Determinants of Household Food Security in Murehwa District, Zimbabwe

Edgar Muhoyi[1*], Tamuka Joel Mukura[2], Desmond Ndedzu[3], Tendai Makova[4] Onias Munamati[5]

1. Department of Economics, University of Zimbabwe, PO Box MP167, Harare, Zimbabwe

2. Department of Economics, University of Zimbabwe, PO Box MP167, Harare, Zimbabwe

3. Department of Economics, University of Zimbabwe, PO Box MP167, Harare, Zimbabwe

4. Department of Economics, University of Zimbabwe, PO Box MP167, Harare, Zimbabwe

5. Department of Economics, University of Zimbabwe, PO Box MP167, Harare, Zimbabwe

* E-mail of the corresponding author: emuhoyi@gmail.com

Abstract

The aim of the study was to examine the determinants of household food security in agricultural regions which receive normal to above normal annual rainfall using Murehwa District as a case study. A logistic regression procedure was employed on household socio-economic cross-sectional data collected in 2010 (November and December). Of the ten variables fitted in the model; household size, farmland size, farmland quality, climatic adaptation and livestock ownership were found to be significant. Marginal effects showed that households that practised conservation agriculture, had good quality land and those owning bigger farmland and livestock were more likely to be food secure than their counterparts. However, bigger households were likely to be more food insecure than smaller ones. The results confirm the significance of both agro-climatic and socio-economic factors in determining household food security status. These results have important policy implications. Improving access to higher quality farmland through some redistributive land reforms; introduction of livestock restocking programmes at the household level, and encouraging the adoption of farming methods that curb the effects of climate change, can indeed improve the food security status of households.

Keywords: household, food security, logistic regression, Murehwa District

1. Introduction and Background

Since the turn of the millennium, Zimbabwe has failed to meet its annual cereal requirements. Domestic cereal output for human and animal consumption has persistently been either declining or fluctuating below required levels of about 2.2 million tonnes and 400 000 tonnes for maize and wheat respectively (Ministry of Agriculture, Mechanisation and Irrigation Development, 2007). This has resulted in increasing levels of food insecurity at both the national and household levels. The country has been forced to augment domestic production with government and commercial imports as well as food aid from international donors to lessen the impact since the strategic grain reserve was no longer operational. The fall in production has been attributed to the fast-track land reform programme, input shortages due to unfavourable macroeconomic conditions and adverse weather conditions, among others. The multiple challenges have resulted in almost all agricultural regions being adversely affected such that food insecurity has become a nationwide challenge. This state of affairs is threatening the achievement of the Millennium Development Goal of eradicating extreme poverty and hunger by half by 2015.

The subject of food insecurity has attracted attention the world over, given its direct link to malnutrition which leads to poor physical and mental health. According to Collins (2005), food insecurity is linked to acute and chronic physical and mental health conditions such as higher levels of stress, anxiety, irritability, social isolation, heightened emotional responsiveness, eating disorders, depression as well as impaired cognitive abilities. This is harmful to human capital formation as it can ultimately result in low labour productivity. The undesirability of food insecurity due to its negative effect on the livelihoods and economy has prompted governments to commit themselves to achieving food security through food self-sufficiency given the unreliability of imports.

Agriculture is the major source of livelihood for the majority of rural Zimbabweans. Several factors have worked against the growth of this sector resulting in low agricultural productivity and hence food insecurity. Generally, food security in Zimbabwe is synonymous with maize availability. A fall in maize production which is accompanied by inadequate imports means food insecurity in the country. Maize output went down from a peak of more than 2.5 million metric tonnes in 1980 to 1 million metric tonnes in 2007. While commercial farmers dominated maize production before independence in 1980, from 1983 onwards, communal farmers have

contributed more to total national output (Ministry of Agriculture, Mechanisation and Irrigation Development, 2007).

Over the past decade, the frequency of adverse weather conditions has been increasing in Zimbabwe. While between 1980 and 2000 the country experienced only two major droughts (1982 and 1992); since 2000, there were droughts in 2002, 2005 and 2007, and a number of mid season dry spells and floods which led to crop failures in many parts of the country (ZIMVAC, 2006). This led some farmers to adopt conservation agriculture (CA), an approach which promotes soil conservation, improves soil water/moisture holding capacity, and enhances soil nutrients. According to Zvobgo (2010), the number of farmers practicing conservation farming in Murehwa District (Ward 4), had increased from 64 in 2004 to 1 000 in the 2009 farming season.   Furthermore, Zimbabwe experienced a severe economic crisis over the period 1997 to 2008 which was characterized by hyper-inflation; foreign currency, fuel and power shortages; massive unemployment; negative economic growth and an unfavourable balance of payment position. Agro-input companies faced operational challenges leading to input shortages which adversely affected agricultural production.   Most food items and inputs were mainly found on the parallel market where they were sold at exorbitant local prices and in many instances in foreign currency due to hyperinflation. This compromised food availability and affordability leading to food inadequacy.

In an effort to ensure food security, the Government of Zimbabwe implemented the Fast-Track Land Reform Programme (FTLRP) in 2000 meant to facilitate access to productive agricultural land. Magaramombe (2001) asserts that land reform is one of the key instruments for addressing rural poverty and food insecurity. Moreover, various agricultural input and credit schemes such as the Government Input Scheme (GIS), Operation *Maguta/Inala*, Champion Farmer Programme, the Agricultural Support and Productivity Enhancement Facility (ASPEF), Farm Mechanisation Programme, the SADC Input Facility, alongside other donor and NGO initiatives were put in place to allay the input challenges. These had varying degrees of success in terms of addressing the food insecurity challenges.

The harsh economic conditions also led to people engaging in various livelihood activities like casual labour, informal trading and gold panning, among others. Barter trade became the order of the day with many rural households forced to exchange their livestock for maize at unfavourable terms of trade. This led to a massive depletion of livestock which compromised draught power availability.

While most studies have been carried out in arid regions of the country where food insecurity is more pronounced, this study focuses on Murehwa District an area which receives normal to above normal annual rainfall. We argue that food insecurity is not only determined by agro-climatic conditions, but socio-economic factors may also come into play. As such, pockets of food insecure households may be found in areas which are generally considered to be food secure at an aggregated level. The study proceeds as follows: Section 2 looks at the literature review. The methodology is presented in Section 3 while Section 4 focuses on the estimation and interpretation of the results. The final section gives the summary and policy recommendations.

2. Literature Review

Ellis (1993) highlighted the four farm household economic theories that seek to explain peasant economic behaviour. There is the Profit Maximization Theory which treats the household as a farm firm, operating in fully formed and competitive input and output markets. Utility is taken to be solely a function of income, thus utility maximization coincides with profit maximization. The higher the market prices, the more the inputs put into production. The profitability of farming activities thus determines utility maximisation and hence food security.

On the other hand, the Risk Aversion Theory propounds that utility maximization involves a trade-off between higher income and greater security. Uncertainty introduced into the utility function may mean lower input use than is suggested by the Profit Maximization Theory so as to avoid losses which could be incurred due to phenomena like droughts. Households then employ risk management strategies such as climatic adaptation methods and multi-cropping to ensure livelihood stability and food security.

The Drudgery Aversion Theory assumes that no labour market exists for farm households such that they rely entirely on family labour. Household size thus becomes the major determinant of production and consumption, and thus utility levels. Bigger households, with more labour supply, are more likely to be food secure.

Contrary to the Drudgery Aversion Theory, the Farm Household Theories assert that a labour market exists such that farm output may not be the only source of income. Different household members can confront different

market wages and the farm-gate and retail prices may differ, meaning that the sale and purchase of food have different relative price implications for household decisions. This therefore implies that the general economic status can also affect the food security of households as it tends to affect the prices of commodities and the labour market wage.

Several studies have been carried out on the determinants of food security in many different contexts (urban/rural) and levels (regional, national, local) using different variables and methodologies. Some studies focussed on household characteristics such as size and structure; gender, educational attainment and age of household head; and household preferences and tastes as the main drivers of food insecurity (Kidane, 2005; Kabbani, 2005 and Iram and Butt, 2004). However, others looked at economic factors such as income and expenditure (consumption) patterns; food and input prices (Makombe *et al*, 2010, Onianwa and Wheellock, 2006). Access to markets, land, and water; production and marketing infrastructure and also availability of services such as extension have been identified as key to food security (Misselhorn, 2004 and Makombe *et al*, 2010). Bahiigwa (1999) singled out inadequate rainfall, pests and diseases, and excess rainfall as the three main causes of household food insecurity. Issues of land size and productivity, fertilizer application, ownership of cattle (draught power) and production of grains have also come out as key in other studies (Khan and Gill, 2009; Sikwella, 2008; Kidane, 2005; and Bahiigwa, 1999).

The above review makes it clear that both socio-economic and climatic factors seem to have an impact on the food security status of households. However, the dominance of one over the other is chiefly determined by area specific aspects.

3. Data and Methodology

3.1 Sampling and Data Collection

The study utilised cross-sectional data based on a survey carried out in Murehwa District in Mashonaland East between November and December 2010. Murehwa District lies 75 kilometers northeast of the capital, Harare at an altitude of almost 1400m above sea level. It is categorized under agro-climatic Natural Regions II and III, receiving 650mm to 1000mm of rainfall annually. The district has thirty wards, of which two are urban. However, the study concentrated on the rural wards where agricultural activities are the main source of livelihoods. The two-stage cluster sampling procedure was used to draw out three wards from the twenty-eight. Proportional random samples of households were drawn from each ward based on the number of households as reported in the 2002 Zimbabwean census figures. Using the rule of thumb by Roscoe (1975), a sample size of 150 farmers was settled for. A self administered questionnaire was used to collect the data.

3.2 Estimation Procedure

The study employed the Logit Model to estimate the likelihood of a household being food-secure conditional upon a given set of explanatory variables. The model took the following form:

$$food \sec_i = \beta_0 + \beta_i X_i + \mu_i \text{ --------------------------------- (1)}$$

Where:

$food \sec_i$ = food security status of household i

$\beta_0 =$ *constant term*

$\beta_i =$ vector of parameters to be estimated

$X_i =$ vector of the factors determining food security status of household i.

$\mu_i =$ error term which is assumed to be normally distributed

Food security status is the dependent variable taking a value of one if a household is food-secure and zero otherwise. The stock of food available in the household is converted into calories using the International Food Security Policy Research Institute (IFPRI), (2001) conversion. The figure is then compared against the standard

requirements of 2,100 calories per person per day (FAO, 1998). Kidane *et al.* (2005) also used the same method to determine household food security status.

The explanatory variables are; household head age, gender of household head, education of household head, employment status of household head, household size, livestock ownership, farmland size, farmland quality, technology use and climatic adaptation.

Age of the household head is taken as an indicator of experience in agricultural production. Older people are therefore more likely to have more farming experience and hence more output resulting in their families having a lower probability of being food insecure (Uzma and Muhammad, 1995; Romer, 1986; Haile *et al.,* 2005).

Gender of household head is a dummy variable taking a value of one (1) for a male headed household and zero (0) otherwise. According to FAO (1999), lack of access to resources like land, inputs and support services limit the capacity of women to contribute significantly to their families' food basket as compared to males. In this regard, male headed households are expected to be more food secure than female headed ones.

Education is a continuous variable that captures the number of years spend in school. According to Najafi (2003), educational attainment by household heads helps them to quickly adopt new technology and understand farming instructions. It is therefore expected that households whose heads spent more years in school are more likely to be food secure than their counterparts with little or no education.

Employment is a variable which takes a value of one (1) if the household head is formally employed in other sectors of the economy and zero (0) otherwise. Off-farm or non-farm employment helps farmers to diversify and stabilize their incomes, while providing capital for investment in technology and acquisition of critical inputs (Jayne *et al.*, 1994). Being employed is therefore expected to reduce the likelihood of a household being food insecure.

Household size is measured by the number of persons "living at the same address having meals prepared together and with common housekeeping" (Fiegehen and Lansley, 1976: 508-509). Conflicting literature exists on the relationship between household size and household food security. While Solow (1957) asserts that production increases with labour supply implying that bigger households produce more; Lewis (1954) and Fei and Ranis (1961) are of the view that there is surplus labour in developing countries hence the marginal productivity of labour is zero thus making a small household better-off than a bigger one. Nevertheless, most studies (Kabbani, 2005 and Sikwella 2008) have found larger household sizes impacting negatively on household food security status. The same results are expected in this study.

Livestock ownership is a continuous variable that captures the number of cattle owned by a household. Livestock are vital for food security as a source of food (meat and milk) and also as providers of manure and draught power in production (Ndlovu, 1989). In times of drought, households either sell livestock or exchange for cereals, hence they act as an investment for future consumption. Households with more livestock are thus likely to be more food secure than those with less or none.

Farmland size (measured in hectares) captures the size of the land available to the household for food production. Land can be leased in return for food or money thereby increasing the household financial resources thus enhancing access to food. Therefore, households with more land are likely to be more food secure than those with less.

Farmland quality is a variable that captures the fertility of the land taking the value of one (1) if good or zero (0) otherwise. Households with fertile land are expected to be more food secure than their counterparts.

Fertilizer application is taken as a proxy for technology use by a farmer in this study, taking a value of one (1) where a farmer applies fertilizer and zero (0) otherwise.

The practise of conservation agriculture (CA) is used as a proxy for climatic adaptation as it is being practised by some farmers as a way of reducing the effects of droughts (Zvobgo, 2009). The variable takes a value of one (1) where CA is practised and zero (0) otherwise. While studies like Sikwella (2008) used irrigation as a proxy for climatic adaptation in Lupane and Hwange; in Murehwa CA is more common hence we use conservation farming. The practise of conservation farming is expected to reduce the likelihood of a household being food insecure.

The general-to-specific modelling technique was utilised where insignificant variables were dropped one by one until all remaining variables were significant. Marginal effects were also computed to determine the average partial effects of the independent variables on the food security status of households. Marginal effects give the quantitative effects of the determinants of food security status.

4. Results and Discussion

4.1 Descriptive Statistics

From a target of 150 questionnaires, 117 were successfully completed of which 84 were male and 33 were female. Out of this sample, 51.3% were food secure whilst the remainder was food insecure as shown in Table 1.

Food insecurity seemed to be more prevalent in male headed households which were 72% of the sample as shown in Table 2.

While only 33% of female-headed households were food insecure, male-headed households had a higher proportion of 55%. The sample statistics reveal that 35% of the household heads were employed in other sectors of the economy while the remaining 65% solely depended on agriculture. Households dependent on agriculture had a higher prevalence of food insecurity (53%) than those employed outside agriculture (41%). While 69% of the households own good quality land, 37% of these are food insecure suggesting that other soil quality alone does not guarantee food security. However, of the 41% who have poor quality land, 75% are food-insecure. The majority of the farmers, 74% applied fertilizer to their crops showing a high adoption of technology. However, there was not a significant difference in the proportion of those who applied fertilizer and where food-secure (52%) and the food insecure (48%). The proportion between the food-secure and food-insecure was the same for non-users. Almost 70% of the farmers had adopted CA of which 63% were food-secure. Of the non-adopters, 75% were food-insecure.

According to the statistics shown in Table 3, the food-secure households have more land and livestock; have older and less educated household heads but smaller household sizes. These features seem to be in line with literature save for education and age.

4.2 Restricted Logit Model Results

Using the general-to-specific approach; the variables sex, age, employment, education and technology-use were dropped. The results from the parsimonious model are shown in Table 4.

4.2.1 Diagnostic Tests

The Pearson's correlation test showed that there was no evidence of multicollinearity. The Reset Test had a Chi-squared statistic of 0.21 with p-value 0.6497 indicating that the model was correctly specified. The Log-likelihood was equivalent to -51.630229 showing that the model was appropriate for the study. The significant LR Chi-Square statistic of 58.86 with six degrees of freedom means that at least one of the regression coefficients in the model was not equal to zero.

4.3 Marginal Effects Results

Marginal effects were computed to show the quantitative effects that the significant variables have on the food security status among households under study as shown in Table 5.

In line with expectations, household size, had a negative and statistically significant effect on household food security at the 5% level. This means that bigger households are more likely to be food insecure than smaller ones. The marginal effects results review that each additional household member increases the probability of a household being food insecure by 7%. These results are consistent with Kidane, et al. (2005). This may be explained by the fact that bigger households mean more pressure on available food.

The relationship between farm size and household food security is positive and significant at the 5% level as shown in Table 5. An additional hectare owned by a household increases the probability of a household being food secure by about 3%. More land also allows households to practice soil conservation techniques like crop

rotation which enhance yields. In addition those who have more land are likely to rent it in exchange for money or farm produce and this increases their chance of being food secure.

Farmland quality was found to be significant and positively affecting food security at the 1% level. The results show that the likelihood of households with good quality land being food secure is 42% higher than that of households with poor quality land.

Based on results in (Table 5), climatic adaptation was significant at the 1% level and showed that the chances of households which practise conservation agriculture being food secure are 49% higher than their non-practising counterparts. Conservation agriculture mitigates the impact of moisture stress due to erratic rainfall, which increases output and hence food security.

The livestock variable is positive and significant at the 5% level. Ownership of an additional beast increases the likelihood a household being food secure by 3%. This concurs with the results of Sikwela (2005) for a similar study in Lupane and Hwange Districts (dry regions). Livestock is critical for draught power, enabling timely land preparation as well as acting as a store of wealth and source of food (meat and milk).

5. Conclusions and Policy Recommendations

The aim of this study was to find the determinants of household food insecurity in agricultural regions which receive normal to above normal annual rainfall using Murehwa District of Zimbabwe as a case study. Cross-sectional data fitted to a logistic model was used, with a household food security status being the binary dependent variable. The results showed that household size, farmland size, farmland quality, availability of draught power and climatic adaptation had a significant impact on the food security status of households. Household size was found to have a negative relationship with food security while the other four variables had a positive impact on food security. Gender of household head, age of household head, education of household head, employment status of household head and fertilizer application by the household were found to be statistically insignificant in determining the food security status of households.

The results have several policy implications. They show that large households are more vulnerable to food insecurity indicating the need for policy makers to promote family planning since the notion that more children means more labour seems not to hold. There is still need to improve access to quality farmland through land redistribution as it has a significant impact on food security status. While a positive relationship was found between farm size and food security status, access to quality farmland may remove the need to give more land since productivity on a small piece of fertile land may be higher than that on a bigger infertile land holding. The Department of Agricultural Technical and Extension Services (AGRITEX) and other organisations involved in the promotion of CA should intensify their efforts in order to increase climate change adaptation. Draught power remains critical for production hence government and other strategic partners like the Food and Agricultural Organisation should help farmers rebuild their herds to ensure that households do not need to hire oxen for land preparation as this impacts negatively on timeliness. Alternatively, the District Development Fund (DDF) could also be revitalised to provide tillage services to farmers facing draught power challenges. All these efforts will improve the food security status of households.

References

Altman, M. (2009), "Household Food Security Status in South Africa", *Journal of Agricultural Association of South Africa* **48**, 4345-4361

Bahiigwa, G.B.A. (1999), "Household Food Security in Uganda: An Empirical Analysis", Economic Policy Research Centre, Kampala Uganda

Collins, I. (2005), "Impact of Food Insecurity on Women's Mental Health: How It Negatively Affects Children's Health and Development", *Journal of the Association for Research and Mothering*, **11**, 251-262

Ellis, R. (1993), Peasant Economics: Farm Households and Agrarian Development, Cambridge.

Fiegehen, G.C., & Lansley, P.S. (1976), "The Measurement of Poverty", *Journal of the Royal Statistical Society. Series A (General)* **139** (4), 508 – 513.

Fei J.C. & Ranis, G. (1961), "A Theory of Economic Development", *American Economic Review Journal* **51** 533-565

Food and Agricultural Organisation (FAO) (1998), Transitioning Emergency into Rehabilitation and Growth, Rome, Italy

Food and Agricultural Organization (FAO) (1983), World Food Security: A Reappraisal of the Concepts and Approaches, Director General's Report, Rome, Italy

Food and Agricultural Organization (FAO) (2009), The State of Food Insecurity In The World, Rome, Italy

Food and Agricultural Organization (FAO) (2009), FAO/WFP Crop and Food Security Assessment Mission to Zimbabwe, Rome, Italy

International Food Security Policy Research Institute (IFPRI) (2001), Sustainable Food Security for All by 2020, available from, http://www.ifpri.org/pubs/books/2020conpro/2020conpro.pdf

Iram U & Butt M (2004) "Determinants of Household Food Security, An Empirical Analysis of Pakistan", *International Journal of Social Economics* **31** (8)   753-766

Jayne T.S., Tschirley D.L., Staatz J. M., Shaffer J. D., Weber M. T., Chisvo M., & Mukumbu M. (1994), Market Oriented Strategies to Improve Households to Food Experience from Sub-Saharan Africa, MSU International Development Working Paper No 15, Department of Agricultural Economics Michigan State University

Kabbani, N. & Wehelie, Y. (2005), "Survey Results on Hunger and Food Insecurity in Yemen," Topics in Middle Eastern and North African Economics: Proceedings of the Middle East Economic Association **7**

Kidane H, Alemu Z, G & Kundlhande G (2005), "Causes of Household Food Security in Koredegaga Peasant Association, Oromiya Zone"*, Ethiopia Agricultural Economics Journal* **4**, 543-560

Khan, R.E.A. & Gill, A.R. (2009), Determinants of Food Security in Rural Areas of Pakistan. Munich Personal RePEc Archive (MPRA)

Lewis, W.A. (1954), "Economic Development with Unlimited Supplies of Labour", *The Manchester School* **22** (2), 139-191

Magaramombe, G. (2001), "Rural Poverty, Commercial Farm Workers and Land Reform in Zimbabwe" , Paper Presented At The SARPN Conference on Land Reform and Poverty Alleviation, South Africa, Pretoria.

Makombe T., Lewin, P. and Fisher, M. (2010), "The Determinants of Food insecurity in Rural Malawi: Implications for Agricultural Policy", *International Food Policy Research institute*, Policy Note 4.

Ministry of Agriculture, Mechanisation and Irrigation Development (2007), "Agricultural Statistical Bulletin".

Missehorn, A. (2004), "What Drives Food insecurity in Southern Africa: A Meta Analysis of Household Economy Studies", *Journal of Global Environmental Change*, **15,** Pp 33- 43.

Najafi, B. (2003), "An Overview of Current Land Utilization Systems and Their Contribution to Agricultural Productivity", Report of The APO Seminar on Impact of Land Utilization Systems on Agricultural Productivity, Productivity Organization, Islamic Republic of Iran Asian.

Ndlovu, L.R. (1989), "The Role of Livestock and Small Ruminants in Promoting Food Security", Department of Agricultural Economics and Extension, University of Zimbabwe.

Onianwa, O.O. and Wheelock, G.C. (2006), "An Analysis of the Determinants of Food Insecurity with Severe Hunger in Selected Southern States", *Southern Rural Sociology*, **21**(1), 80-96.

Romer, P. (1986), "Increasing Returns and Long Run Growth", *Journal of Political Economy* **94**, 1002-37.

Roscoe, J.T. (1975), Fundamental Research Statistics for the Behavioral Sciences, Second Edition, New York.

Holt, Rinehart and Winston in Sekeran, U. (2003), "Research Methods for Business: A Skill-Building Approach", Fourth Edition, New York: John Wiley & Sons, Inc.

Sah, R.P. (2002), "Sustainable Livelihoods and Poverty Alleviation: Case Study in Improving Food Security and Livelihood of Mountain People Through Development of Agriculture", A Paper Presented at The International Seminar on Mountains (ISM) Kathmandu, Nepal March 6-8 2002, Agricultural Research Station Lumle, Kaski, Nepal.

Sikwela, M.M. (2008), "Determinants of Household Food Security in The Semi-Arid Areas of Zimbabwe: A Case Study of Irrigation and Non-Irrigation Farmers in Lupane and Hwange Districts", *Thesis For The Degree of Master of Science in Agriculture*, Department of Agricultural Economics and Extension, University of Fort Hare, Republic of South Africa.

Solow, R.M. (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, **70,** 65-54.

Zimbabwe Vulnerability Assessment Committee (ZIMVAC) (2006), Zimbabwe Rural Food Security and Vulnerability Assessments, Available at www.Zimrelief.info/Files/Attachments/Doclib/0003.Pdf .

Zvobgo, T. (2010), "Pathways Out of Poverty in Conditions of Chronic Fragility", Paper Presented at the SARPN Conference on Land Reform and Poverty Alleviation, Pretoria, South Africa.

Table 1: Distribution of the sample by food security status

Food security status	Frequency	Percent
Food secure	60	51
Food insecure	57	49
Total	**117**	**100.00**

Source: Survey data

Table 2: Household Characteristics based on discrete variables

Characteristics	Food Insecure		Food Secure		Overall	
	Number	(%)	Number	(%)	Number	(%)
Sex						
Male	46	81	38	63	84	72
Female	11	19	22	37	33	28
Employment Status						
Other sectors	17	30	24	40	41	35
Agriculture only	40	70	36	60	76	65
Farmland Quality						
Good	30	53	51	85	81	69
Poor	27	47	9	15	36	31
Technology Use						
Yes	41	72	45	75	86	74
No	16	28	15	25	31	26
Climate Adaptation						
Yes	30	53	51	85	81	69
No	27	47	9	15	36	31

Source: Survey data

Table 3: Household Food Security Status based on continuous variables

Variable	Food secure	Food insecure
Average farm land size (ha)	8.88	4.68
Average household size	3.57	4.22
Average livestock	7.83	3.21
Average number of years spend in school (yrs)	8.98	9.65
Age of household head (yrs)	48.85	45.81

Source: Survey data

Table 4: Restricted Logit Regression Results

| Log likelihood= -51.630229 | | | | LR chi2 (5) = 58.86 | | |

| Pseudo R2 = 0.3631 | | | | Prob> chi2 = 0.0000 | | |

Variable	Coef.	Std. Err	z	P>|z|	[95% Conf. Interval]	
hhsize	-0.2992735**	0.1524584	-1.96	0.050	-0.5980866	-0.0004605
lsize	0.1067675**	0.0483695	2.21	0.027	0.0119649	0.20157
lqua	1.814068***	0.5753523	3.15	0.002	0.6863985	2.941738
adapt	2.146503***	0.5364675	4.00	0.000	1.095046	3.19796
lstock	0.1042489**	0.0455752	2.29	0.022	0.0149231	0.1935747
_cons	-2.456351***	0.8821295	-2.78	0.005	-4.185293	-.727409

***, **, means significant at 1% and 5% levels respectively

Table 5: Marginal effects Results

Variable	dy/dx	Standard error	z	P>|z|	Mean
hhsize	-0.074453	0.0379	-1.96	0.050	3.88761
lsize	0.0265615	0.01197	2.22	0.026	6.83333
*lqua**	0.4210091	0.11355	3.71	0.000	0.692308
*adapt**	0.4903894	0.10197	4.81	0.000	0.555556
lstock	0.0259349	0.01129	2.30	0.022	5.5812

(*) dy/dx is for discrete change of dummy variable from 0 to 1