less than 3

Table A4: Production side data Description

	N	Mean	Minimum	Maximum	Median	Std. Deviation
X_aP_a	184	1849.4579	179.70297	11301.177	1473.5262	1670.8452
X_vP_v	184	692.11399	10	4800	590.5	495.49446
$X_LP^*_L$	184	1182.6369	32.29532	3856.7435	1168.2932	615.48256
X_L	184	2291.1685	584	5329	2190	1003.8249
X_v	184	239.47552	3.1372549	1505.8824	186.35294	185.1059
X_a	184	725.14817	78.401728	4668.7728	558.7249	622.0118
Age*	184	48.027174	22	82	48	12.483621
Dep**	184	1.7880435	0	7	2	1.332104

***** Age of the household head.

** Member of household who are below age of 10 years old and above 70 years old.

Table A5: Consumption Side data Description

	N	Mean	Minimum	Maximum	Median	Std. Deviation
C_aP_a	184	137.7519	0	1469	95	188.26511
C_mP_m	184	34.39283	3.3	423	22.125	43.7587752
C_LP_L	184	886.9777	24.22149	2892.558	876.2199	461.611919
Y	184	1059.122	132.8616	3715.68	1032.225	535.350018
C_a	184	24.13705	0	203.5602	13.96193	32.6727889
C_m	184	8.402774	0.826222	336.4615	4.457825	25.6617922
C_L	184	1718.376	438	3996.75	1642.5	752.868698
Age*	184	48.02717	22	82	48	12.4836208
Dep**	184	1.788043	0	7	2	1.332104

* Age of the household age.