THE ROLE OF AGRICULTURAL INPUT SUBSIDY PROGRAMME IN RURAL POVERTY REDUCTION: INDIVIDUAL HOUSEHOLD MODELING APPROACH

Master of Arts (Economics) Thesis

By

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Declaration

I hereby declare that this thesis is my own work and that it has never been submitted for similar purposes, to any university or institution of higher learning. Acknowledgements have been duly made where other people's work has been used. I am solely responsible for all errors that this document contains.

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List of Acronyms

ADMARC	Agricultural Development and Marketing Corporation
AERC	African Economic Research Consortium
AISP	Agricultural Input Subsidy Programme
DY/AE	Disposable income per adult equivalent
GDP	Gross Domestic Product
GoM	Government of Malawi
HEA	Household Economy Approach
IHMA	Individual Household Modeling Approach
IHS	Integrated Household Survey
Kg	Kilogram
MARDEF	Malawi Rural Development and Entrepreneurship Fund
MASAF	Malawi Social Action Fund
MDGs	Millennium Development Goals
MGDS	Malawi Growth and Development Strategy
MPRSP	Malawi Poverty Reduction Strategy Paper
MT	Metric tonnes
ODI	Overseas Development Institute
PAP	Poverty Alleviation Programme
PRSPs	Poverty Reduction Strategy Papers
PWP	Public Works Programme
SAPs	Structural Adjustment Policies
SOLT	Standard of Living Threshold
SSA	Sub-Saharan Africa
TIP	Targeted Input Programme

Dedications

To my loving wife Anna Scevah, thank you for your encouragement and support. To my daughter and great friend, Emma. I understand why you did not understand why dad had to go away. To my sons, Nick Jr., Jack, Paul, Noah and Eric Jr. and daughter, Etta.

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For a testimony to the faithfulness of the Lord.

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ABSTRACT

This study investigates the role of Agricultural Input Subsidy Programme on poverty reduction in rural Malawi using the Individual Household Modeling Approach. The study is based on information derived from a village in Chingale area in Zomba District. Using a "with" and "without" the subsidy project evaluation approach, the study makes a comparison of the ultra poverty and poverty rates in the two scenarios. The Agriculture Input Subsidy Programme has a positive impact on the poverty rate. However, the programme does not affect the proportion of households living below food security threshold. The poorest of the poor are not made any better off as a result of the AISP. The implication is that on average, the food security situation of the lowest income group is not improved by the subsidy programme. Moreover, the maize price escalations that occur during the traditional lean months of December to February implies worsening food security situation for all maize deficit households and more so for the ultra poor since it usually means surviving on less than the required kilocalorie intake. However, complete coverage of smallholder households with one 50kg bag of fertilizer is expected to greatly reduce both the poverty and ultra poverty rates.

The study also examines the targeting efficiency of the AISP and finds that the programme is biased towards the richer households. Although this conforms to the programme's design structure, it is also a constraining factor to the programme's effectiveness as a social safety net tool.

CHAPTER ONE

INTRODUCTION

1.1 Background

Poverty in Africa and in the Sub-Saharan Africa (SSA) in particular, has remained constant over the last two decades. For instance, between 1981 and 2005, the poverty rate in the SSA has shown no sustained decline in that it remained at around 50%. In absolute terms, the number nearly doubled from 200 to 380 million people. Over the same period, poverty had been declining elsewhere in the developing world (World Bank, 2008)

Concerned with the uneven progress of development, the United Nations designed new poverty reduction interventions known as the Millennium Development Goals (MDGs) in the year 2000. The MDGs are a set of eight goals for which eighteen numerical targets have been set and about forty quantifiable indicators have been identified. To show its seriousness to poverty issues, the first goal of the MDGs calls for the eradication of poverty and extreme hunger (World Bank, 2008). Precisely; this goal has two specific targets namely: to halve between 1990 and 2015, the proportion of people under the poverty line as well as the proportion of people who suffer from hunger (World Bank, 2010).

To enable the developing countries to achieve the Millennium Development Goals, the international donor community complements individual governments' efforts within the Poverty Reduction Strategy Papers (PRSPs) framework. That is, governments are required to prepare policy documents (PRSPs) which form the basis for negotiations with the donor community on General Budget Support. The overall goal of the PRSPs is poverty reduction through empowerment of the poor.

Malawi has demonstrated concerted effort to fight poverty within the confines of the MDGs, using both policy instruments and targeted interventions to the poor or vulnerable sectors of society. For instance, the government launched the Poverty Alleviation

Program (PAP) in 1994 which was aimed at fighting rampant poverty in Malawi (AFRODAD, 2005). The PAP framework laid out four specific objectives namely, to raise the productivity of the poor, to promote sustainable poverty reduction, to enhance participation of the poor in the social economic development process so as to raise and uphold individual and community self esteem, and to increase income and employment opportunities for the poor.

The PAP was followed by the launch of the Malawi Social Action Fund (MASAF) in 1995 to provide targeted assistance to the chronically poor and finance community driven development. A key component of MASAF was Public Works Programme (PWP) in food deficit areas involving self-targeting food and cash for work (Devereux, 1997). At a later stage, a revolving credit facility named Malawi Rural Development and Entrepreneurship Fund (MARDEF) was added to MASAF. The PAP lacked effective implementation mechanism (AFRODAD, 2002), as a result it was replaced by the Malawi Poverty Reduction Strategy Paper (MPRSP) as the country's growth strategy.

The MPRSP was launched in 2002. The overall goal is poverty reduction through empowerment of the poor to be pursued through interventions in rural infrastructure development, human capital development, provision of social safety nets to the vulnerable and good governance (GoM, 2002). The MPRS tended to be biased toward public spending with insufficient treatment of rural productive sectors and failure to explore their potential contribution to pro-poor growth (Rakner *et al*, 2004). In 2005 the government therefore began developing its second generation PRSP known as the Malawi Growth and Development Strategies (MDGS). MGDS' objective is to reduce poverty through sustained economic growth and infrastructure development, particularly in rural areas through the development of rural growth centers. One of the key areas the MDGS focuses on is agriculture and food security (GoM, 2007).

Nonetheless, despite the determined efforts to eradicate or alleviate poverty, poverty in Malawi still remains high and was last estimated at 52.4%, of which 22.2% lived in ultra poverty (GoM, 2005). The Integrated Household Survey (IHS) of 2005 also indicates that

of the 85% of the population that constitute rural smallholder farmers, 58% of these earn their income from the sale of crops. Hence, interventions that aim to enhance agricultural productivity of the cash constrained, poor rural households by giving them free agricultural inputs can have widespread positive impacts on people's welfare. Conversely, a decline in the agricultural sector has serious consequences on people's welfare. It is on this basis that current agricultural input subsidies have been adopted as an intervention to promote agricultural growth and to address food security and poverty alleviation goals. This study therefore attempts to investigate the impact of the fertilizer subsidies on poverty alleviation among the rural households.

1.2 Statement of the Problem

Since 1994, the Government of Malawi made poverty alleviation a priority concern in its economic policy. Consequently, many programmes whose objective is to reduce poverty generally and rural poverty specifically, have been implemented not only by the Malawi government but also by various bilateral and multilateral donor agencies. Most notable among such programmes are Malawi Social Action Fund, the Public Works Programme and the Malawi Social Cash Transfer Programme.

Despite these efforts, poverty in Malawi remains pervasive. The Second Integrated Household Survey (IHS) report of 2005 indicates a national poverty rate of 52%. This implies that between 1998 and 2005 the poverty rate only dropped by 2% from 54% as of 1998 (GoM/World Bank 2007). Poverty in Malawi is a predominantly rural phenomenon because 94% of the poor people live in the rural areas (GoM, 2005). Most of the people living in the rural areas are smallholder farmers who earn their living through agriculture since the Malawian economy is agro-based.

Malawian smallholder agriculture is characterized by large numbers of very poor farmers heavily dependent on low input maize production on small land holdings which are very short of nitrogen (Dorward *et al*, 2008). Maize production by these farmers is normally not sufficient to meet annual consumption needs, and they depend upon casual labouring and

other income earning opportunities to finance the purchase of the balance of their needs. In the 2002/3 and 2003/4 cropping seasons when the government implemented the Targeted Input Programme(TIP), around 40% of smallholder households purchased an average of 65kg of fertilizer on commercial terms. (Dorward *et al*, 2008). These numbers suggest that more than half of the smallholder population did not afford to purchase adequate quantities of fertilizer on commercial terms. The implication is that many farmers are vulnerable to impoverished livelihoods based on low productivity maize cultivation and casual labouring. Food insecurity problems facing such farmers worsen with national food shortages due to poor production seasons and late and expensive government-funded imports leading to large increases in maize purchase prices. In trying to mitigate these problems, the government started implementing the Agricultural Input Subsidy Programme (AISP) in the 2005/06 season with the objectives of improving smallholder productivity and food and cash crop production and reducing vulnerability to food insecurity and hunger. Other objectives were to promote food self sufficiency, development of the private sector input markets, and wider growth and development.

The AISP has generated considerable debate in Malawi and internationally. Both sides of the debate however, agree that the program has significantly improved the national food security situation in Malawi. Several studies (Dorward *et al*, 2008; Chirwa, 2007; Chinsinga and O'Brien, 2008) have confirmed this observation. Other studies have focused on private sector displacement effect of the subsidy (Dorward *et al*, 2008, Ricker-Gilbert and Jayne, 2009) and household food security (Chirwa, 2010). Anecdote studies on targeting efficiency of the programme also exist (Chinsinga, 2002). There is however, discernible absence of literature about the impact of the AISP on the income welfare of the households. This study endeavours to bridge the knowledge gap by determining whether the agricultural input subsidies have an impact on rural poverty and also examines the targeting efficiency of the programme. The study utilizes data obtained through enumeration of a village called Chisanje I located in the Chingale area in Zomba District. Despite the single village focus of the study, we expect to draw lessons that apply for the nation. The study uses Individual Household Modeling (IHM) approach for data analysis.

1.3 Significance of the Study

In the light of the problem articulated in the foregoing section, this study therefore contributes to understanding the impact of the agricultural input subsidy program on the welfare of rural households in Malawi. Agricultural input subsidies' central goal is to promote adoption of new technologies and thus increase maize production both nationally and at household level. In a country such as Malawi, with 94% of the poor residing in rural areas (GoM, 2005), 85-90% of whom work in agriculture mainly as smallholders who produce maize first and foremost for home consumption (Chirwa, 2010; Harrigan, 2008; Rickert-Gilbert and Jayne, 2009), and with over 80% of food share in the poverty line (ODI, 2004), there is a close link between food security and poverty. By increasing maize productivity, agricultural input subsidies address the issue of food security which is fundamental to rural poverty reduction. Food insecure households are likely to engage in coping strategies such as *ganyu* labour and asset depletion which further intensifies the vicious food insecurity-poverty cycle. Increased maize productivity on the other hand enables households to produce surplus yields which they sale to meet other household needs as well as to accumulate assets, and thus enables them to meaningfully participate in the economic development process.

The significance of the study with respect to policy cannot be overemphasized. Poverty reduction is at the core of the Millennium Development Goals (MDGs) which inform the Malawi Growth and Development Strategies (MGDS). Malawi's pathway to poverty reduction, as envisaged in the MGDS, involves increased agricultural productivity and food security as the primary goals of the first key priority area. One of the key strategies for achieving the goals include providing the means for Malawian's to gain income and put in place effective social protection programs with improved targeting (GoM, 2005). AISP is implemented as part of this strategy. However the direct impact of the strategy on rural household poverty has not been examined.

1.4 Study Objectives

The main objective of this study is to investigate the impact of the AISP on household poverty. To achieve this main objective, the study specifically attempts:

1. To determine the impact of the AISP on household incomes.
2. To investigate the household food security impact of the AISP.
3. To examine the extent to which the input subsidy is targeting poor households.

1.5 Hypotheses Tested

Based on the foregoing objectives, the study will test the following null hypotheses:

1. The Agricultural Input Supply Program does not have an impact on household income.
2. The AISP does not contribute to food security of households.
3. The AISP is not efficiently targeted

1.6 Organization of the Thesis

Chapter Two is devoted to background information. It gives the history of input subsidies in Malawi and also describes the poverty situation in Malawi between 1998 and 2005. It then analyzes the economic environment in Malawi from 1994 to 2007. Chapter Three reviews the literature. It starts by exploring two contending schools of thought regarding government intervention in the market and then shows the link between agricultural development and poverty reduction. It then reviews other papers that have attempted to assess the impact of subsidies in Malawi and elsewhere.

Chapter Four describes the methodologies used in this study while Chapter Five is devoted to the presentation and discussion of results. Chapter Six winds up by drawing conclusions and policy implications based on the results and discussions.

CHAPTER 2

HISTORY OF AGRICULTURAL INPUT SUBSIDIES IN MALAWI

2.1 Introduction

The agricultural sector is the single most important sector of the Malawi economy. At independence, the Malawi economy was predominantly agricultural, with the agricultural sector accounting for 55% of the gross domestic product (GDP) and 90% of domestic employment (McCracken, 1983). Agriculture continues to be a significant driver of economic growth, accounting for 38% of the Malawi economy's GDP, 80% of its export earnings and supports 85% of the population (World Bank, 2009).

2.2 From 1952 to Early 1980s: The Era of Universal Input Subsidies

Due to its strategic importance to the Malawi economy, the agricultural sector has benefited from subsidies practically for most of Malawi's modern history, having been introduced in 1952. The objective of the subsidies in colonial Malawi was to ensure the distribution of vital agricultural inputs at a low cost to even the most geographically remote smallholder farmers and the goals were to increase maize productivity and maintain soil fertility. Post Colonial government's involvement in agricultural sector was widespread. Apart from promoting an agricultural-based export-oriented development strategy, government placed national food security high on its domestic policy. The national food security goal was achieved via emphasis on smallholder production of maize. The strategy received strong support from the state through the state marketing board, Agricultural Development and Marketing Corporation (ADMARC), which offered smallholder farmers, subsidized maize seed and fertilizer and purchased the maize output at guaranteed pan territorial prices. ADMARC also sold the maize in the domestic market at subsidized consumer prices (Harrigan, 2008)

Although the strategy succeeded in achieving national aggregate food security, individual household food security was not guaranteed because of conflicting policy objectives

which favoured the estate sector (Harrigan, 1988) and led to the impoverishment of the smallholder sector.

2.3 Structural Adjustment Policies and Removal of the Universal Input Subsidies

By late 1970s, Malawi suffered the impact of a series of exogenous shocks such as the dramatic deterioration in the terms of trade; a sharp rise in international interest rate; drought conditions in 1979-80 (Mosley *et al*, 1991); and disruption of Malawi's traditional trade route to the sea due to the civil war in Mozambique. Government's budgetary position worsened and this was aggravated by financial deterioration experienced by ten major parastatal companies which were operating at a loss from 1977 onwards (Mosley *et al*, 1991).

These conditions underscored the need for a reorientation of agricultural policy in Malawi under the auspices of the World Bank and International Monetary Fund structural adjustment and stabilization programmes (SAPs). Liberalization of the agricultural sector led to increased ADMARC producer prices for smallholder export crops while the producer price of maize was reduced. Simultaneously, Malawi liberalized the agricultural input markets and started phasing out subsidies on smallholder fertilizer and seed (Mosley, 1991; Harrigan, 2008). By 1996, government had completely removed the universal fertilizer subsidy. The objective was to remove price distortions and increase the smallholder contribution to export earns.

Consequently, the cost of agricultural inputs increased dramatically, making fertilizer unaffordable to most smallholder farmers. Smallholder fertilizer uptake declined in absolute terms as a consequence of the price increase and the collapse of the Smallholder Credit Administration. With the collapse of the formal marketing system in 1985-6, many risk-averse farmers shifted their cash cropping pattern out of improved maize and towards groundnuts which enjoyed well developed informal markets. By the 1990s, both household and national food security had become more precarious in Malawi (Chilowa, 1998; Sahn *et al*, 1990) and poverty had increased. Rural livelihoods were deteriorating

(Frankenberger, *et al*, 2003) and inequality among smallholders had increased (Peters, 1996). In addition, the effect of market liberalization and the reduced role of ADMARC in the maize market were such that the intra-seasonal maize consumer price widened. This adversely affected rural households' food security, 80% of which had become net purchases of maize (Hamington, 2001).

2.4 Starter Pack and Targeted Input Programs

The Starter Pack Programme was launched in 1998 in response to the growing evidence of catastrophic decline in soil fertility and maize productivity (Harrigan, 2008). The program was intended to meet several objectives including increasing maize yields and food security, countering soil nutrient depletion, and making a new line of fertilizer-responsive semi-flint hybrids available to small farmers who otherwise would not take the risk to experiment with them. The program was designed to provide all smallholders with small packages containing semi flint hybrid (2kg) and fertilizer (15kg) as well as legumes (1kg of seed) to improve soil fertility. The pack was enough to cultivate about 0.1 hectares of farm size and it was estimated that that farmers would be able to produce an extra 100-150kg of maize.

In terms of coverage, it extended to all rural farming households and was repeated in the 1999/2000 growing season. With the assistance of good weather, smallholder maize production registered a record 2.5 million tons which was 1.0 million tons higher than the long term average production and 500 thousand tons higher than the previous record of 1993 (Crawford *et al*, 2005; Harrigan, 2008; Dorward, 2009; Gilbert and Jayne, 2009).

The programme thus improved households' food security and income position (Cromwell et al, 2001, Oygard *et al*, 2003) via two channels. Firstly it provided an extra 2 to 2.5 months of maize cover for an average household of six members. The second channel worked through the market mechanism since the increased household maize production reduced demand for maize in the market and hence dampened the intra-seasonal increase in the maize consumer price. This further lessened the crowding out of the chronically

poor households by the better off in the maize market (Harrigan, 2008). The Starter Pack thus contributed to poverty alleviation particularly in the early years when nearly all rural households were beneficiaries (Crawford *et al*, 2006).

2.5 Agricultural Input Subsidy Program

Another acute hunger crisis repeated in the 2004/05 growing seasons, which affected five million people and forced the government into a costly exercise of importing emergency food. Consequently government deepened fertilizer subsidies by introducing a large-scale input subsidy, the Agricultural Input Subsidy Program in the 2005/06 growing season. The objective was to promote access to and use of fertilizer in both maize and tobacco production in order to increase agricultural productivity and food security (Mann, 2003; Dorward, *et al*. 2008). The programme was particularly intended to improve land and labour productivity and production of both food and cash crops by smallholder farmers that faced heavy cash constraints restraining them from purchasing the necessary inputs (Dorward, *et al*. 2008). The overall goal was to promote economic growth and reduce vulnerability to food insecurity, hunger, and poverty.

The program was implemented through the distribution of coupons for four types of fertilizer which recipients could redeem at parastatal outlets at approximately one third of the normal cash price. In the first year, 50% of farming households were provided with 2.8 million vouchers for 100kg of fertilizer and a small quantity of maize seed. However, the programme left out the poorest farm households since it was felt that 100kg of fertilizer was too much to be used effectively on the small land holdings typical of such households.

The result was increased national maize output (MT 2.6 million) in the 2005/06 season while in the 2006/07 growing season the surplus was recorded at 1.3 million metric tons (Chinsinga, 2002). At household level, the programme improved food security and lowered the food prices than would have prevailed without the subsidy.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

The objective of this chapter is to review literature with respect to agricultural input subsidies. We first discuss the two major contending schools of thought concerning the role of government in a free market economy and the objectives behind governments' adoption of input subsidies. Then we explore the link between agricultural growth and poverty. The chapter closes with a review of various papers on the impacts of subsidies.

3.2 Theoretical Literature

3.2.1 The Contending Schools of Thought Concerning Government Intervention

Classical welfare economics is premised on Adam Smith's dictum that each individual, in pursuit of his own self-interest, is led as if by an "invisible hand" to a course of action that promotes the general welfare of all. His axiom has been formulated into two Fundamental Theorems of Welfare Economics. The first theorem states that a *perfectly competitive market economy leads to a Pareto optimum*[1] *allocation of resources provided certain conditions are met* (Weimer and Vining, 2005). The theorem implies that the market economy will, under certain conditions, lead to efficiency.

Perfect competition in all markets is therefore the benchmark that will lead to a position of Pareto optimality, given the assumptions that underlay the analysis. These conditions include availability of: producers and consumers as rational agents who maximize benefits and minimize costs; a complete set of markets with well defined and costless enforced property rights; many buyers and sellers who are passive price takers; and zero transaction costs. Under these conditions, a set of prices arise that allocates resources Pareto optimally. Pareto efficiency however, depends on the initial endowments of

[1] An allocation is said to be Pareto optimal or efficient when every reallocation that augments the utility of one individual necessarily reduces the utility of another (Gould and Ferguson, 1980)

resources to individuals. If the initial distribution of endowments was not equitable, then the second theorem applies. It states that *after a suitable redistribution of initial wealth, any desired Pareto-efficient allocation of resources can be achieved by a perfectly competitive economy, provided certain conditions are met*. The second theorem claims that under those conditions, the market economy will lead to an outcome that is both efficient and equitable.

Using the Marshalling demand, such a competitive market economy has a tendency to converge towards a general equilibrium in sense that the quantity demanded exactly equals the quantity supplied. The equilibrium is Pareto optimal in that it also maximizes social surplus[2] and is characterized by zero economic rent[3] as long as entry into the industry is free. Therefore, policy interventions that move prices away from the equilibrium price and quantity lead to inefficiencies through loss of social surplus.

However, there are instances when perfect competition does not lead to maximum social welfare due to existence of external economies[4]. Coase (1937), argued that even in these cases, a perfectly competitive economy would still achieve a socially optimal level of output without government interventions through taxes or subsidies. Assuming that the income effects and transaction costs were negligible, voluntary contracts among the different parties concerned would lead to a socially optimal output even in the presence of externalities. He further argued that the result would be the same regardless of which party is assigned the property rights to the contestable resource.

According to this theory, a farmer is motivated by profit in his pursuit of self interest and would therefore demand the amount of fertilizer that maximizes financial returns (Shultz,

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[2] Net benefits consumers and producers receive from participation in the market or the sum of consumer surplus and producer surplus.

[3] That is, total revenue minus payments at competitive market prices to all factors of production, including an implicit rental price for capital owned by the firm.

[4] An external economy (diseconomy) is said to exist when marginal social cost is less than (greater than) marginal social benefit (Gould and Ferguson, 1980).

1964). This amount is determined by the intersection of the farmer's effective demand for, and firms' supply curve of fertilizer (Ellis, 1992). At the point of intersection, the farmer's marginal cost of the last unit of fertilizer applied is equal to the value of the marginal benefit.

Accordingly, fertilizer subsidies should be discouraged because the distortions they induce have consequences for the economy (Shultz, 1964) especially if the distribution function is not function well. For instance, they distort resource allocation at the farm level to the extent that they encourage farmers to use excessive amounts of fertilizer beyond profit maximizing levels (Ellis, 1992); they may be hard to target and go to well-off farmers or those with high cash income (Donovan, 2004; Kherallah, *et al*, 2002), in which case they may be regressive as they may displace unsubsidized sales; price control and rationing may encourage rent seeking behaviour (Ellis, 1992).

Despite its sound economic argument, the profit maximization goal does not augur well with the smallholder situation due to the dual role of maize in rural Malawi economies. Malawian smallholder production is food security driven; only surplus production is sold on the market. Maize is rarely grown for sale and smallholder farmers do not reason in terms of price signals and profit margins (Donge *et al*, 2001). Smallholder maize production decisions are about maximizing output given the constraints of land, labour and inputs. Moreover, before the introduction of the AISP, 60% of the smallholders did not purchase any fertilizer (Buffie and Atolia, 2009). In addition, although smallholders know that correct application of the input greatly increases maize yields, current fertilizer intensity in Malawi, estimated at 34kg per hectare against the recommended 150kg per hectare, is very low to achieve food security. Therefore, rather than encouraging excessive use of fertilizer, provision of subsidized fertilizer in Malawi encourages fertilizer consumption towards the socially optimal level (Pender *et al*, 2004), improves efficiency and enhances food security for the poor (Buffie and Atolia, 2009). In this case therefore, subsidies do not distort the allocation of resources.

The other school of thought consists of two theories, Economic Theory of Regulation and the Public Interest Theory, which argue for government intervention in markets. The economic theory of regulation (Stigler, 1975; Peltzman, 1976) treats regulation like an ordinary good whose equilibrium price and output are determined by the intersection of the demand for and supply of regulation. Regulation, such as provision of subsidies and restriction of entry by rivals, results in the transfer of wealth from government to some producers and interest groups. The price of this commodity (wealth) takes the form of open bribes, campaign contributions, and lucrative jobs for relatives of politicians. The demanders are a small, controllable group of firms or other interest groups while the suppliers are political regulators who wish to maximize votes and hence ensure security of tenure.

State legitimacy in Malawi is closely linked to the availability of maize or more broadly, food security (Chinsinga, 2007, Sahley *et al*, 2005). The closer the state legitimacy is linked to maize availability, the more likely food security policy will be politicized and therefore jeopardizing maize availability and affordability puts at risk the ship of the state. Consequently, the issue of food security in Malawi has been used to build wider support for a party or to bolster support for a government (Sahley *et al*, 2005).

The public interest theory on the other hand is premised on the argument the market mechanism plays a vital role in the optimal allocation of resources. Market failures are however, inevitable because the assumptions of the competitive model do rarely conform to the real world situation and are in practice violated. The violation of the assumptions produces Pareto optimally inefficient outcomes that do not maximize welfare.

Traditional reasons that account for market failure include the existence of: public goods, externalities, information asymmetry, and technical externalities. The major reason that account for market failure in the Malawi rural economy is existence of thin maize input, output and financial markets which require high risk premiums and margins in order to make it profitable to engage in such markets. The high margins however, depress

effective demand and thus result in a low level equilibrium trap and hence market failure (Dorward et al, 2004).

Government intervention therefore is intended to bring about a more equitable outcome at a lower cost than the private organizations. Government intervention may take a number of ways. Pigou (1912) argued that in the presence of externalities, government should intervene by levying taxes on those imposing external costs and subsidies on those who contribute external benefits. Subsidies will stimulate production or consumption, while taxes will limit them. Sometimes the government may intervene by directly providing the public goods and services such as health and education.

This school of thought argues that because of market failure, farmers may not necessarily seek to maximize profit from fertilizer use since they may not know the yield response curve and they face affordability, production or output marketing, constraints (Kelly, 2005). Not surprisingly, most African countries have responded to this suboptimal use of fertilizer by adopting agricultural input subsidies primarily as a means of promoting the adoption of new technology among farmers and thus increase agricultural productivity (Ellis, 1992). Subsidies achieve this by allowing farmers to access purchased fertilizer and improved seeds at low cost and thus remove the disincentives to technology adoption (Dorward, 2008). These disincentives stem from risk aversion, cash constraint, and low expectations of returns from investment in agricultural inputs due to limited information about input benefits. In the Malawi case for instance, the adoption of the Agricultural Input Subsidy (AISP) has been justified on the basis that it compensates for incomplete markets that prevent smallholder farmers from investing in highly profitable green revolution inputs.

Given market failures that account for low fertilizer use and hence smallholder productivity in Malawi, government intervention in the market is therefore justifiable. However, a clear understanding of the rationale underlying government policy objective is crucial for assessing policy impacts on the population. By adopting the AISP, the Government of Malawi's objectives were to increase agricultural productivity, to increase

food security and particularly, to improve land and labour productivity and production of both food and cash crops by smallholders that are faced by heavy cash constraints restraining them purchasing the necessary inputs (Dorward *et al*, 2008). Implied in these objectives are efficiency, equity and externality considerations.

3.1.2 Efficiency Considerations

Farmers' use of fertilizer may be suboptimal due to several factors that influence their adoption and intensity of fertilizer use, such as price factors, lack of information, lack of liquidity and risk aversion.

Price factors affect profitability of fertilizer use. According to Kelly, (2005), profitability of fertilizer is directly influenced by fertilizer-yield response (or agronomic response), and input-output prices. Yield response, defined as kilograms of grain obtained by applying one kilogram of plant nutrient, is a function of soil characteristics and climatic factors. If the farmer's perception of yield response and profitability is substantially lower than that perceived by researchers, then the difference between potential demand and effective demand will be wide.

Dorward *et al* (2008) however contended that the many years of fertilizer subsidies in Malawi have improved farmers' perceptions of yield response. However, despite smallholders' full awareness of the potential for hybrid seed and fertilizer to increase their maize production, purchases of both is limited (Dorward *et al*, 2008). The problem that still remains is the variability in farmers' ability to effectively and efficiently use fertilizer. Kumwenda *et al*. (1997) however, argue that the variability of the environment over time and space in Malawi and the other SSA countries contributes to the cost of developing information about agronomic potential and of transmitting this information to farmers. The role of input subsidies in such an environment should therefore be to help especially poorer farmers to learn from experience. In the presence of perfect information, the decision to adopt fertilizer is determined by the interplay of the agronomic response and the input-output price ratio. In theory, farmers should adopt

fertilizer use if the marginal agronomic response is greater than the input-output price ratio.

The input-output price ratio, which indicates the number of kilograms of production a farmer needs to purchase 1kg of fertilizer, is unfavourable in Malawi, mainly because maize prices have been highly volatile especially over the last ten years (Minot, 2010). Volatility is a consequence of thin agricultural markets in the country and the SSA region generally; (because only a small portion of many crops enter the market) which means that small changes in total production can result in large proportional changes in marketed surplus. Output price volatility therefore induces uncertainty and risk[5]. Risk associated with fertilizer use in Malawi includes production risk (variability in fertilizer response) and price risk. Production risk and uncertainty arise from erratic future rainfall pattern and output prices which may cause large losses of income or missed opportunities for increasing income. Output price volatility induces risk of low food prices leading to low profitability of fertilizer use which may depress fertilizer use (Dorward, 2009). In addition to the production and price risks, fertilizer costs constitute a larger part of production related cash outlay in Malawi (Takane, 2007). Therefore investing in this high-cost input under such conditions is likely to further subject the farmer to greater financial risk or income loss (Heisey and Mwangi, 1996, Takane, 2007).

Suboptimal fertilizer use is also an effect of low farm incomes (constrained affordability or lack of liquidity, particularly for farmers producing food crops) and high cost of inputs which limit affordability (Takane, 2007). The other factors that constrain affordability include limited opportunities to purchase fertilizer in bags smaller than 50kg (as above), and lack of market power that can be acquired through strong farmers' organizations. It is argued that farmers should be able to finance input purchases from farm savings, non farm income sources or by borrowing (Paulton and Dorward, 2008). However, poorer farm households are not able to save enough income for the purpose while the absence of financial services that allow these farmers access to credit limit their ability to borrow.

[5] Hardaker *et al* (1997) defined uncertainty as imperfect knowledge and risk as uncertain consequences, particularly, exposure to unfavourable consequences.

Moreover, smallholder farmers in Malawi perceive credit as risky and difficult to obtain. Therefore poorer farmer's access to fertilizer can be increased only if the subsidies induce sufficiently large enough reductions in fertilizer prices (Dorward, 2009).

3.2.3 Equity Considerations

In the face of market failure, one of the roles of the state is to redistribute wealth provided that the redistribution process is Pareto Optimally efficient (Gravelle and Rees, 2004). Given that farm income for most smallholders is below average, the cost of the subsidy could represent a transfer from the state (hence tax payers) to the poor.

The role of the state in providing the subsidies for equity considerations can be viewed as a process of empowering the poor so that they can get out of the poverty trap. Sen (1993) used the capability approach as a framework for discussing wellbeing. While entitlements refer to a person's command over goods and resources, that is, what a person has, capabilities refer to the set of options from which a person can choose to obtain that command. Capabilities therefore indicate that a person is able to realize certain entitlements. Therefore poverty is lack or breakdown of capabilities. In the long term, poverty can be overcome by empowering the poor so that they have the capabilities to achieve and the state may choose subsidies to achieve this goal.

In this case, the challenge is to justify that the fertilizer subsidies are better targeting than alternative programs such as cash transfers. Fertilizer subsidies are unlikely to be pro-poor unless targeted or rationed. Dorward (2009) argues that if not targeted, subsidies may represent income transfers to producers who are already using fertilizer, which is an inefficient way of stimulating increased production and productivity since economic gain from using subsidized fertilizer is substantially reduced. He also argues that without targeting, producer transfers may bid up demand for inputs (land and labour), hence such transfers may be passed back to the suppliers of the inputs as pure economic rent. Rationing on the other hand may create opportunities for those controlling subsidies to divert them from intended beneficiaries.

Kelly, (2005) and Dorward, (2009) identified three targeting conditions that increase the likelihood of subsidies being useful and these include: targeting subsidies on those who are not using inputs because of market failure; targeted on products where they can induce substantial supply shift and intended to stimulate products with inelastic supply, and particularly, inelastic demand among poor producers and consumers (so as to maximize both economic and welfare gains from the subsidies). Staple grain products tend to have these characteristics in poor large and land locked countries with suitable agro ecological conditions.

3.2.4 Externality Considerations

Fertilizer subsidies could be justified if fertilizer use generates benefits to others besides the farmer. Since subsidies promote fertilizer use, they may be used to arrest and reverse the decline in soil fertility caused by low fertilizer use and infrequent fallowing. Soil nutrient depletion is a common consequence of most African agriculture (Stoorvogel *et. al.*, 1993). Households with infertile land may be forced to move to marginal or forested areas, thus causing rapid deforestation and land degradation which may lead to declining levels of soil nutrients such as nitrogen, phosphate and potassium in arable lands (Crawford *et al*. 2005). However, subsides will in this case have externalities in terms of increased fertilizer use, high soil fertility and high farm yields, which provide benefits to society rather than to individual farmers.

The way in which we rationalize fertilizer subsides has got implications on the methodology that will be adopted to assess its impact on the target population. If we rationalize subsidies as a way to help farmers offset the constraints they face and reach economically optimal fertilizer use such that additional farm income or crop production exceeds the cost of the program, then they can justified on efficiency grounds. Then, it may become imperative to conduct a cost-benefit analysis. Alternatively, if fertilizer subsidies are a cost effective way of assisting the poor, they can justified on equity grounds. Then, the important question to ask is whether the targeted beneficiaries were better off or worse off after the intervention was implemented, basing on the effect of the

subsidy on the selected welfare indicators which in this study are food security and poverty. Of course, the intervention will have externalities that will impact the wider economy. For example, increased land productivity will be a catalyst of poverty reduction since it will raise productivity and incomes in particular areas. Reduction in poverty will ease rural-urban migration and hence will reduce social costs of addressing rural-urban poverty (Sanchez *et al*. 1997). Such impacts may be captured through the price mechanism in the general equilibrium analysis.

3.1.5 Linkage between Agriculture and Poverty Reduction

The role of agriculture in economic development has long been recognized. Rostow's (1961) growth theory placed emphasis on agriculture as the "*take off point*" towards industrialization. Agriculture has a multifunctional role to play in economies. Apart from providing food, agriculture is the main source of economic growth in Malawi and most of the SSA. Growth coming from agriculture is known to be twice as effective in reducing poverty as GDP growth originating from outside agriculture (World Bank, 2008). Thus, even though high rates of economic growth per se may rapidly reduce the proportion of the population in absolute poverty but it is the direct and indirect effects of agricultural growth that accounts for virtually all the poverty decline (Mellor, 2000). Therefore farm productivity is a precondition for broad based economic development in most of the developing world (Johnston and Mellor, 1961; Tiffen, 2003).

The Mellor's view is strongly supported in literature by other studies. For example a study by Hanmer and Nashchold (2000) found that the higher the ratio of agricultural labour productivity to the labour productivity in the modern sector, the greater the poverty reduction. Another study by Ravallion and Datt (1999) found that poverty reduction in India is related to crop yields and to growth within sectors as opposed to transfers between low and high income sectors. They provided evidence that growth in the agricultural and service sectors have had poverty reducing effects but that growth in the manufacturing sector has not. Supporting these findings, Timmer, (1997) found that if

agricultural GDP per capita grew by 1%, per capita income of the bottom quintile of the population increased by 6.1%.

However, Johnston and Mellor, (1961) argue that for agricultural growth to be pro-poor and support widespread poverty reduction, there are some necessary conditions that need to be satisfied. Firstly, it must be accompanied with price and productivity increases in tradable products that have a high labour content. It must be induced by changes in technology, reduced barriers to entry, or access to assets which allow the poor to engage in production of tradable products which they could not previously engage in. In addition, there should be productivity increases in non tradable products which have a high average budget share in the poor peoples' expenditure. Lastly, it should result in gains to significant numbers of non poor, leading to expanded demand for goods and services produced by the poor as a result of consumption linkages. They therefore concluded that agricultural growth, particularly cereal based intensification, offers the best potential for poverty reduction for large numbers of poor rural people in SSA.

However, given the obstacles to such growth in the SSA region, such as high transaction costs and low profitability, it is important to identify a viable alternative strategy for achieving such growth. There is widespread agreement that increased use of productivity enhancing inputs such as fertilizer is a precondition for rural productivity growth and poverty reduction. Currently however, fertilizer use in SSA averages between 8 to 10kg per hectare, which is too low compared to 78kg in Latin America and 101kg in South Asia (Morris *et al*, 2007).

One reason that has been found to contribute to low fertilizer use in SSA is that the real price of fertilizer is higher than in many developing regions. The removal of subsidies and the liberalization of the exchange rate over the past decade caused relative prices paid by farmers to rise and reflect closely the economic cost of fertilizer (Heisey and Mwangi, 1996). The price of fertilizer is also high or unaffordable because Africa's agricultural policy has tended to neglect other factors that affect fertilizer price and demand such as availability of cheap credit, appropriate agricultural research and developed and well

maintained infrastructure. Less developed infrastructure in much of Africa raises the real cost of fertilizer distribution above levels for much of the developing world and therefore reduces farm level profitability.

3.3 Empirical Literature

Given the growing tendency for African governments to adopt agricultural input subsidies, recent research has focused on assessing the impacts and effectiveness of this policy option.

For example, Dorward *et al*, (2008) conducted a benefit- cost analysis of the AISP, taking into account a range of assumptions about grain-fertilizer response rate in 2006/07 growing season, displacement of commercial sales of fertilizer, and contribution of improved maize seed to aggregate output and maize price. The estimated benefit-cost ratio ranged from 0.76 to 1.36. This made it ambiguous to justify the program on efficiency considerations (Minot and Benson, 2009), but since the program delivered benefits to the beneficiaries, it could be justified on equity grounds. Moreover, the study dispelled fears that the AISP adversely impacted on government budget allocation to non agricultural sectors such as infrastructure and health. However, within the Ministry of Agriculture and Food Security, the AISP budget of about USD80 to USD91 million (45% of the Ministry of Agriculture and Food Security budget) did seem to adversely affect delivery of services such as research and extension.

Chirwa (2010) however argued that what matters in any assessment of an intervention that seeks to improve the welfare of the poor, is whether the targeted beneficiaries were better off or worse off after the intervention. The benefit-cost implications are irrelevant. Using a fixed effects approach to assess the impact of both the TIP and AISP, he found that the TIP was not effective in reducing food security. This finding concurred with other studies by Dorward *et al*. (2008); Ricker-Gilbert *et al*. (2009). The study however, found that the AISP positively contributed to household food expenditure. He therefore,

concluded that the impact of input subsidy programs in Malawi becomes stronger as policy makers improve on the quantities of input subsidies.

Ricker-Gilbert *et al*. (2009) set out to compare maize yield response to fertilizer from farmers who received subsidized fertilizer with yield response from those who paid commercial prices for the input. The study used household panel data sets from 2002/03, 2003/04 and 2006/07 to get a before and after measure of the subsidy impact. Descriptive statistics indicated that farmers who purchased subsidized fertilizer got lower yields than those who purchased fertilizer while regression results showed that farmers with subsidized fertilizer received higher marginal product from fertilizer. That is, the yield response from maize plots that used subsidized fertilizer was higher than other plots. The study observed that the aforementioned results seemed to be influenced by those farmers who did not use any fertilizer before the subsidy. Based on this finding, the paper concluded that subsidized fertilizer should specifically target smallholder farmers who lack access to commercial markets or to those who would not otherwise find it profitable to purchase the input. However, it can be argued that researchers who use panel data are prone to committing the error of using data sets developed using different conditions. Rather, an assessment of the impact of the fertilizer subsidy before and after an intervention is made, should be justified by creating a counterfactual within the same period in order to reduce potential selection bias (Chirwa, 2010). That is, a subsidy should be evaluated using cross sectional data.

A study by Xu *et al*. (2006) used post harvest data for the period 1996/97 to 1999/2000 in Zambia to estimate maize yield response to nitrogen in two provinces with various soil types and power of hydrogen (P^H) levels. The estimation results suggest that the marginal product of nitrogen index is the highest for the group of households that obtained fertilizer on time and used animal draft power or mechanical power for land preparation. The results from economic analysis of fertilization also suggest that households that obtain fertilizer on time and used animal draft or mechanical power are more likely to find fertilizer more profitable than other groups in the same district. The study also finds proximity to the provincial centres as the other factor that impact on

profitability of fertilizer use. Distances and transportation costs from provincial centres coupled with high interest rates on credit erode the profitability of fertilizer use; therefore, applying fertilizer is likely to be more profitable near provincial centres where the price ratio of fertilizer is highest. Subsidized fertilizer in Zambia has often been distributed late which causes uncertainty for private traders; they first have to assess whether subsidized fertilizer will be circulated in their area of operation before deciding to sell. Consequently, despite achieving relatively high crop response rates to fertilizer use in some areas, smallholder farmers may find fertilizer use unprofitable until efforts are made to reduce transportation costs and interest rates as well as to ensure more timely delivery of fertilizer.

Buffie and Atolia (2009) investigated the impact of a large AISP type increase in input subsidies on GDP, food security, and real income of the poor. The study finds that if the government increases lump sum taxes in order to pay for subsidies, all poor groups gain but private investment contracts. In the long run Gross Domestic Product (GDP) is negative but not significant unless the shadow price of fertilizer is five times as large as the infrastructure investment. The results are distinctly less favourable when input subsidies crowd out infrastructure investment. In addition, smallholders who derive much of their from farming enjoy permanent, large gains but positive effects on real output and income of the unskilled labour are limited to the short term; across the steady state, GDP decreases 2-12% and the real unskilled wage falls 1-11%.

Javdani (2009) has studied the role of AISP on food security and assessed the coupon distribution process in six clusters of villages in Zomba using qualitative and quantitative methods. With regard to coupon distribution between households, she found that the process was highly uneven and problematic, such that many of those who did receive subsidized fertilizer received the wrong amount or type, or received it at the wrong time. She also found that although nearly everyone in the subject population was desperate for the subsidy, only those who are otherwise advantaged in the local political economy have the power to guarantee their own access to it. Additionally, between the 2006/07 and 2007/08 farming season coverage by expenditure quartile both increased and evened out,

with the lowest quartile receiving the fewest coupons. Moreover, households that held the most farmland marginally received the least number of coupons in 2007/2008, and it was common for households to receive only one coupon, or to share a coupon with another household.

The paper also found that chemical fertilizer had a clear effect on overall household maize production in 2008. Those households that used no chemical fertilizer harvested an average of 162.7kgs of maize, while those using fertilizer harvested an average of 501.9kgs. Households that purchased some fertilizer at the unsubsidized price, either in addition to or in place of subsidized fertilizer, harvested an average of 701.2kgs of maize, and those households relying on subsidized fertilizer harvested an average of 521.3kgs. The study also found that production rose consistently with expenditure quartile, with the lowest expenditure quartile producing an average of 273.0kg while the highest income quartile produced 792.5kgs.

A paper by Seaman *et al*, (2008) set out to assess the impact on household income and welfare of the pilot Social Cash Transfer and Agricultural Input Subsidy Programmes in Mlomba TA, Machinga District, using the IHM methodology. The study found that 84.6% of surveyed households obtained subsidized fertilizer and that the proportion of households obtaining subsidized fertilizer vouchers did not vary markedly with income although poorer households received on average less fertilizer than better off ones. In addition, 18.8% of the households in the poorest income quintile and 6.7% in the richest quintile used 25 kg fertilizer while the proportions using 50kg fertilizer in the two quintiles were 75% and 63% respectively. A simulation based on assumptions about the maize return with and without fertilizer suggests that all households using fertilizer gained income, with the richest households on average gaining most and that the gross gain in income substantially exceeded the cost of the subsidy.

CHAPTER 4

METHODOLOGY AND DATA ANALYSIS

4.1 Introduction

This chapter discusses the methodology and data analysis techniques employed in order to measure the impact of subsidized fertilizer on poverty.

4.2 Data Collection

To examine the effects of the fertilizer subsidy on rural poverty, a household survey was conducted in Chisanje I village between 11th and 28th of January, 2010. The survey collected primary data sourced from 100% enumeration of household units which existed in the agricultural year, October, 2008 to September, 2009[6]. Selection of the village was purposive; the survey was interested in a typical rural area that had participated in or benefited from the AISP. One village was selected because of time constraint.

The techniques employed for the collection of the data included a combination of focus group discussion and semi-structured interviews. The data collected through focus group discussion were mainly contextual information about farming patterns, types and local market prices for crops grown in the area, employment types, rates and season. Information on current interventions by both government and non-governmental organizations in the area was also collected.

Semi-structured interviews involved a total of 32 household units. The data collected using the semi-structured questionnaires included household demographic data which included household membership by age and sex, school attendance, marital status; household land type and area cultivated; household income by source; household assets; crop type and its production, split into amounts consumed, sold and given out as gifts and household participation in social programmes.

[6] The agricultural year of October, 2008 to September, 2009 was selected in order to capture information from both the rain-fed farming, and upland/*dimba* irrigation farming seasons which extend from October to March and March to September respectively.

4.3 Conceptual Framework

The study uses the Individual Household Modeling (IHM) approach for data analysis. The approach has been developed by Evidence for Development, a UK based organization in collaboration with Chancellor College of the University of Malawi.

The IHM approach provides predictions of the impacts of policy changes and other defined shocks on people's ability to maintain their income and to meet their survival needs. It also provides quantitative and qualitative descriptions of defined populations based on various strategies that people employ to access food and income. The approach is based on the individual analysis of a representative sample of households which provides the flexibility to handle a diverse set of problems.

In the IHM framework, household income is used as a proxy for welfare. Households in rural areas obtain their income mainly from crops, livestock and off-farm employment. They also supplement their income, in cash or kind, with wild foods and gifts. The household income function can be represented as:

$$Income = f(crop\ \ production, livestock, employment, other\ sources) \qquad 1$$

Rural household $income$ is therefore defined as the aggregate amount of cash income[7] obtained by the household from all household activities at the time of survey. In order to allow for comparisons across households, incomes have been standardized by using adult equivalents[8].

$Livestock$ is the total revenue a household obtained from the sale of its own livestock and livestock products; $employment$ stands for the money income household members obtained from different kinds of work; $other\ sources$ represents income obtained from remittances, wild foods and gifts.

[7] In the IHM framework, the amounts of food kilo-calories in excess of household requirements are converted into cash equivalent and added to household income.

[8] Adult equivalents are based on the assumption that each household member enjoys the same level of welfare for different levels of consumption.

Crop production represents the total money value a household obtained from different crops that it produced. Crop yields can be seen as a function of input variables that are under the farmer's control and exogenous variables that are beyond the farmer's control.

The model that maps inputs and exogenous variables to output can be written as:

$$y_i = f(x_i, Z), i = 1.....n \quad 2$$

Where, y_i is household i^{th} crop yield, x_i is household i^{th} input variable, and Z is a vector of exogenous variables. Z is assumed to be constant while,

$$x_i = x_1, x_2.....x_n, D_i \quad 3$$

Where, D_i is a dummy variable that takes a value of 1 if the intervention occurred or 0 otherwise. According to Cameron and Trivedy (2005), for a given intervention, it is the effect of a change in D_i on y_i, holding a vector of x_i constant which is of interest. In this case, the outcome y_i is compared to the treated and non treated states from the same population.

4.4 Counter-factual

This study creates a counterfactual from the non treated group. That is, it assumes that in absence of the subsidized fertilizer, the maize yields per acre for the households that received the subsidy (the treatment group) would have been equal to the average maize yield per acre of all the households that did not receive the subsidy (comparison group). The average maize yield per acre for the households that did not receive the subsidy is equal to the total maize production of those households divided by their total cultivated land.

For each household, yield increase attributed to subsidized fertilizer is the product of that household's acreage and the difference between the actual maize yield per acre and average maize yield per acre of the households that did not benefit from the subsidized fertilizer.

4.5 Confounding Factors

In order to ascertain that the observed differences in maize yields are not being influenced by factors other than application of fertilizer, the study has accounted for the most likely confounding factor i.e. average land holding between those who used fertilizer and those who did not. The study also accounts for income differences between the two groups of households due to participation in other interventions.

4.6 Analytical Framework

The first step in evaluating the impact of the AISP involves establishing whether there are statistically significant differences in yield between those who used subsidized fertilizer and those who did not. Descriptive statistics are used to establish this. The second step involves the use of partial budgets to calculate the net returns of subsidized fertilizer application. A partial budget looks at only the costs and returns that have changed as a result of fertilizer application. The calculations involved can be summarized as below:

$$Net\ \text{Re}turns_i = (Y_i * P_o) - (F_i * P_F) - OTH_i,\ i = 1.....n \qquad 4$$

Where, Y_i is household i^{th} yield increase attributed to subsidized fertilizer; P_o is the price of output; F_i is household i^{th} quantity of fertilizer used; P_F is the price of fertilizer; OTH_i are household i^{th} costs of acquiring, applying fertilizer, and harvesting the additional yield.[9].

The third step involves conversion of households' net returns into net returns per adult equivalent by dividing the net returns by the appropriate households' adult equivalents. Lastly, since the survey income values are obtained "with" the subsidy, to obtain the "without" scenario for the households which benefited, the net returns in adult equivalents are subtracted from the survey disposable income per adult equivalent values.

[9] All beneficiaries received 1*50kg bag of fertilizer at MK850.00. Since the additional yield due to subsidized fertilizer is not known to the farmer, the costs associated with that yield could not be quantified. Y is in kilograms (kg) and the cost of a 50 kg bag of maize at harvesting season during which time many farmers sell their maize to vendors was estimated at MK20/kg.

Household disposable income per adult equivalent is defined as the money income remaining to a household after it has met its food energy requirements, divided by that household's adult equivalents. Calculating the household's disposable income per adult equivalent is a three step procedure as follows:

1. The household food energy requirement is calculated as the sum of individual requirements of household members using United Nations (World Health Organisation, 1985) values. Averaged over a population typical of developing country, this approximates to 2010kcal/person/day.
2. In the case of a deficit in food production, we first establish the:
   (i) The food energy which the household needs to purchase to meet its requirements; this is equal to the calculated household food energy requirement minus the food energy produced and consumed by the household.
   (ii) then calculate the household disposable income which is equal to household money income minus the cost of food energy to be purchased from (i).
3. The calculated disposable income for each household is then standardized by the number of adult equivalents in the household i.e. the food requirement of the household per an adult food requirement (average energy requirement of a young and young female adult which is equal to 2600kcal/day.

To investigate whether the fertilizer subsidy input is associated with an increase or decrease in food security, the study compares the proportion of households below the food threshold "with" and "without" the subsidy. The food threshold, distinguishes between households that are food poor and those are food sufficient. The proportions of households falling below the thresholds represent the ultra poverty rate. The goal is to find out whether or not the proportion of households falling below the food threshold differ in the "with" and "without" the subsidy scenarios.

A standard of living threshold (SOLT) differentiates between households that are able to satisfy not only their food needs but also a set of goods and services which define social inclusion in a particular place and at a particular time. The items that constitute social inclusion in developing countries mostly include soap, fuel, utensils and salt which are

allocated by household and, replacement clothes and, school costs which are allocated per person and take into account age and sex. The proportion of households falling below the SOLT represents the village poverty rate. The objective is to find out whether or not the proportions of households below the SOLT differ in the "with" and "without" the subsidy scenarios.

Similarly, an investigation of the targeting efficiency of the program compares the proportion of households below and above the SOLT "without" the subsidy.

4.7 Simulation

4.7.1 Two Hundred and Fifty Percent (250%) Maize Price Increase

The study simulates the effect of an increase in the selling price of maize that comes about due to seasonal variations. One 50kg bag of maize costs at MK1, 000. 00 during harvesting season but the same bag costs MK2, 500.00 during traditional hunger months of November to February, representing a 250% price increase. Suppose that households were patient enough to wait for this price increase before selling their maize production, how would this affect their income? The operation is executed by adjusting the price of maize from MK20.00/kg to MK50/kg.

4.7.2 One Hundred Percent (100%) Coverage of the Village with Subsidized Fertilizer

The study also simulates a scenario where all rural farming households benefited one 50kg bag of fertilizer. What would be the impact of 100% coverage of the village on household poverty and food security? The simulation is based on the following assumptions.

1. The average yield per acre without the subsidized fertilizer is 107.17kg for all households.
2. Suppose that as a result of applying subsidized fertilizer, the seven households that were left out from the programme achieved an average yield equal to the average yield

achieved by the twenty five households that benefited from the subsidy. That is, we assume that fertilizer application increases the maize yield of the seven households to 322.52kg/acre.

We proceed to calculate the net returns as indicated in Appendix 2. In this case, the "simulated 100% coverage" disposable income per adult equivalent is the sum of net returns per adult equivalent and the without subsidy disposable income per adult equivalent as calculated in Appendix 1.

4.8 Some Methodological Issues

Poverty measures involve three steps: choosing a quantitative welfare indicator: choosing a means of discriminating between the poor and non poor through use of a poverty line and finally aggregating this information into a poverty measure for a particular population (Dercon, 2005a).

Consumption expenditure and income can alternatively be used as welfare indicators in assessing poverty. Most studies in the developing countries prefer consumption expenditure over income on the basis that the former tends to be smoother and more reliable than the latter. This is said to be particularly true in rural societies where much income is self produced in the form of agricultural goods and it is difficult to assign income values to these enterprises (Murkherjee and Benson, 2003). In this study we use disposable income per adult equivalent[10] as a measure of welfare. This approach has an advantage over per capita income or consumption measures since it takes into accounts sex and age differences among household members and therefore it normalizes consumption by taking into account household composition. Presenting the results in terms of disposable income per adult equivalent is also a standardization method that

[10] Disposable income per adult equivalent is the money income left to a household after it has met its food needs divided by that household's adult equivalents.

The adult equivalents are computed on the basis of energy requirements by age and sex.

allows the income of individual households to be directly comparable and household income to be set against a standard of living threshold (SOLT) i.e. the cost of a standard package of non-food goods, in this case set at a level commensurate with social inclusion.

In IHM, there are two standard of living thresholds (SOLTs). The first SOLT, defined by the zero line, distinguishes between households that are food poor and those are food sufficient. A second SOLT defines a set of goods and services which a household should be able to afford after it has met its food needs. The aim is to establish the set of services which define 'social inclusion' in that place and their price. This information can be obtained either from key informants or by interviewers gathering a basic set of expenditure data from a subset of households. The items that constitute social inclusion in developing countries mostly include soap, fuel, utensils and salt which are allocated by household and, replacement clothes and, school costs which are allocated per person and take into account age and sex.

CHAPTER 5

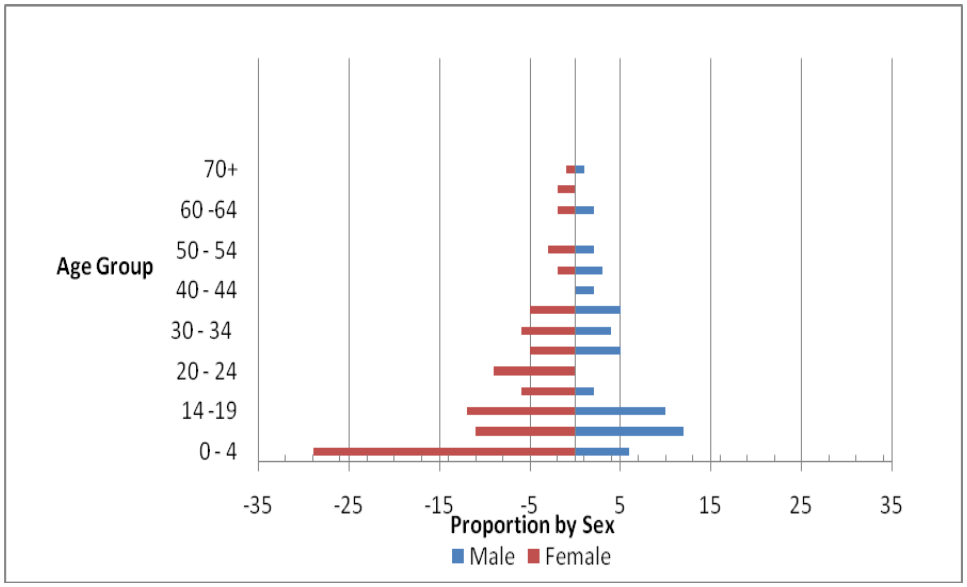
RESULTS AND INTERPRETATION

5.1 Introduction

This chapter presents and interprets the results of the descriptive as well as the IHM analysis following the methodologies explained in chapter four.

5.2 Demographic Characteristics

Figure 1: Population Pyramid



Source: Kamanga, 2010

The 32 households that were identified and enumerated had a total population of 147 persons. The age and sex distribution of the population is shown in Figure 1. The male to female ratio of 37:63 deviates from the national ratio of 49:51 (GoM, 2005). Further, the figure shows that the population is young with 53.8% being less than or equals 15 years old and 65.5% of the population being at least 25 years old.

The average household size consists of 4.59 persons (std. dev. 1.9; range, 1 – 8) which resembles the national figure of 4.5 persons and rural figure of 4.6 persons per household.

The high proportion of people at the base of the pyramid translates into a dependency ratio of 1.52 (Dependents include all children aged 16 years old and below and, all adults aged 70 years and older) which is higher than the national ratio estimated at 1.1. This implies that in Chisanje I village, there are 0.52 more economically inactive persons for every economically active person. The poorest income group (quintile 1 in Table 2) has an average household size of 6.14 and dependency ratio of 2.36 while that of the richest income quintile are 4.5 and 1.29 respectively. In terms of demographic characteristics therefore, poor households mostly have large households with higher dependency ratios. This may suggest that household size and dependency ratio tend to be related inversely to household disposable income per adult equivalent.

Table 1: Summary statistics for demographic variables

Variable	Population Mean	Standard Deviation	Minimum	Maximum
Dependency Ratio	1.52	1.16	0	6
Household Size	4.59	1.9	1	8

Table 2 Average Dependency ratio, Age and Household income by income quintile

Variable	Quintile 1= poorest	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Dependency Ratio	2.36	1.36	1.92	0.56	1.29
Household Size	6.14	3.86	5.17	3.17	4.5

5.3 Household Assets

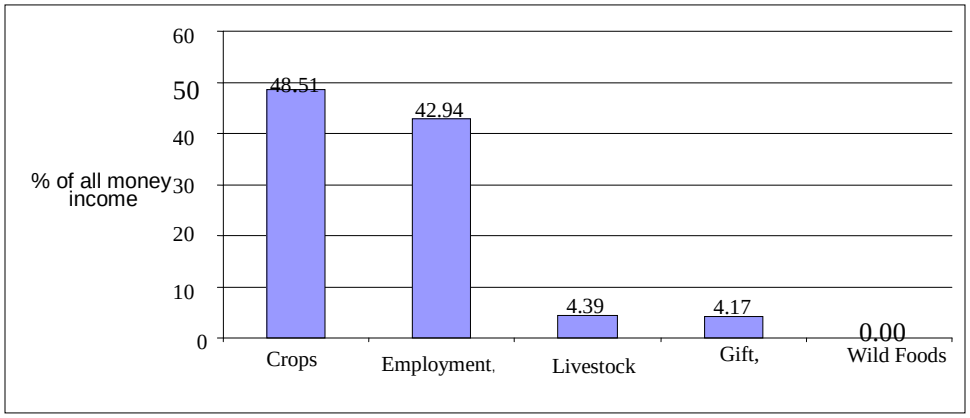
Table 3: Household Asset Holding by Type and Income Quintile

Asset Type	Quintile 1= poorest	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Land (Acres)	2.05	2.51	2.07	3.14	3.67
Poultry (units)	10.29	7.57	18.83	3.50	5.50
Fish Pond (units)	0.00	0.36	0.33	0.17	0.17
Livestock (Units)	0.86	0.71	1.67	2.67	2.13
Other (Units)	1.71	1.00	2.50	3.33	2.33

Table 3 indicates that on average, household holding of assets tends to positively correlate with disposable income per adult equivalent except for poultry. More importantly, the richest income group has 1.62 acres more land on average than the poorest group. It also has 1.27 more livestock on average than the poorest income group.

5.4 Household Income Sources

Figure 2: Percentage contribution of different sources to total village income



Source: Kamanga, 2010

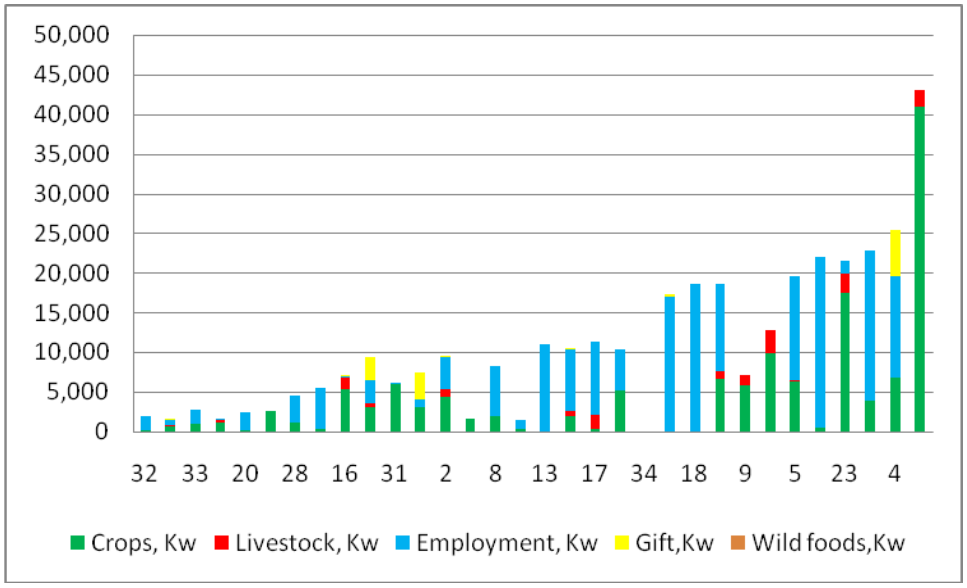
Figure 2 shows the relative importance of the different income sources. Households derive 48.5% of their cash income from production and sale of crops, followed by employment (43%), while the remainder is obtained from sale of livestock and livestock products (4.4%) and from gifts and remittances (4.2%). This means that almost 53% of rural household cash income is obtained from direct agricultural production and therefore indicates the importance of agricultural activities in rural livelihoods.

Moreover, it is evident from Table 4 that the richest income group gets the highest percentage share of the village's total crop income and livestock income at 62% and 35% respectively. This further confirms the importance of agriculture in rural welfare. It is not surprising therefore that the richest household in the village gets the highest cash income from the sale of crops (Figure 3).

Table 4: Percentage distribution of income from different sources by income quintile

	Quintile 1= poorest	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Crops, MK	4.4	13.0	8.8	11.8	62.0
Livestock, MK	3.3	18.7	18.8	24.1	35.2
Employment, MK	6.6	7.3	27.4	24.9	33.8
Gift, MK	2.0	58.3	1.5	3.9	34.3
Wild foods, MK	0.0	0.0	0.0	0.0	0.0

Figure 3: Contribution of different sources to household cash income

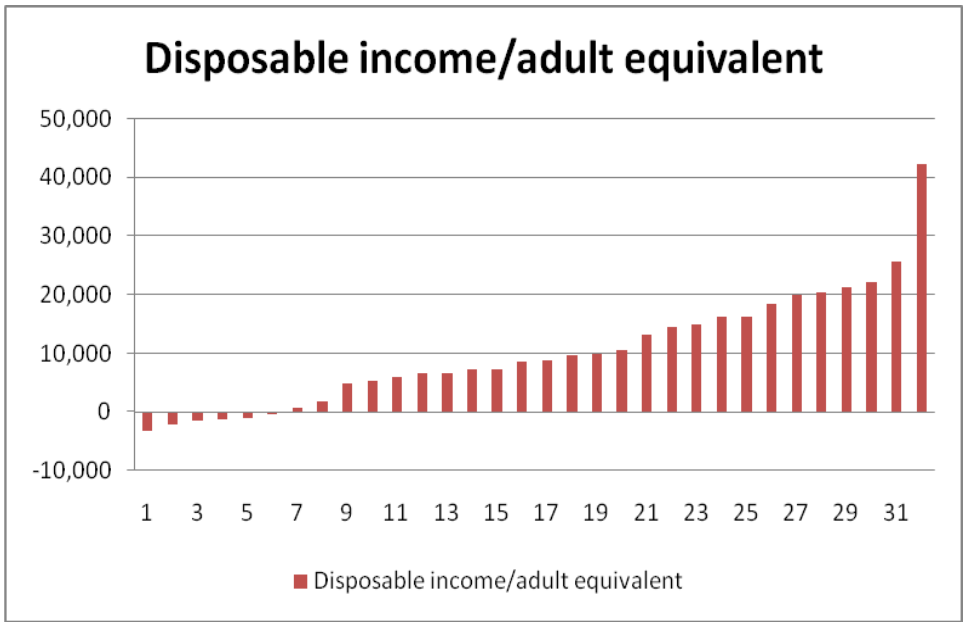


Source: Kamanga, 2010

5.5 Household Disposable Income

Figure 4 shows the households' disposable incomes per adult equivalent. The study indicates that 18.75% of the households are unable to meet their food needs, that is, they are ultra poor. Further, figure 5 indicates that the poverty rate is 28.13%, implying that 71.88% of the households are able to meet both their food and non food requirements.

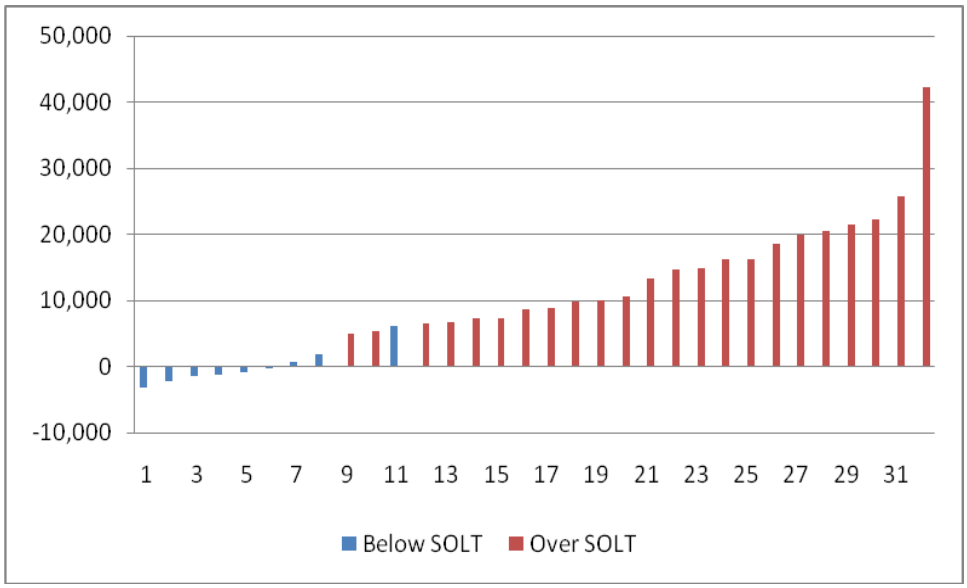
Figure 4: Household Disposable income per adult equivalent showing households below the "food requirement" threshold



Source: Kamanga, 2010

Moreover, the income inequality in the village is serious. The implication is that households in the poorest income group survive on less than the recommended kilocalorie food energy requirement and without consumption of some basic necessities.

Figure 5: Household disposable income per adult equivalent showing households below and above the SOLT

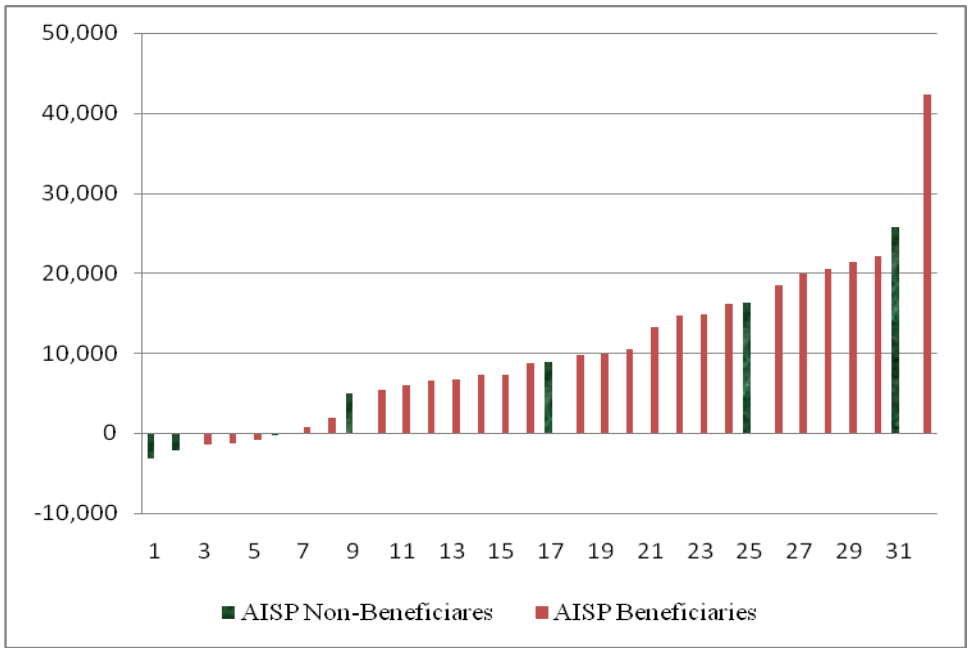


Source: Kamanga, 2010

5.6 Distribution of the Subsidized Fertilizer in the Village

The government's distribution arrangement is such that the targeted households should each receive two 50kg bags of subsidized fertilizer; one for basal and the other for top dressing. However, the village committee distributed one 50kg bag per household. This indicates that the people feel the coverage is not adequate. Through this arrangement, 78.13% of the households in the village benefited one 50kg bag of subsidized fertilizer. The households that benefited and those that did not benefit are indicated in Figure 6.

Figure 6: Household disposable income per adult equivalent showing households benefited and those that did not benefit from the AISP



Source: Kamanga, 2010

A total of 1,250kg of fertilizer was distributed to the village and of this, 98% was used in 61.13acres of upland rain fed maize fields while 2% was used on 1.47 acres lowland maize fields. However our analysis targets usage on upland rain fed maize field category because that is the program's target and 98% of the subsidized fertilizer was used on this land type. The average rate of application is therefore 20kg per acre, which is very little compared to the recommended 100kg per acre.

5.7 Confounding Factors

Table 5: Distribution of upland maize farms and average yield per acre between households that received fertilizer and those that did not

Maize production	**Total area cultivated (Acres)**	**Total prodn (Kg)**	**Average prodn/HH (Kg)**	**Average area cultivated/HH (Acres)**	**Yield (Kg/acre)**
with fertilizer	60.83	14,768.80	590.75	2.43	243.11
without fertilizer	16.98	1,721.25	245.89	2.43	101.19

In terms of average land holding sizes between those that benefited and those that did not benefit from the subsidized fertilizer, we find that both categories had the same average land holding sizes (Table 5). Given homogenous agronomic conditions such as soil type and rainfall patterns and, insignificant use of (money) capital in rural farming, we should expect the maize yields for both categories to be the same. Otherwise, any differences in maize yields between the two categories can confidently be attributed to agricultural inputs that were used by one group and not the other, in this case subsidized fertilizer. We therefore conclude that fertilizer application on average resulted in 140.25% maize yield increase, assuming that the average yield for all households would have been equal to 101.19kg per acre if they did not apply the subsidized chemical fertilizers.

Table 6: Distribution of average income per household from other intervention in the village

	Goat Revenue (MK)	**Fish Revenue (MK)**	**Total Revenue (MK)**	**Average/ HH (MK)**
with fertilizer	6,000.00	17,000.00	23,000.00	920.00
without fertilizer	3,000.00	0	3,000.00	428.57

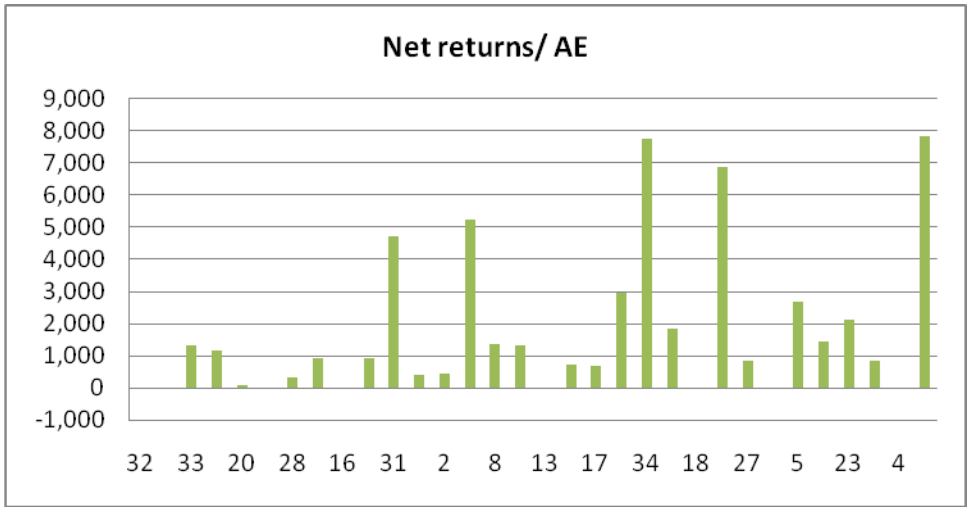
Table 6 indicates that households that used subsidized fertilizer obtained 2.1 times as much income from other sources in the village as the households that did not use

subsidized fertilizer. This implies that the income differences between the two categories of households are also a reflection of the impact of other interventions in the village. Consequently it is necessary to net out the impact of the subsidy programme on the households' disposable income because not all the income differences between the two categories can be attributed to the subsidy programme.

5.8 Impact of the Agricultural Input Subsidy on the Poverty Profile

Appendix 1 indicates the calculations of incremental incomes arising from application of fertilizer on rain-fed maize fields.

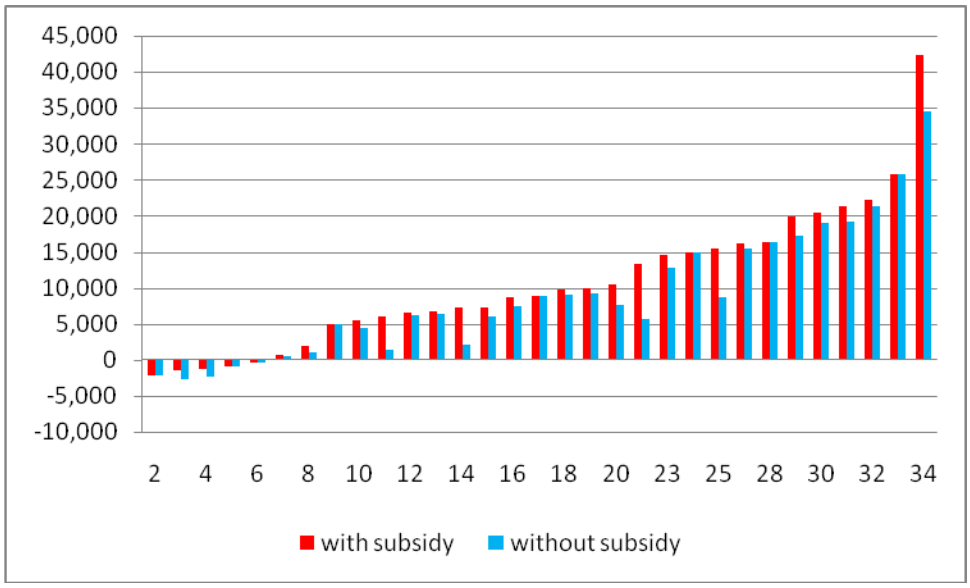
Figure 7: Net returns per adult equivalent from maize production



Source: Kamanga, 2010

Figure 7 clearly indicates that all households that benefited from the subsidized fertilizer consistently experienced positive net gains on their disposable incomes per adult equivalent. Moreover, the households benefited differently from the subsidy irrespective of their initial relative position on the income distribution. Consequently, the distribution of households by disposable income per adult equivalent changed such that some households became wealthier relative to other households as a result of the subsidy. Figure 8 which show the distribution of disposable income per adult equivalent in the village *with* and *without* the subsidy, captures this observation more clearly.

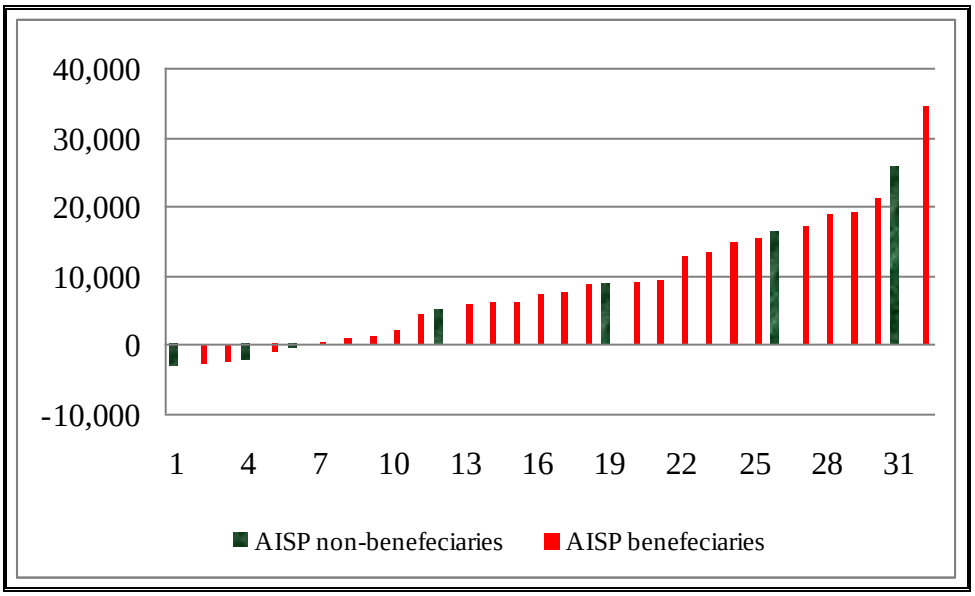
Figure 8: Disposable income per adult equivalent with and without the subsidized fertilizer



Source: Kamanga, 2010

Figure 9 arranges the households' disposable income per adult equivalent *without* the subsidy in ascending order and identifies households that benefited and those that did not benefit from the subsidy programme. Notable from this analysis is the fact that 50% of the ultra poor households and, 84.62% of the non food poor households received the subsidized fertilizer. This clearly indicates that the distribution of the subsidized fertilizer is biased against the ultra poor households.

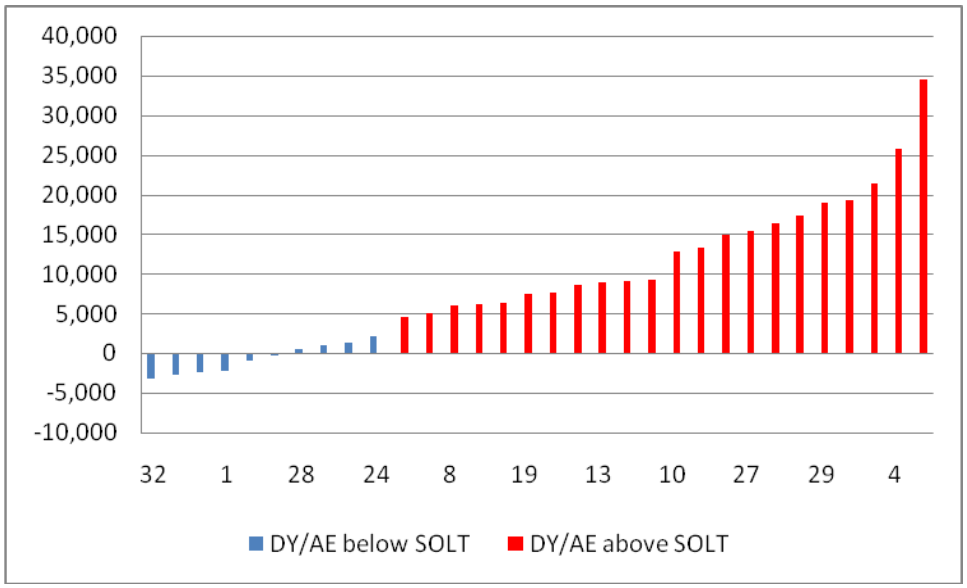
Figure 9: Disposable income per adult equivalent without the subsidy showing the initial income status of the households



Source: Kamanga, 2010

Furthermore, considering Figures 9 and 10 together indicates that the proportion of the poor households that benefited from the subsidized fertilizer was even much lower, estimated at 30% while the proportion of non poor that benefited is 81.82%. The distribution of the subsidized inputs in rural areas is therefore biased against the poor households.

Figure 10: Disposable income per adult equivalent showing households below and above the food and SOLT thresholds without the impact of the subsidy



Source: Kamanga, 2010

Figure 10 further indicates that the incidence of ultra poverty in the village was not affected by the input subsidy as it remained at 18.75% with and without the subsidized fertilizer. However, the incidence of poverty declined from 31.25% without the subsidy to 28.13% with the subsidy. This observation conforms to the design structure of the programme since it was not designed to reach the poorest farm households as it was felt that the 100kg of fertilizer distributed per household was too much to be used effectively on small land holdings typical of such households. The programmes potential to reduce poverty is thus limited by its design constitution and therefore, there is need for the policy makers to employ other social safety nets that would enable the ultra poor households to escape poverty.

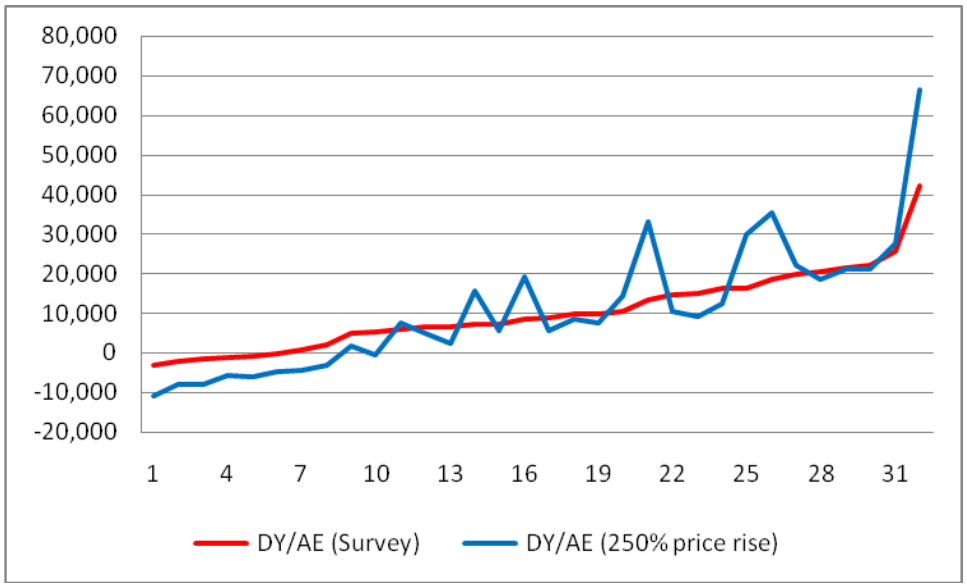
5.9 Simulations

5.9.1 Scenario I: A 250% Increase in the Price of Maize

Many smallholder farmers sell their maize when producer prices are low rather than waiting for prices to rise, as they inevitably do during the cultivating season when maize is scarcer. It is often the case that in the absence of other forms of cash income, the smallholders will have no other options than to sell the maize early in order to meet other household expenses. A farmer with readily available cash income, on the other hand, is able to wait and take advantage of higher prices later in the season. In addition, it is more profit maximizing for the maize vendors to buy the local supply of maize while prices are low and resell it when prices go up. As a result we observe a pattern whereby rural smallholder households are forced to sell maize at prices as low as MK20/kg and buy the maize back from the vendors when the prices have risen to as much as MK50/kg, representing a 250% price increases.

From Figure11, we can conclude that increasing the price of maize by 250% makes some households generally poorer and other households richer than before. Three groups of households are discernable in terms of the way the price rise impacts them. The first group of households consists of those that were initially food insecure. The effect of the price rise on these households is such that their food insecurity situation worsens, as indicated by the widening of the gap between the zero line and DY/EA (250% price rise) line. This is the result of households reduced capacity to purchase supplementary maize which is needed to cover their kilocalorie requirements.

Figure 11: Comparison of DY/AE before and after a 250% rise of maize price

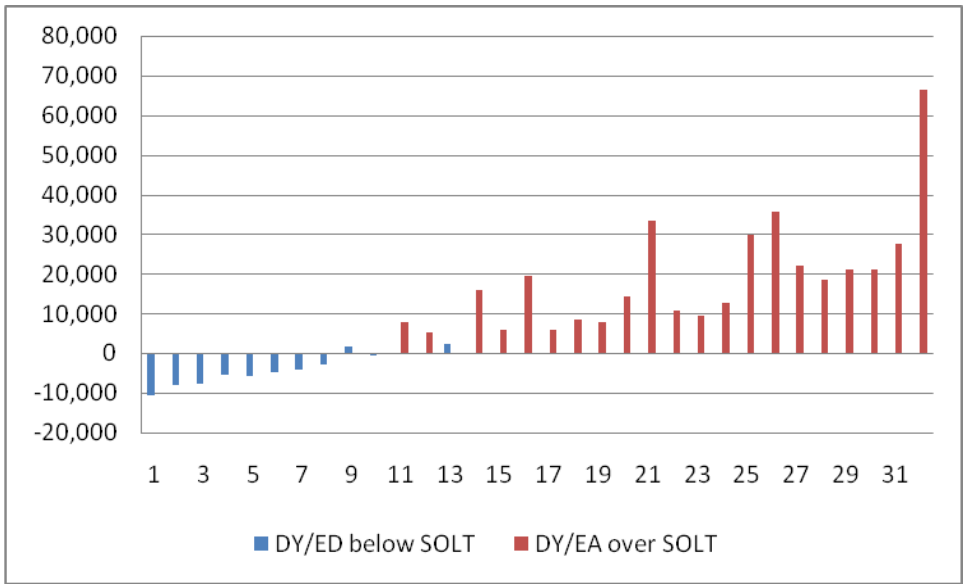


Source: Kamanga, 2010

The second group of households is that which still manages to maintain positive but less disposable incomes per adult equivalent after the price rise. This group of households is characterized by own maize production levels that are less than their household food energy requirements. However, unlike the first category, these households are able to acquire the deficit through purchases on the market using alternative resources. Hence the drop in their disposable incomes per adult equivalent reflects the increased budgets they have to incur in order to acquire their supplementary food needs.

The third category of households is food surplus and hence consists of suppliers of maize in the market. These households gain from the price increase because they now sell the surplus at a higher price than previously. Consequently their disposable incomes per adult equivalent are greater than they were previously.

Figure 12: DY/AE showing households below and above the food and SOLT after the price rise



Source: Kamanga, 2010

Moreover, Figure 12 indicates that price increase seems to be associated with worsening poverty in the village. Whereas incidences of ultra poverty and poverty before the price rise were 18.75% and 28.13% respectively, the price rise has resulted in greater incidences of ultra poverty and poverty to 28.1% and 34.4% respectively[11]. Some households that managed to cover up their food requirements using incomes from other sources joined the ranks of the ultra poor because their disposable incomes suddenly became insufficient to purchase the supplementary maize. Other households on the other hand, had to spend more of their disposable income in order to purchase the same amount of supplementary maize as before such that the disposable income left to the households were not enough to meet other essential needs.

This means that low maize prices benefit the poor and therefore, may provide one reason for the policy makers to consider carefully the implementation of price liberalization on maize, at least in the village under investigation. An appropriate rural policy response to maize price increases might centre around two objectives: moderating price increases

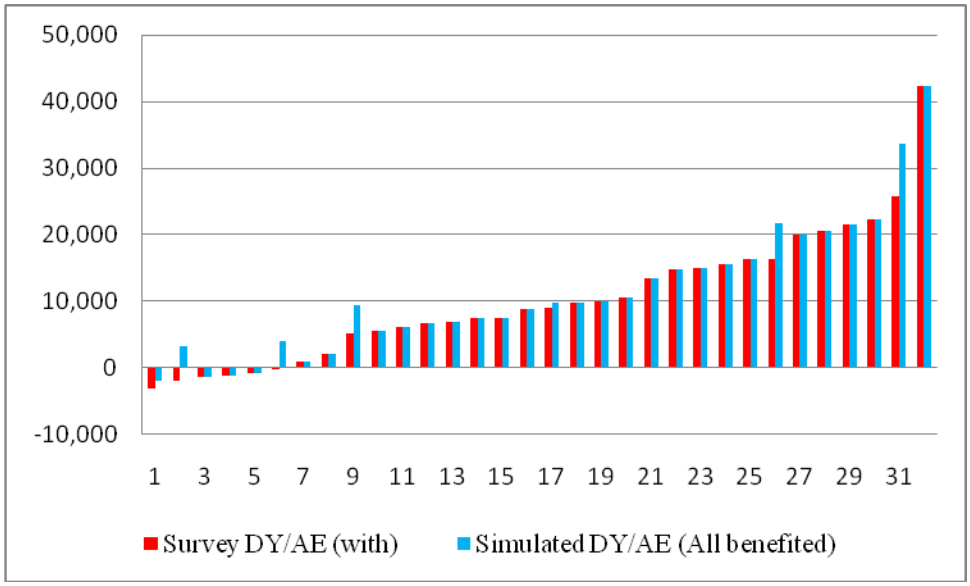
[11] One household that is both ultra poor household has disposable income per adult equivalent of MK(–549) which is not observed on the graph due to scaling.

which may be achieved through price ceilings to prevent seasonal wide swings in maize prices; and strengthening other social protection interventions through mechanisms such as food for work and social cash transfers to avoid the most harmful coping strategies such asset depletion.

5.8.2 Scenario II: 100% Coverage of the Village with the Input Subsidy Programme

Assuming that government does not face stringent cash constraints and that its input subsidy program is strictly motivated by the objective of improving household food security and income, we next consider a scenario where at least one coupon is extend all rural farming households. The scenario is synonymous to 100% coverage of the village such that each household receives one coupon worth one 50kg of fertilizer.

Figure 13: Comparison between survey values and 100% coverage values of DY/AE



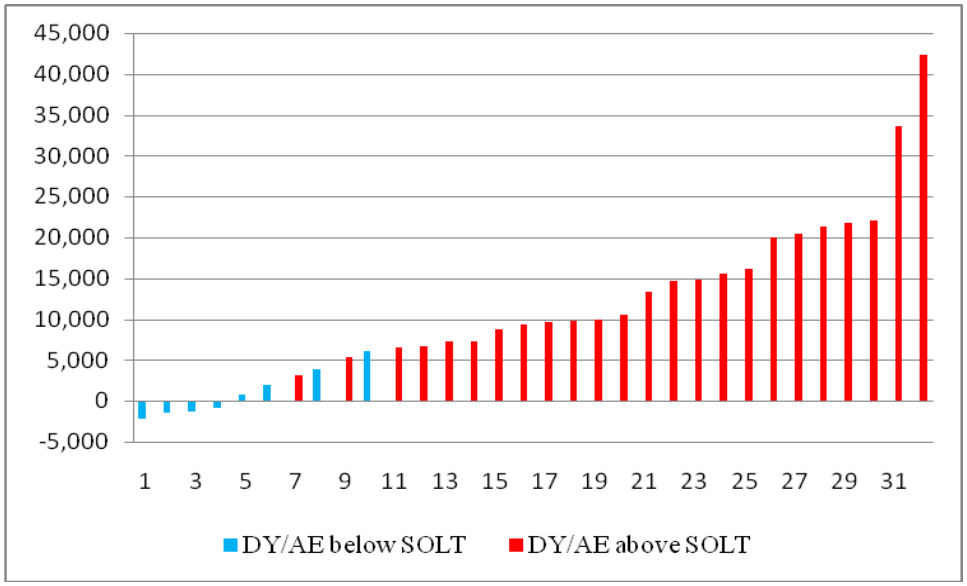
Source: Kamanga, 2010

In figure 13 we observe that four of the households that did not previously participate in the programme and had disposable incomes above the zero line experience improvements in their disposable incomes per adult equivalent; two households that were unable to meet

even their food requirements are now able to consume some household essentials whereas one household has reduced its food deficit.

Moreover, we observe that 100% coverage of the village reduces the incidences of ultra poverty and poverty rates from the survey (observed) values to12% and 25% respectively (Figure 14).

Figure 14: Welfare impact of 100% coverage of the village



Source: Kamanga, 2010

These are substantial reductions which suggest that the government should reconsider its decision of leaving out from the programme the bottom 20% of producers on efficiency grounds. Including this category of households in the programme will make it more aligned with its objective of reducing poverty.

CHAPTER 6

CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1 Summary

The study set out to achieve three objectives namely, to determine whether or not AISP is associated with poverty reduction, to find out the impact of the subsidy program on food security, and how efficiently the programme targets the intended beneficiaries. To achieve these objectives, a village in rural Zomba consisting of 34 households was enumerated. The sample consisted of 25 subsidized farmers and 7 non-subsidized farmers, while two households were declared null and void because they did not meet the inclusion criteria. The paper employed the Individual Household Modeling (IHM) approach to determine the three objectives.

Our empirical results indicate that the introduction of agricultural input subsidies in the village surveyed contributes to decreasing incidence of poverty but does change the incidence of ultra poverty. The incidence of poverty was higher (31.25%) in the village when the income values were analyzed without the subsidy than with the subsidy (28.13%). However, the incidence of ultra poverty remained constant at (18.75%) with and without the subsidized fertilizer. Perhaps, for this village, direct income assistance to the poor, in the form of fertilizer subsidies, seems to be necessary as the basis for them to increase their incomes and improve their living conditions.

Although the study found that the intervention is overall household poverty reducing, comparison of the proportion of poor and non poor households that benefited from the subsidy programme indicates that the programme is biased to higher income households. For instance, one third of the poor households benefited from the intervention compared to over four fifth of the richer households. This clearly indicates that the intervention achieves its objective in terms of the targeted programme beneficiaries. However, leaving out the poorest of the poor households from the programme limits its effectiveness as an instrument of poverty reduction. This explains why the ultra poverty rate remained constant with and without the subsidy. In other words, the input subsidy programme does

not have an impact on food security situation of the poorer households. Food insecurity further deepens poverty, not just in terms of negative nutritional effects on health due to less kilocalorie intake, but also through the use of impoverishing coping mechanisms such as asset sale which make it harder for households to lift themselves out of the poverty trap.

Also, simulation of a 250% rise in the price of maize indicates that increasing the price of maize is associated with worsening incidence of both ultra poverty and poverty. Increasing the price of maize has a negative effect on the disposable income of staple-food deficit households. This is so because such households have to spend more of their money income on maize purchases in order to achieve households' food requirements. Hence the ultra poverty rate increased from 18.75% to 28.13% while the poverty rate increased from 28.13% to 34.4%.

On the contrary, 100% coverage of the village seems to be more favourable in terms of reducing the incidences of both ultra poverty and poverty rates in the village. This suggests that the input subsidy programme would be more effective if it were implemented on similar principles as the Starter Pack Programme. That is, the programme should target all rural farming households with one 50kg bag of fertilizer distributed to all rural farming households.

6.2 Policy Recommendations

There are several policy recommendations which can be drawn from this study, basing on the on foregoing conclusions.

First, it is a must for policy makers to continue with policies aimed at income redistribution and farmer support since these policies are effective in overcoming rural poverty and achieving distributive objectives. However, these policies should be designed to ensure the maximum effectiveness of the instruments. For example, policy makers may consider redesigning the AISP such that the package which consists of 100kg of fertilizer and 5kg of hybrid maize seed should be distributed to all rural farming households except

estate farmers. Such an undertaking is feasible considering that the 2005/06 AISP covered all farming households including estate farmers. Alternatively, policy makers should experiment with cutting down on the quantity of fertilizer by half and extending the subsidy to more smallholder farmers especially those on the lower end of the income distribution. As it is, the programme exacerbates rural income inequality.

Economic strategies such liberalization of the agricultural produce market should be carefully implemented especially where demand for the produce is inelastic, as is the case with maize in Malawi. Liberalization should be undertaken partially and with consideration to Government's social obligations. It seems that policy makers should continue intervening by setting price ceilings, that is, it should be setting minimum producer prices and maximum vendor prices in order to protect both the producer from extremely low producer prices that makes it unprofitable to grow maize, and the consumer from an oligopolistic maize-market structure that exists during the hunger months. Moreover, such a policy would reduce uncertainty that arises from variations in the input-output ratio and would therefore improve fertilizer adoption by smallholder farmers.

Moreover, policy makers should resolve to strengthen other social protection interventions such as the Public Works Programmes and Social Cash Transfers in order to reach out to the poorest households which are left out from the fertilizer subsidy programme. Otherwise the most vulnerable households will continue to engage in the most harmful coping mechanisms such as asset depletion which exacerbate their poverty condition. As the poverty status of households worsens, they become more marginalized in terms of information transmission and participation in other income generating activities. This explains why households that participated in the AISP obtained twice as much income from other external sources as the households that did not. Consequently such households find themselves in a vicious circle of poverty from which they may not extricate themselves unless they are deliberately targeted with policy interventions such as direct food and cash transfers.

6.3 Limitations

However, there are limitations to this village survey data which must be acknowledged. First, the data collected in survey area were fixed at only one point in time. Thus, the findings should be interpreted on the basis of the distribution of income by household units at a point in time. Such cross sectional data fails to capture dynamic effects of various risk factors (e.g. droughts and flooding) on production. Second, due to time and financial constraints, data was collected at the household level only and not at the individual level, and as such, the poverty figures obtained from this study refer to household poverty. This makes them incomparable to national poverty figures such the IHS.

6.4 Direction for Future Research

Future studies should be aimed at achieving a time series so that dynamics in household welfare can tracked over time. In addition, there should be effort to capture a baseline scenario in order to facilitate the creation of a counterfactual for each household.

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APPENDICES

Appendix 1: Net Returns and Disposable Income without subsidized fertilizer

	Acres	Yield	Yield per	Average yield/acre	Difference	Y_i	$Y_i * P_o$	$F_i * P_F$	Net Returns	AE	Net Returns/AE	DY/AE	DY/AE
HH	Applied	(kg)	acre	(without)	(per acre)							(with)	(without)
1	5.00	502.50	100.50	101.17	0.00	0.00	0.00	0.00	0.00	4.06	0.00	-2,153.00	-2,153.00
2	2.00	355.00	177.50	101.17	76.33	152.66	3,053.20	850.00	2,203.20	4.92	447.80	6,738.00	6,290.20
3	1.50	400.00	266.67	101.17	165.50	248.25	4,964.90	850.00	4,114.90	4.46	922.62	5,416.00	4,493.38
4	3.50	375.00	107.14	101.17	0.00	0.00	0.00	0.00	0.00	1.98	0.00	25,781.00	25,781.00
5	4.75	1,093.00	230.11	101.17	128.94	612.44	12,248.85	850.00	11,398.85	4.25	2,682.08	19,988.00	17,305.92
6	2.00	350.00	175.00	101.17	73.83	147.66	2,953.20	850.00	2,103.20	2.96	710.54	9,760.00	9,049.46
7	2.50	2,025.00	810.00	101.17	708.83	1,772.08	35,441.50	850.00	34,591.50	4.44	7,790.88	42,325.00	34,534.12
8	1.50	550.00	366.67	101.17	265.50	398.25	7,964.90	850.00	7,114.90	5.23	1,360.40	7,302.00	5,941.60
9	3.00	368.75	122.92	101.17	0.00	0.00	0.00	0.00	0.00	2.44	0.00	16,298.00	16,298.00
10	0.50	429.50	859.00	101.17	757.83	378.92	7,578.30	850.00	6,728.30	3.71	1,813.56	14,633.00	12,819.44
11	2.50	425.00	170.00	101.17	68.83	172.08	3,441.50	850.00	2,591.50	3.15	822.70	22,137.00	21,314.30
12	2.00	290.00	145.00	101.17	43.83	87.66	1,753.20	850.00	903.20	2.27	397.89	6,559.00	6,161.11
13	0.75	81.00	108.00	101.17	0.00	0.00	0.00	0.00	0.00	4.90	0.00	8,908.00	8,908.00
14	1.50	825.00	550.00	101.17	448.83	673.25	13,464.90	850.00	12,614.90	4.27	2,954.31	10,515.00	7,560.69
15	1.00	370.00	370.00	101.17	268.83	268.83	5,376.60	850.00	4,526.60	3.90	1,160.67	-1,263.00	-2,423.67
16	2.50	154.00	61.60	101.17	0.00	0.00	0.00	0.00	0.00	2.56	0.00	4,988.00	4,988.00
17	1.00	270.00	270.00	101.17	168.83	168.83	3,376.60	850.00	2,526.60	3.79	666.65	9,907.00	9,240.35
18	1.00	137.50	137.50	101.17	36.33	36.33	726.60	850.00	-123.40	2.92	-42.26	14,884.00	14,926.26
19	2.50	463.40	185.36	101.17	84.19	210.48	4,209.50	850.00	3,359.50	2.60	1,292.12	8,695.00	7,402.88
20	1.00	160.00	160.00	101.17	58.83	58.83	1,176.60	850.00	326.60	4.83	67.62	-913.00	-980.62
22	4.90	1,087.50	221.94	101.17	120.77	591.77	11,835.34	850.00	10,985.34	1.60	6,865.84	15,532.00	8,666.16
23	2.00	512.50	256.25	101.17	155.08	310.16	6,203.20	850.00	5,353.20	2.52	2,124.29	21,380.00	19,255.71
24	1.50	575.00	383.33	101.17	282.16	423.25	8,464.90	850.00	7,614.90	1.46	5,215.68	7,298.00	2,082.32
25	1.48	170.00	114.71	101.17	0.00	0.00	0.00	0.00	0.00	1.56	0.00	-328.00	-328.00
27	1.50	337.50	225.00	101.17	123.83	185.75	3,714.90	850.00	2,864.90	3.50	818.54	16,206.00	15,387.46
28	1.00	225.00	225.00	101.17	123.83	123.83	2,476.60	850.00	1,626.60	5.29	307.49	747.00	439.51
29	1.00	362.50	362.50	101.17	261.33	261.33	5,226.60	850.00	4,376.60	3.06	1,430.26	20,461.00	19,030.74
30	0.50	235.00	470.00	101.17	368.83	184.42	3,688.30	850.00	2,838.30	3.15	901.05	1,923.00	1,021.95
31	1.50	548.00	365.33	101.17	264.16	396.25	7,924.90	850.00	7,074.90	1.50	4,716.60	6,021.00	1,304.40
32	0.75	70.00	93.33	101.17	0.00	0.00	0.00	0.00	0.00	3.37	0.00	-3,163.00	-3,163.00
33	1.50	552.40	368.27	101.17	267.10	400.65	8,012.90	850.00	7,162.90	5.54	1,292.94	-1,489.00	-2,781.94
34	1.50	468.75	312.50	101.17	211.33	317.00	6,339.90	850.00	5,489.90	0.71	7,732.25	13,315.00	5,582.75

Appendix 2: 100% Coverage of the Subsidy Programme

HH	Acres Applied	Yield (kg)	Yield/acre (Kg)	Average yield/acre (without)	Difference (per acre)	Y_i	$Y_i * P_o$	$F_i * P_F$	Net Returns	AE	Net returns per	Survey DY/AE) (with)	Survey DY/AE (without)	Simulation DY/AE 100% coverage
1.00	5.00	502.50	322.52	101.17	221.35	1,106.73	22,134.68	850.00	21,284.68	4.06	5,242.53	-2,153.00	-2,153.00	3,089.53
2.00	2.00	355.00	177.50	101.17	76.33	152.66	3,053.20	850.00	2,203.20	4.92	447.80	6,738.00	6,290.20	6,738.00
3.00	1.50	400.00	266.67	101.17	165.50	248.25	4,964.90	850.00	4,114.90	4.46	922.62	5,416.00	4,493.38	5,416.00
4.00	3.50	375.00	322.52	101.17	221.35	774.73	15,494.50	850.00	14,644.50	1.98	7,396.21	25,781.00	25,781.00	33,177.21
5.00	4.75	1,093.00	230.11	101.17	128.94	612.44	12,248.85	850.00	11,398.85	4.25	2,682.08	19,988.00	17,305.92	19,988.00
6.00	2.00	350.00	175.00	101.17	73.83	147.66	2,953.20	850.00	2,103.20	2.96	710.54	9,760.00	9,049.46	9,760.00
7.00	2.50	2,025.00	810.00	101.17	708.83	1,772.08	35,441.50	850.00	34,591.50	4.44	7,790.88	42,325.00	34,534.12	42,325.00
8.00	1.50	550.00	366.67	101.17	265.50	398.25	7,964.90	850.00	7,114.90	5.23	1,360.40	7,302.00	5,941.60	7,302.00
9.00	3.00	368.75	322.52	101.17	221.35	664.05	13,281.00	850.00	12,431.00	2.44	5,094.67	16,298.00	16,298.00	21,392.67
10.00	0.50	429.50	859.00	101.17	757.83	378.92	7,578.30	850.00	6,728.30	3.71	1,813.56	14,633.00	12,819.44	14,633.00
11.00	2.50	425.00	170.00	101.17	68.83	172.08	3,441.50	850.00	2,591.50	3.15	822.70	22,137.00	21,314.30	22,137.00
12.00	2.00	290.00	145.00	101.17	43.83	87.66	1,753.20	850.00	903.20	2.27	397.89	6,559.00	6,161.11	6,559.00
13.00	0.75	81.00	322.52	101.17	221.35	166.01	3,320.25	850.00	2,470.25	4.90	504.13	8,908.00	8,908.00	9,412.13
14.00	1.50	825.00	550.00	101.17	448.83	673.25	13,464.90	850.00	12,614.90	4.27	2,954.31	10,515.00	7,560.69	10,515.00
15.00	1.00	370.00	370.00	101.17	268.83	268.83	5,376.60	850.00	4,526.60	3.90	1,160.67	-1,263.00	-2,423.67	-1,263.00
16.00	2.50	154.00	322.52	101.17	221.35	553.38	11,067.50	850.00	10,217.50	2.56	3,991.21	4,988.00	4,988.00	8,979.21
17.00	1.00	270.00	270.00	101.17	168.83	168.83	3,376.60	850.00	2,526.60	3.79	666.65	9,907.00	9,240.35	9,907.00
18.00	1.00	137.50	137.50	101.17	36.33	36.33	726.60	850.00	-123.40	2.92	-42.26	14,884.00	14,926.26	14,884.00
19.00	2.50	463.40	185.36	101.17	84.19	210.48	4,209.50	850.00	3,359.50	2.60	1,292.12	8,695.00	7,402.88	8,695.00
20.00	1.00	160.00	160.00	101.17	58.83	58.83	1,176.60	850.00	326.60	4.83	67.62	-913.00	-980.62	-913.00
22.00	4.90	1,087.50	221.94	101.17	120.77	591.77	11,835.34	850.00	10,985.34	1.60	6,865.84	15,532.00	8,666.16	15,532.00
23.00	2.00	512.50	256.25	101.17	155.08	310.16	6,203.20	850.00	5,353.20	2.52	2,124.29	21,380.00	19,255.71	21,380.00
24.00	1.50	575.00	383.33	101.17	282.16	423.25	8,464.90	850.00	7,614.90	1.46	5,215.68	7,298.00	2,082.32	7,298.00
25.00	1.48	170.00	322.52	101.17	221.35	328.04	6,560.81	850.00	5,710.81	1.56	3,660.78	-328.00	-328.00	3,332.78
27.00	1.50	337.50	225.00	101.17	123.83	185.75	3,714.90	850.00	2,864.90	3.50	818.54	16,206.00	15,387.46	16,206.00
28.00	1.00	225.00	225.00	101.17	123.83	123.83	2,476.60	850.00	1,626.60	5.29	307.49	747.00	439.51	747.00
29.00	1.00	362.50	362.50	101.17	261.33	261.33	5,226.60	850.00	4,376.60	3.06	1,430.26	20,461.00	19,030.74	20,461.00
30.00	0.50	235.00	470.00	101.17	368.83	184.42	3,688.30	850.00	2,838.30	3.15	901.05	1,923.00	1,021.95	1,923.00
31.00	1.50	548.00	365.33	101.17	264.16	396.25	7,924.90	850.00	7,074.90	1.50	4,716.60	6,021.00	1,304.40	6,021.00
32.00	0.75	70.00	322.52	101.17	221.35	166.01	3,320.25	850.00	2,470.25	3.37	733.01	-3,163.00	-3,163.00	-2,429.99