TEGEMEO INSTITUTE OF AGRICULTURAL

POLICY AND DEVELOPMENT

World Agroforestry Centre

TRANSFORMING LIVES AND LANDSCAPES

PARTICIPATION IN AGRICULTURAL MARKETS AMONG THE POOR AND MARGINALIZED: ANALYSIS OF FACTORS INFLUENCING PARTICIPATION AND IMPACTS ON INCOME AND POVERTY IN KENYA

STUDY REPORT

Mary Mathenge, Frank Place, John Olwande, Dagmar Mithoefer*

July 2010

* *Mary Mathenge and John Olwande : Tegemeo Institute, Egerton University*

Frank Place and Dagmar Mithoefer : World Afroforestry Centre (ICRAF)

Executive Summary

Poverty in Africa has been found to be predominantly a rural phenomenon. About 75 percent of the world's poor are believed to work and live in rural areas, and it is estimated that, by the year 2020, 60 percent of the poor will still be rural. Among the worst hit in these rural communities are women and those in marginal agricultural production areas. Meeting the challenge of reducing poverty and improving rural incomes in Africa, especially for these marginalized groups, will require some form of transformation out of the semi-subsistence production systems that currently characterize much of rural Africa to a more commercialized agriculture. Increased market participation by the poor has been found to be important as a means of breaking from the traditional semi-subsistence farming. It has been argued that market-oriented production can achieve welfare gains through specialization and comparative advantage, economies of scale and regular interaction and exchange of ideas. Unfortunately, the most vulnerable who need this kind of welfare boost may be constrained by several factors in their quest to participate in the market for their goods and services.

This study aimed at assessing the extent of market participation among smallholder farmers in Kenya with a view to identifying potential market opportunities and constraints for the vulnerable and marginalized groups. The study is within the broader project by Tegemeo Institute of Egerton University, Makerere University and the World Agroforestry Centre (ICRAF) looking at market participation among marginalized groups in Kenya and Uganda.

In this study, we use a three-year panel data set collected in 2000, 2004 and 2007 and across various agro-ecological zones of Kenya under the Tegemeo Agricultural Policy Research and Analysis (TAPRA) project. The study assessed the potential output market opportunities for different marginalized rural populations in Kenya and identified factors that could enhance their participation in both output and input markets. The study was carried out mainly through desk top analysis of the existing data set with some complementary secondary data. Additional information was received through a few key informant and stakeholder consultations. The data analysis mainly focused on the characteristics of these marginalized groups and their participation in different input and output markets. Critical questions under the study related to the type of markets that these marginalized groups access, their important enterprises and degree of commercial orientation, and market opportunities that could help them increase their incomes and transition out of poverty, among others. The study also

looked at how access to financial services, agricultural information and participation in farmer groups impact on market participation. In addition, the study explored factors that affect participation in different markets for the marginalized groups.

The marginal/social groups of interest include women, the poor (both income and land poor) and those in marginal agricultural production areas. For women, the study considers female headed households, who form about a quarter of the sample. Income poor households are those below the poverty line as generated by the Kenya National Bureau of Statistics (KNBS). Land poor households are those found to own less than the average per capita land size in Kenya of 0.2 hectares (0.49 acres) as indicated in the World Development Report (WDR, 2008). Information on land was not available for 2000 and is thus reported for 2004 and 2007 only. Marginal agricultural production areas are defined based on a binary variable representing low and high agricultural potential areas. The low potential/marginal agricultural areas comprise of the lowlands and other borderline regions while the high potential agricultural areas comprise of the highlands and the high potential maize zone.

Descriptive results show that female headed households consisted of about 12% of the sample in 2000 but increased to about a quarter in 2007 (over 80% of these females are widows). On the other hand, the proportion of income poor households decreased from 42% to 37% between 2000 and 2007, a scenario that is well consistent with the general reduction in the national poverty figures reported across that period. The share of land poor households remained stable at about 37% between 2004 and 2007. The proportion of the sample living in the marginal agricultural areas was 32%. Relationships among these groups reveal that at least half (and a third) of female headed households are income poor (land poor) and that there is a positive correlation between land and income poverty. As expected, we observe higher proportions of the marginalized groups in the low potential areas implying that if households are marginalized in one aspect, they are also likely to be marginalized in other aspects.

In terms of their socio-economic characteristics, female headed households are less educated with over 40% of the heads having no formal education and only less than 10% having attained a secondary education. A slightly better scenario emerges for income poor households, with the proportion of heads with no formal education declining to about 26% and those with secondary education increasing to about 15%. In general, land poor households and those in the low potential areas had a similar distribution in education to the

general population or average household. However, the proportion of heads with no formal education in marginal areas remained higher despite a slight decline across the years. The largest deviation from the average household was mainly observed with female heads and thus revealing the clear disadvantage that women/female heads have with respect to education.

Female household heads were found to be slightly older than the average head and had smaller family sizes, while income poor households had higher than average family sizes. As expected, land poor households were headed by slightly younger persons. In the low potential areas, both the age of head and family size were similar to those for the average household. Overall, the number of persons per household in the sample declined from seven to six between 2000 and 2007.

Compared to the average household, female headed households have significantly lower household incomes, lower asset values, and less land. Equally disadvantaged are land poor households with significantly lower incomes than the average household. These land poor households have an average of 0.3 acres per capita land size compared to about 1.2 acres for the average household. Households in the low potential areas, have lower income levels than the average household but higher than for the other marginalized groups. In general, however, incomes, asset values and land size of all marginalized groups are below those of the average household, and are, therefore, disadvantaged in these respects in the general population. In terms of income distribution, there is a significantly higher proportion of female headed households in the bottom lowest income quintiles compared to their male counterparts. This proportion however declined between 2000 and 2007. Conversely, there is a significantly lower proportion of female headed households in the top income quintiles and this increases slightly over time. Again, this trend across years is consistent with the general poverty improvement in the country between 2000 and 2007.

Female-headed households compared to their male counterparts have relatively higher shares of crop income in total household income, which are generally stable across years. Low income compared to high income households also have relatively higher shares of income from crops in total household income which seem to decline over time. They also have relatively higher shares of income from informal labour and business activities. High income households have relatively higher income shares from salary and remittance which also generally increase over time. Despite having smaller pieces of land, the relatively land poor

households have a sizable share of income from crops and relatively higher share of income from informal labour and business activities compared to the households with larger land sizes. The share of income from livestock enterprises is much larger on larger farms. Crops and livestock account for a higher share of household income in the high potential than in the low potential agricultural areas. The reverse is true for the share of off-farm activities (business and informal labour activities and salaries and remittance). This may be an indication of greater off-farm diversification by households in the low potential areas as a response to the attendant low agricultural performance. In general, however, whether out of choice or a survival strategy, these results indicate that farming is an important livelihood source for the marginalized households and interventions that promote these households' commercial orientation to farming could result into huge payoffs.

On information sources, results of this study indicate that a similar proportion of both male and female headed households accessed agricultural information from public extension, perhaps an indication of lack of any gender bias in the provision of public extension. A slightly lower proportion of low income households as compared to their high income counterparts receive agricultural information from public extension though the trend is not clearly conclusive. Also, public extension agents are the most important sources of information in both the low and high potential agricultural areas. Further analysis on this issue would be critical in informing the debate on privatization of public extension service and the implications of the demand-driven extension. Generally though, more female headed and income poor households and households in low agricultural potential areas receive agricultural information through private agents/NGO's and neighbours and friends, the latter clearly indicating the important role of social networks among these marginalized groups.

In terms of access to financial services, the study results reveal only very minor difference between the proportion of households that sought credit across gender of head, and hardly any difference in success rate among those who sought. This result remains largely inconclusive and thus begs for a deeper and more focused study given the low proportions of households that sought credit in this sample and also the general nature of the questions posed during the survey. A clearer picture is observed with respect to income groups and agricultural potential whereby we observe a significantly smaller proportion of low income households and households in the low potential areas seeking credit as compared to their high income counterparts and those in the high potential areas. Generally though, across gender,

income groups and agricultural potential, the results indicate that the proportion of credit seekers has been declining over time, a result that could emanate from both the supply or demand side issues. This could indicate a need to come up with favourable credit packages that are both affordable and suitable to small scale farmers. Unfortunately though, close to half of the credit amount received was used to meet household needs and another quarter for education purposes with insignificant amounts invested in farming.

The role of collective action in assisting small scale farmers through economies of scale, bargaining power and information sharing/learning cannot be overemphasized. These attributes can enhance market participation and increase income of participants. This study indicates very high participation rates in these groups by the sample households; over 70% of all households belong to groups and this proportion increases with income. The causal relationship between social capital, households' income and other factors, however, remains a question for further inquiry in this case.

On participation in input markets, fertilizer adoption in the entire sample is generally high and has been increasing over time. Intensity of use has however been declining from an average of 72kg/acre in 2000 to 63kg/acre in 2007. Although a similar trend is maintained across gender and income, there are significantly lower fertilizer adoption rates and intensity of use among female headed households and low income households compared to their respective male and high income counterparts. The reduction in intensity of fertilizer use over time amidst growing adoption rates could be an indication of increasing awareness in the importance of using fertilizer but within a very constrained budget. This scenario clearly limits households' ability to adequately gain from productivity levels possible with expanded fertilizer use. As expected, the disparity in fertilizer use between low and high potential agricultural areas is perhaps the largest with about 94% of households in the high potential areas using fertilizer compared to less than a half (38%) in the low potential areas in 2007.

Generally, adoption of improved maize variety is relatively high across all households (over 70% of all households). While a higher proportion of male than female headed households planted improved maize varieties, female headed households had a larger proportion of their land under maize with improved varieties than their male counterparts. Adoption of improved maize varieties generally increased with increase in income and land size, suggesting the influence of income and land on household's adoption decision for improved seed varieties. As with fertilizer, the disparity in use of improved maize variety between low and high

potential agricultural areas is again the largest with about twice as many households in the high potential areas using improved maize seed compared to the low potential areas in 2007. Similar trends as described above are observed when considering all other improved seed varieties used by these households.

There is generally high level of crop diversification among all households with marginalized groups having similar crop portfolios as with their counterparts. The results, however, indicate that the poor and female headed households generally produce lower volumes for most enterprises.

In terms of the crops that are most important for commercialization, traditional cash crops e.g. tea coffee and sugarcane lead, though vegetables and fruits are also substantially marketed. Thus, market orientation for these higher value crops is greater than for cereals, roots and tubers among these households. Although both male and female households sell various crops, a significantly higher proportion of male than female headed households sold maize, vegetables, roots/tubers and cash crops other than tea, coffee and sugar cane. Female headed households always sell smaller amounts, with other cereals (sorghum, millet etc) and bananas being more important as measured by their share in total value of production. On livestock, female headed households not only generally lag behind their male counterparts in keeping improved cattle, but they also keep small herd sizes.

As with female headed households, the poor are generally less market oriented. Maize is very important among the poor, accounting for over 42% of total value of crop production in 2007, closely followed by vegetables. Yet, even though maize is important, most is subsistent as the marketed volume is barely 10%. Income poor households lead in keeping indigenous cattle and lag behind in keeping improved cattle. Generally, market participation among the poor is low for all livestock, but relatively greater participation is observed for sheep, goats and chicken. Milk production and sales is also generally lower for the poor.

Market orientation is less in the low than in the high potential areas. With the exception of fruits, volumes sold for most of the crop enterprises are higher in the high than in the low potential areas. In the low potential areas, market orientation was highest for the cash crops, bananas, fruits and vegetables while in the high potential areas cash crops, bananas, fruits, vegetables, maize and roots and tubers had the highest market orientation. On livestock, market participation among the households in low potential areas is low for all livestock, but

relatively greater participation is observed for cattle. Participation in marketing small ruminants and chicken is low but increased between 2000 and 2007. Milk production and sales is lower for households in the low than in the high potential areas. Overall, market participation is dominated by 20% of the households, who sell well over two thirds of the marketed volume for various crops. There seems to be a strong link between income and the share of revenues from sales of tea, coffee and sugar cane, indicating that these crops have helped high income households out of poverty. Fruits and maize appear to be more pro-income poor while vegetables, bananas, fodder and maize show higher levels of being pro-land poor. With regards to livestock marketing, results have shown an increasing importance of small ruminants (sheep and goats) and chicken among women and the poor. Dairy production (in terms of the percentage of households) is high among the households, but the income poor and land poor households hardly produce or sell.

Results from the econometric analysis of determinants of input market participation show that all the marginal groups are less likely to use fertilizer than their respective counterparts. We find that the degree of commercialization of crop enterprises by female headed households is significantly and positively affected by land size, membership in farmer groups and access to credit. The degree of commercialization by the income poor households is significantly and positively influenced by membership in farmer groups, access to credit, ownership of transport and communication equipment, while market participation by the households that exited poverty is positively influenced by group membership and ownership of communication equipment. Access to credit and group membership also affects market participation among the land poor households and those in the low agricultural potential areas. Therefore, credit and collective action appear to be attractive investment areas for efforts aimed at increasing market participation by all these marginalized groups.

On market participation and transitioning out of poverty, the results of this study show that households that exited poverty registered significant increases in both the proportion of households selling and the proportion of marketed crop and milk production. The increase in the proportion of marketed production was particularly large for fruits, bananas, other cash crops (such as pyrethrum, tobacco, cashew nuts, coconuts, etc), roots and tubers and vegetables. Increased market participation by poverty exiters is an indication of the importance of linking these smallholder farmers to markets for income growth and poverty

reduction. These results show a strong correlation between market participation and exiting poverty.

In conclusion, the study finds that the identified social groups are clearly disadvantaged in many aspects than the average household. Female headed households are locked in some kind of marginalization with over half of them being income poor, and over 90% having at most a primary education. Income poor households are also equally marginalized with over 50% of them also being land poor and about 80% having at most a primary education. Both female headed households and low income households are characterized by high crop income shares yet with low incomes and thus implying some locking up in low productivity–low return farming activities with limited alternatives outside of agriculture given the low income shares from business of salaried wage activities.

Further, these marginalized groups lag behind their respective counterparts in use of productivity enhancing inputs and thus are limited in their ability to produce sufficient marketable surplus. Although crop diversification is also high for these marginalized groups, they are, however, less market oriented and occupy a very small portion of the market compared to their respective counterparts. Given the results that positively link increased market participation with transitioning out of poverty, efforts to link these marginalized groups to markets should be seen within the broader goal of poverty reduction.

Regarding the enterprises in which opportunities may exist for the marginalized groups, vegetables, fruits and bananas have substantial market orientation and would hold promise in integrating the poor in agricultural markets. Cereals such as sorghum and millet, pulses such as beans cowpeas, green gram and groundnuts and bananas are important to female headed households and could hold key to unlocking their potential to participate adequately in markets. On livestock, small ruminants (goats and sheep) and chicken are gaining increased importance in commercialization among both the female headed and income poor households. Targeting these livestock could also be important in efforts aimed at increasing market participation among women and the poor. In addition, promoting collective action and facilitating access to credit are also key intervention areas that can significantly enhance access to both input and output markets and thus integrate women and the poor to market for income growth and poverty reduction.

Acknowledgements

The authors wish to thank everyone who contributed in the preparation of this report, and for the successful completion of the entire project on "***Market Participation among the Poor and Marginalized Groups in Kenya and Uganda***", a collaborative project between Tegemeo Institute of Egerton University, Makerere University and the World Agroforestry Centre (ICRAF). We acknowledge and appreciate the support from various organizations: the FORD Foundation for their support in carrying out the project and in particular for enabling the collaboration between the three institutions; the United States Agency for International Development (USAID) Kenya mission for their long term support of the Tegemeo panel data collection and maintenance; and the National Graduate Institute for Policy Studies (GRIPS) in Japan for supporting the panel data collection of the RePEAT data in Kenya and Uganda. We also acknowledge support from other Tegemeo colleagues for their contribution during the analysis of data, report writing and preparation of the Workshop. In addition, we appreciate the valuable contribution from the various stakeholders who participated during the Kenyan Workshop. We would also like to acknowledge cooperation and support accorded to us by the administration of Egerton University and ICRAF, without which the completion of this project would have been difficult.

Table of Contents

Executive Summary i
Acknowledgements ix
Table of Contents x
List of Tables xiii
List of Figures xvii
Acronyms xviii
1. Introduction 1
1.1 The Promise of Improving Smallholder Participation in Markets 1
1.2 Challenges in Improving Market Participation by Smallholders 3
1.3 Objectives and Focus of the Study 5
1.4 Hypotheses 6
1.5 Organization of the Report 7
2. Conceptual Approach, Analytical Methods and Estimation 8
2.1 Conceptual Approach 8
2.2 Analytical Methods 12
2.2.1 Descriptive Analysis 12
2.2.2 Econometric Model 12
2.2.2.1 Model Specification 12
2.2.2.2 Variable Descriptions 16
2.2.2.3 Estimation 18
2.2.3 Input and Output Categories 18
3. Data and Sample 20
4. Results and Discussion 21
4.1. Descriptive Analysis 21
4.1.1. Characteristics of Marginalized Groups 21
4.1.1.1. Classification and Relationship among Marginalized Groups 21
4.1.1.2 Socio-Economic Characteristics 24
4.1.1.3 Collective Action and Access to Information and Financial Services 33
4.1.1.3.1 Collective Action 33
4.1.1.3.2 Access to Agricultural Information 35
4.1.1.3.3 Access to Financial Services 37
4.1.2 Market Participation among Marginalized Groups 43

4.1.2.1 Input Markets 43
4.1.2.1.1 Use of Improved Plant Varieties 43
4.1.2.1.2 Use of Fertilizer 45
4.1.2.1.3 Use of Hired Labour 47
4.1.2.2 Output Markets 49
4.1.2.2.1 Production and Marketing of Crop Enterprises 49
4.1.2.2.1.1 Production of Crops 49
4.1.2.2.1.2 Marketing of Crops 54
4.1.2.2.1.3 Price Analysis for Selected Crop Enterprises 65
4.1.2.2.2 Livestock Production and Marketing 66
4.1.2.2.2.1 Live Animals 66
4.1.2.2.2.2 Animal Products 74
4.1.2.3 Market Participation and Transitioning out of Poverty 79
4.1.2.4 Output Market Participation and Credit Access 83
4.2 Econometric Results 85
4.2.1 Determinants of Participation in Markets for Selected Crops 85
4.2.2 Determinants of Participation in Dairy Markets 95
4.2.3 Determinants of Fertilizer Adoption and Intensity of Use 97
4.2.4 Determinants of Access to Financial Services 99
5. Determinants of Agricultural Commercialization by the Marginalized Group of Households 103
5.1 Female Headed Households 103
5.2 Income Poor Households 105
5.3 Land Poor Households 109
5.4 Households in Marginal Agricultural Areas 111
6. Summary of Key Findings and Conclusion 113
References 116
Annexes 121
Annex 1: Conversion Factors for Computing Adult Equivalents 121
Annex 2: Mean Value (Ksh) of Production for Various Crops by Gender of Household Head 122
Annex 3: Mean Value (Ksh) of Production for Various Crops by Income Quintiles 123
Annex 4: Mean Value (Ksh) of Production for Various Crops by Quintiles of Land Size 124

Annex 5: Econometric Estimation Results of Market Participation 125

List of Tables

Table 1: Distribution of Sampled Districts by Agro-Regional Zones 20
Table 2: Marginal Groups and their Relationships 22
Table 3a: Proportion of Households by Education Category 25
Table 3b: Age of Head and Household Size 26
Table 4: Household Mean Annual Income (Ksh) 27
Table 5: Distribution of Households by Gender of Head across Quintiles of Income Per Adult Equivalent 28
Table 6: Share (%) of Income Sources in Total Household Income, by Gender of Household Head 29
Table 7: Share (%) of Income Sources in Total Household Income, by Quintiles of Income and Land Size 30
Table 8: Share (%) of Income Sources in Total Household Income, by Agricultural Potential 31
Table 9: Mean Household Land Size 31
Table 10: Distribution of Households by Gender of Head across Quintiles of Land Size 32
Table 11: Sources of Agricultural Information by Gender of Household Head, 2007 36
Table 12: Sources of Agricultural Information, by Quintiles of Income and Land Size, 2007 36
Table 13: Proportion (%) of Households Seeking and Receiving Credit, by Gender of Head 38
Table 14: Proportion (%) of Households Seeking and Receiving Credit, by Quintiles of Income and Land Size 38
Table 15: Proportion (%) of Households Seeking and Receiving Credit, by Agricultural Potential 39
Table 16: Uses of Credit by Quintiles of Income and Land Size, 2007 41
Table 17: Mean Amount of Credit (Ksh) Used by Quintiles of Income and Land Size, 2007 42
Table 18: Proportion (%) of Improved Seed Varieties in Total Planted Varieties Across Gender,, Quintiles of Income and Land Size and Agricultural Potential 43
Table 19: Percent of Households Planting and Percent of Area Planted With Improved Maize Variety 45
Table 20: Fertilizer Adoption and Intensity of Use 47
Table 21: Proportion (%) of Households that Hired Labour and Value 48

Table 22: Percent of Households Producing Various Crops, Volume of Production and Percent Contribution Total Value of Crop Production, by Gender of Household Head....50
Table 23: Percent of Households Producing Various Crops, Volume of Production and Percent Contribution to Total Value of Crop Production, by Income Quintiles....52
Table 24: Percent of Households Producing Various Crops, Volume of Production and Percent Contribution to Total Value of Crop Production, by Quintiles of Land Size....53
Table 25: Quintile Ratios of the Mean Volume of Production....54
Table 26: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production....56
Table 27: Distribution of Marketed Volumes of Various Commodities Across the Sample ..57
Table 28: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production, by Gender of Household Head....58
Table 29: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production, by Income Quintiles....60
Table 30: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production, by Quintiles of Land Size....61
Table 31: Marketed Volumes and Proportion of Production Marketed for Various Enterprises, by Agricultural Potential....62
Table 32: Distribution (%) of Total Marketed Volume of Various Crops Across Income Quintiles....63
Table 33: Distribution (%) of Total Marketed Volume of Various Crops Across Quintiles of Land Size....64
Table 34: Quintile Ratios of Mean Volumes of Marketed Crops....65
Table 35: Mean Prices (Ksh/Kg) for Maize, Beans and Bananas Received by Households by Gender of Household Head....65
Table 36: Mean Prices (Ksh/Kg) for Maize, Beans and Bananas Received by Households across Quintiles of Income and Land Size....66
Table 37: Percent of Households Keeping Improved Cattle and Mean Size of Herd....67
Table 38: Percent of Households Selling Improved Cattle and Percent of Sales Over Stock Kept....68
Table 39: Percent of Households Keeping Indigenous Cattle and Mean Size of Herd....69

Table 40: Percent of Households Selling Indigenous Cattle and Percent of Sales Over Stock Kept 70
Table 41: Percent of Households Keeping Sheep and Goats and Mean Size of Herd 71
Table 42: Percent of Households Selling Sheep and Goats and Percent of Sales Over Stock Kept 72
Table 43: Percent of Households Keeping Chicken and Mean Size of Flock 73
Table 44: Percent of Households Selling Chicken and Percent of Sales Over Stock Kept 74
Table 45: Proportion (%) of Households that Produced Milk and Mean Volume (in Litres) of Milk Produced 75
Table 46: Proportion (%) of Households that Sold Milk and Proportion (%) of Milk Sold 76
Table 47: Percent of Households Producing and Selling Eggs and Percent of Produced Eggs Marketed 78
Table 48: Selected Market-Related Characteristics of Households by Income Poverty Status 80
Table 49: Participation in Crops Markets by Poverty Status 81
Table 50: Participation in Dairy Market by Poverty Status 83
Table 51: Volume and Proportion of Production Marketed for Various Enterprises, by Access to Credit 84
Table 52: Probit Estimates of Determinants of Decision to Participate in Markets for Food Crops 87
Table 53: Truncated Regression Estimates of Determinants of Extent of Participation in Markets for Food Crops 89
Table 54: Determinants of Decision to Participate and Extent of Participation in Markets for Cash Crops and Animal Feeds 93
Table 55: Determinants of Decision to Participate and Extent of Participation in Milk Market 96
Table 56: Determinants of Decision to Adopt and Extent of Use of Fertilizer 98
Table 57: Determinants of Household Credit Access 100
Table 58: Determinants of Ownership of Savings Account 101
Table 59: Determinants of Crops Output Commercialization by Female Headed Households 104
Table 60: Determinants of Crops Output Commercialization by Income Poor Households. 106

Table 61: Determinants of Crops Output Commercialization by Poverty Exiting Households 108
Table 62: Determinants of Crops Output Commercialization by Land Poor Households 110
Table 63: Determinants of Crops Output Commercialization by Households in Agriculturally Low Potential Areas 112

List of Figures

Figure 1: Household Mean Annual Income (Ksh) Per Adult Equivalent across Income Quintiles 28
Figure 2: Mean Household Land Size (Acres) Across Quintiles of Land Size 32
Figure 3: Mean Value (Ksh) of Household Assets 33
Figure 4: Proportion (%) of Households Belonging to Groups, by Gender of Head 34
Figure 5: Proportion (%) of Households Belonging to Groups by Income Groups 34
Figure 6: Proportion (%) of Households Belonging to Groups, by Agricultural Potential 35
Figure 7: Proportion (%) of Households that Accessed Agricultural Information, by Membership in Groups 37
Figure 8: Uses of Credit by All Households 40
Figure 9: Uses of Credit by Gender of Household Head, 2007 40
Figure 10: Mean Amount of Credit (Ksh) Used by Gender of Household Head, 2007 41

Acronyms

AE	-	Adult Equivalent
ASK	-	Agricultural Society of Kenya
Ksh	-	Kenya Shillings
NALEP	-	National Agriculture and Livestock Policy
NGO	-	Non-Governmental Organization
TAPRA	-	Tegemeo Agricultural Policy Research and Analysis
USAID	-	United States Agency for International Development
WDR	-	World Development Report

1. Introduction

1.1 The Promise of Improving Smallholder Participation in Markets

Rural poverty levels remain high in Africa and the East Africa region. The World Bank (2008) showed that the number of rural poor in Africa increased over the period between 1992 and 2002 to reach over 210 million people. Most of Africa's poor reside in rural areas -- 70% of its poor – and this is expected to dominate urban poverty for several more decades. The rural populations depend on small scale agriculture for food and income. Smallholder agriculture remains the major engine of rural growth and livelihood improvement for any pathway that can lift large numbers of the rural poor out of poverty (Hazell, 2005). Meeting the challenge of improving rural incomes in Africa will require some form of transformation out of the semi-subsistence, low-input, low-productivity farming systems that currently characterize much of rural Africa (Govereh et al., 1999)

Data at the global level also indicate that through investments, rural poverty rates can decline. Between 1992 and 2002, the percentage of the rural population in poverty reduced from 37 to 29, with virtually all of this taking place in East Asia. Nonetheless, there are examples of significant agricultural productivity and income growth as a result of increased linkages to markets in Africa. In Kenya, there are many examples of smallholder farming successes in which households have diversified from staple food subsistence production into more market oriented and higher value commodities. Evidence shows that in Kenya, there are approximately 300,000 smallholders growing tea, 500,000 coffee growers, hundreds of thousands are producing horticultural crops and nearly 2 million have dairy production systems (Place et al., 2006).

This shift towards more commercialization has also been found to contribute positively to agricultural income. A study on the effects of smallholder commercialization on rural Kenyan food production and welfare in South Nyanza District, found that farmers participating in the sugarcane scheme enjoyed significantly higher agricultural incomes than their neighbours who did not participate. Much of the difference in income was related to agricultural sales, with most, but not all of these sales being related to sugarcane (Kennedy and Cogill, 1987). A study by Strasberg (1997) on smallholder integration into cash cropping schemes in Mozambique demonstrates that smallholder cash cropping schemes can have a positive effect on smallholder welfare. Related studies on input use have also shown a positive relationship

between cash cropping and input intensification on food crops within households (Kelly et al., 1996; (Govereh et al., 1999); Freeman and Omiti, 2003; Mathenge and Tschirley, 2008).

Agricultural commercialization refers to the shift from subsistence production to an increasingly complex production and consumption system based on the market (Goletti, 2005). Apart from marketing of agricultural outputs, it includes product choice and input use decisions based on the principles of profit maximization (Pingali and Rosegrant, 1995). Jaleta (2009) argues that commercialization strengthens linkages between input and output sides of a market. Demand for modern technologies promotes the input side of production and facilitates the development and advancement of technological innovations. In turn, the use of modern technologies can result in higher productivity and production entering markets. From the other side, output market growth can often drive input market linkages as the cash generated from sales can be used as investment funds.

Commercialization of agriculture benefits the poor by increasing agricultural labour productivity which in turn generates employment in low-capital smallholder agricultural production. Both the households that are commercializing their production and hired laborers receive direct income benefits (von Braun, 1995). However, von Braun (1995) also cautions that, while commercialization by itself rarely has adverse consequences on household welfare, commercialization combined with failures of institutions, policies, or markets can be damaging. Moreover, other studies have found that commercialization may have adverse effects on certain household members, such as women and children, when the allocation of income is not done equitably.

People do not start at the same point in the social system, and as a consequence, have very different capacities to take advantage of change or the status quo (March et al., 1999). Poverty is, amongst other factors, a result of differential access to extension, credit, education and productive inputs and participation in labour markets; as females are typically discriminated against these, poverty has different implications for men and women (Quisumbing et al. 1998), leading to lower agricultural productivity and agricultural incomes (as shown for Uganda by Deininger and Okidi, 2001). This relative structural inequality and discrimination against women make gender subordination and poverty continuously reinforcing (as shown for Uganda by Ahikire, undated).Thus, a multi-dimensional approach to poverty analysis that takes into account the different needs of men, women and other social groups is required; and gender inequality ought to be the guiding principle to help to

highlight other sources of social inequality such as poverty (Ahikire J, undated). In other words, poverty analysis and, thus, mitigating efforts need to recognize that different social groups (e.g., men and women, boys and girls, etc) have different gender roles and access to and control over resources; and thus have different capacities to take advantage of welfare-improving opportunities in the economy, hence the need for targeting.

1.2 Challenges in Improving Market Participation by Smallholders

While there is general agreement that improving market access and commercialization of smallholders will help induce greater investment, productivity, and income, there remains several challenges in making progress:

(1) which output markets and types of commodities, if any, can enable large numbers of smallholders to improve their incomes?

(2) which markets and commodities, if any, can provide significant opportunities for the more marginalized of the smallholder sector, namely the poor, women, landless, and those in neglected or marginal areas?

(3) how can access to these output markets be improved, what are the key constraints for smallholders and the marginalized, and what interventions are important for participation to be improved?

(4) how can access to information, input markets, credit, and agricultural technology be enhanced, what are the key constraints for smallholders and the marginalized, and what interventions are important for improved access to these input side goods and services?

While there are some interventions that have broad effects to improve smallholder market participation (e.g. communications and roads), other types of investments may depend on the types of markets and commodities pursued, e.g. whether export oriented or not, whether with perishable commodities or not. Thus the answers to (1) and (2) are important to uncover before the full identification of investment options can be made.

In terms of the first challenge, several recent studies have reached different conclusions. On the one hand, there is ample evidence to suggest that the sheer magnitude of domestic staple food markets is far greater than those for exported commodities or for higher value commodities (e.g. Hazell (2005), Diao et al., 2007). The implication is that domestic staple

food markets have the potential to involve a much larger number of smallholder farmers than other commodity markets, both domestic and export for most countries in sub-Saharan Africa. Other studies stress the importance of ties between a particular sector and the overall economy through e.g. labour market and other multiplier effects such as induced investment in input use and technological change, which may make certain high value crops such as horticulture a promising growth strategy despite their current small base (Diao and Dorosh, 2007). However, some studies provide evidence on the increasingly stringent health standards on agricultural imports into developed countries, potentially hampering access by smallholders (Asfaw, 2007; Okello *et al.,* 2008).

Yet, other evidence suggests that currently smallholders do not often participate much in staple food markets and their overall market share is very low (Jayne et al., 2005). Jayne et al. (2005) found that the top 2% of commercial farmers sold about 50% of observed marketed maize in Kenya, Mozambique and Zambia. Ellis (2005) also shows that farmers in semi-arid areas of Africa have very low proportions of output marketed. Further complicating the picture is evidence of growing participation of smallholders in horticulture, dairy, tree crops, and the like and a shifting away from staple food production as farm sizes shrink (see evidence on Kenya by Jayne et al. (2005)). This is due to the low prices received for staple foods and farmers' desires to increase their returns. Thus there appears to be divergent trends on the demand and supply side: demand trends which may be creating greater opportunities for staple foods in domestic markets and supply trends which suggest an interest of farmers to diversify away from lower value staple food crops. Thus, the way forward is muddled and requires careful examination on a case by case basis (i.e. in specific countries and regions within countries).

In terms of studies of market participation and the marginalized, very few studies have been done. Jayne et al. (2005) and Jayne et al. (2004) investigated relationships between land holdings, market participation, and incomes. They found that most smallholders did not sell cereals and in fact were net buyers of cereals. The size of land holding was also found to be highly correlated with income, including crop income and livestock income. This shows that the land-poor are not benefitting from markets nearly as much as those with more resources. Yet, an interesting finding is that even the land poor households count on crop production for a sizeable amount of their household income (where crop income is defined as net value of

production) meaning that they do not largely turn their backs on agriculture and seek predominantly off-farm livelihoods.

In terms of understanding the constraints to market participation and the types of interventions that can overcome these constraints, a number of studies have been done. On the constraints, a more in-depth review is given in Chapter 2, but here it is useful to acknowledge that constraints can exist at different levels and cover a range of types. Barrett (2008) stresses the importance of distinguishing location level constraints that tend to influence participation at a meso or community scale from household level constraints that influence participation across households within a given location. Among the types of constraints, others have differentiated between transactions costs, risks, and resources (e.g. skills, land, capital) which all may manifest themselves at a meso or household level (e.g. Bijman et al., 2007, Poulton et al., 2005).

One key point is that interventions may be different for different types of commodity market chains. For example, investments required in vegetables or fruits are different from those in cereals, due to differences in perishability, potential for value adding, and standards, inter alia. Identifying which agricultural commodities offer the best opportunities for sales, income, and poverty alleviation for marginal groups is thus a critical step in the process of making wise investments.

1.3 Objectives and Focus of the Study

The main objective of this report is to assess the potential output market opportunities for different marginalized rural populations, and further to identify factors that enhance their participation in both output and input markets. The marginal groups of interest include women, the income poor and the land poor, and in Uganda, the remotely located and the youth. Specific questions we aim to address in our study are listed below:

1. Access to output markets

   - What factors explain the degree of commercial orientation of households and the marginalized groups?
   - Which commodities are most important for women and the poor, in terms of market participation and benefits?
   - Which products and which enterprises / market opportunities are important in helping the marginalized transition out of poverty?

- What are the most significant constraints to market participation for the different social groups?

2. Access to financial services and input markets

- Which types of households use financial services (savings or credit)?
- Does credit access facilitate market participation and if yes, for which households?
- What were the most significant constraints in accessing financial services?
- What are the relationships between input use and participation in output markets?
- What are the levels of participation in input markets by marginalized groups and what are their key constraints?
- What factors promote the use of credit and input markets among the marginalized groups?

3. Access to transactions cost reducing means

- Which households belong to different types of groups (production/income oriented, savings/credit, social, etc)?
- Does membership in groups help marginalized households to benefit from markets? Which households benefitted the most?
- What is the level of ownership of communication and transport equipment and how does that facilitate market participation among different types of households?
- What is the level of access to information sources (e.g. extension) and how does that facilitate market participation among the marginalized groups?

The various ways in which these questions are assessed, including definitions of market participation, are addressed in Section 2.

1.4 Hypotheses

The study will be guided by the following hypotheses:

- Marginalized groups are characterized by 'unfavorable' internal and external factors that result in higher transaction costs.
- Marginalized groups are constrained in both market entry and level of participation
- Market participation varies by crop; markets for perishable products are less integrated than those for dried staple crops
- Access to credit is positively linked with increased market participation
- Collective action is positively linked with market participation; collective action can lower transaction costs of information acquisition.

1.5 Organization of the Report

Section 2 presents the conceptual approach, analytical methods and estimation. Description of specific variables used in the analysis is also presented. Sections 3 and 4 cover, respectively, an overview of the dataset used and results of descriptive and econometric analyses. Section 5 presents results of deeper analysis on each marginalized group (female headed, income poor and land poor households and households in marginal agricultural areas). Finally, Section 6 provides a summary of key findings and conclusion.

2. Conceptual Approach, Analytical Methods and Estimation

2.1 Conceptual Approach

Market-oriented production can achieve welfare gains through gains from specialization and comparative advantage, gains from larger-scale production due to fixed or sunk cost, and finally gains from regular interaction, exchange of ideas and technological change (Barrett, 2008). Market-oriented production can be described by the decision to participate in the market as well as the intensity of participation as measured by the share of sales in production (output supply) and/ or input demand; both of these decisions are also referred to as '*commercialization*' in this report.

The factors that determine commercialization of smallholder agriculture can be categorized as external and internal. External factors are beyond the smallholder's control like population growth and demographic change, technological change and introduction of new commodities, development of infrastructure and market institutions, development of the non-farm sector and the broader economy, rising labour opportunity costs, macroeconomic, trade and sectoral policies affecting prices and other driving forces (Pingali and Rosegrant, 1995). In addition, development of input and output markets, institutions such as property rights and land tenure, market regulations, cultural and social factors affecting consumption preferences, production and market opportunities and constraints, agro-climatic conditions, and production and market related risks are other external factors that could affect the commercialization process (Pender and Alemu, 2007). For example, nearness to urban centres play an influential role in commercialization and mechanization of agriculture in the hinterland by creating demand for different agricultural products including cereals and vegetables, and by supplying necessary inputs, including fertilizers and machines (Thapa and Nepali, 2009). Household specific, i.e. internal determinants include resource endowments such as land and other natural capital, labour, physical capital, human capital, social capital, etc. (Jaleta, *et al*, 2009). On the importance of resource endowments for market participation, Jayne et al. (2005) showed that the top 2% of households sold 50% of the maize in Kenya, Zambia and Mozambique which could be attributed to better endowment with land resources. Another 20-30% of households sold smaller amounts and had less land available (ibid.).

Commercialization is to a large extent influenced by transaction costs, which include information, negotiation and enforcement costs. Another way to categorize would be to

differentiate between tangible transaction costs such as transport, communication, and legal costs and intangible transaction costs due to uncertainty and moral hazard. Due to increasing globalization of food production and market systems, new transaction costs grow relevant such as those for meeting product quality standards (Pingali et al., 2005). Overall, transaction costs have a deterring effect on market participation. The prevalence of higher market transaction costs also limits household involvement in cash crop production by discouraging participation in food markets and prompting them to give priority to subsistence food production (Fafchamps 1992; Key et al. 2000; Pingali et al. 2005). As a result, agricultural resources are diverted away from their potential use in cash crop production that would generate higher household income.

In addition to the factors listed above, fixed and/ or sunk cost of investment, coordination problems from public goods provision, liquidity constraints at household to government level result in the existence of multiple market participation equilibria ranging from autarchic to fully commercialised rural households (Barrett and Swallow, 2006; cited in Barrett, 2008).

Much of the framework of this study depends on the non-separable household model developed by Barrett (2008), which aims at analyzing household response to price and policy interventions and allows for household-level and market-level transactions costs. This model as well as findings from other models are used to derive hypotheses for our study. The next paragraphs briefly summarize major conclusions from this model.

Non-separable household model

In this model, a household maximizes utility subject to a cash budget as well as non-tradables' availability constraint, with household specific crop prices being determined by the household's net market position. The model differentiates two layers of transaction costs: household specific transaction costs as well as crop and location-specific transaction costs. These determine or vice versa are determined by integration of an individual household in the market as well as the integration of the local market in the regional/ national/ global market. Integration of local markets in the greater economy has impact on price transmission, which is also impacted by the competition amongst intermediaries, which results in locally differentiated price bands. Transaction costs create a wedge, which result in price bands (market prices plus/minus transaction costs), which result in kinked demand and supply functions with diminished price responsiveness (see also Key at al., 2000). The empirical

application mostly concentrates on the food grain market in East and Southern Africa (Barrett, 2008).

Household specific transaction costs are determined by private assets and productive endowments (Barrett, 2008) as well as, age, gender and education (Pingali, Meijer, Khwaja, 2005). Crop specific transaction costs are determined by crop characteristics such as perishability and its requirements such on cooling facilities (Pingali *et a* , 2005). Location specific transactions costs include costs of commerce given by remoteness of the location and its infrastructure (Barrett, 2008).

Household specific transaction costs are determined by private assets and productive endowments (Barrett, 2008) as well as, age, gender and education (Pingali *et a* , 2005). Household specific transaction cost interact with the poverty status of a household and may vary between marginalised and non-marginalised groups. Crop specific transaction costs are determined by crop characteristics such as perishability and its requirements such on cooling facilities (Pingali, et al., 2005). Location specific transactions costs include costs of commerce given by remoteness of the location and its infrastructure (Barrett, 2008).

Extended application

The model does not explicitly differentiate between fixed and variable transaction costs, but we do use variables that would proxy for each type separately. Fixed transaction costs are highly household or commodity-specific, non-variant with the volume of transaction, and basically deter smallholder entry into markets such as owning a pickup truck and local membership in an agricultural or transport association. Proportional transaction costs, as the name indicates, are proportional to the volume under transaction such as crop transport costs and distance to the market (Key et al., 2000). The former have been shown to be a determinant of market entry, while the latter are linked to the intensity of participation (Heltberg and Tarp, 2001. For example, fixed transaction costs estimated to be 15.5% of the price band in maize-producing semi-subsistence households is one of the major deterrents to market participation (Renkow et al. 2004).

Since the Barrett model mostly concentrates on price and policy effects, *other types of intervention such as increased vertical (e.g. through contract farming*[1]*) or horizontal (e.g. collective action of farmer associations) integration* are indirectly analysed and could possibly be more formally put into this framework.

The model also does not explicitly factor in idiosyncratic as well as covariate *risk* that rural households face, and consequently risk management and coping strategies. Agricultural production commercialized at a household level is subject to risk and the household's attitude towards risk (Fafchamps, 1992; Dercon, 1996) matters. The more risky the marketing environment a household is engaged in, the less a household will be involved in agricultural practices that support market orientation (Fafchamps, 1992; Govereh et al., 1999). Furthermore, unreliable and costly food markets and fluctuations in market prices put the relatively market-oriented resource allocation decisions of semi-subsistence households at stake due to less reliability of food markets to guarantee household food security (Govereh et al., 1999). Fafchamps (1992) also shows that a household's decision to commercialize depends on the sum of consumption and income effects of market shocks.

Rural household normally *diversify* into a range of farm, non-farm and off-farm activities (Ellis, 2000) and consequently are integrated into the market through participation in multiple input markets as well as multiple output markets. Overall, increased market orientation moves rural households from subsistence production to profit and (cash) income oriented decision making which can result in increased specialization of production (Pingali et al., 2005). Along this process, a rural household decides on the enterprise mix including non-agricultural income generation, market participation as well as the level of participation.[2] Households may choose to pursue non-agricultural income generation and then continue with producing staple foods with low market participation (Pingali et al., 2005). Hence any analysis needs to control for other livelihoods strategies and look at overall household commercialization.

---

[1] Across many developing countries, contract farming has been found to play an important role in the commercialization of smallholder agriculture through the provision of an assured market, high prices, critical inputs, knowledge of new agricultural technologies for farmers, and as a driver of rural development strategy (Elepu and Nalukenge, 2007).

[2] Bellemare and Barrett (2006) analysed whether the market participation – intensity of participation is simultaneous or sequential with more evidence towards the latter.

Welfare effects of price changes vary by crop, household and location and are influenced by linkages between markets and technologies. Households will respond heterogeneously to opportunities for market participation based on their individual characteristics and resource endowments including liquidity constraints (Stephens and Barrett, 2009), even though market access conditions and other external factors may be similar. In addition, the enterprise portfolio choice also depends on factors within the production function framework (input, service and labour). Overall, analysing and projecting an aggregated supply response is difficult also due to differentiated factor and output market response, e.g. land and labour market response (Dyer et al., 2006; cited in Barrett, 2008; Key, et al., 2000)

2.2 Analytical Methods

2.2.1 Descriptive Analysis

Descriptive methods of analysis were used to generate frequencies, proportions and means to show trends and patterns in input and output market participation over time. The analysis has been disaggregated by gender of head, poverty status and agricultural potential of the region for comparison purposes.

2.2.2 Econometric Model

2.2.2.1 Model Specification

In this study, we estimate both output supply and input demand functions to determine factors that enable small scale farmers to participate in the respective output and input markets. For the output market, we explore factors that determine whether a household sells all or some of their farm production in the market while for inputs, we determine the factors that drive farmer's decisions to purchase and hence use improved inputs.

Various studies on small holder market participation have mainly modelled both/either output and/or input market decisions as a two-step decision process. This is based on the assumption that households make two separate decisions; one involves the decision to participate in the market or not and secondly the level of participation. These studies have used either the sample selection model of Heckman (1979) (Makhura, et al., 2001; Boughton, et al., 2007; Alene at al., 2008) or the two tier/ hurdle models (Omiti, et al., 2009).

The sample selection model is ideally used to deal with non-random samples as a result of survey design, non-response on survey questions, sample attrition or the specific attributes of

the variable being analyzed. The sample selection model of Heckman (1979) was based on wage offer functions given that some wage data was missing due to the outcome of another variable – labour force participation[3]. In this case, usually known as *incidental truncation*, it is important to account for the non-random nature of the sample using a selection model. It would be erroneous to equate these missing observations to zero as would be the case under corner solution outcomes[4] (discussed later). The Heckman type models deal with such a sample selection problem by computing a selection term from the first equation (selection model) and including it as a regressor to correct for self selection in the second stage regression involving observations from the selected sample. In other words, as indicated by Wooldridge (2002), the selection bias is viewed as an omitted variable in the selected sample which is corrected by this procedure.

The two tier/hurdle models are a type of corner solution outcome (sometimes referred to as censored regression model). These models define an initial discrete probability of participation model. Conditional on participation $(y > 0)$, a second decision is made on the intensity of participation. Originally, such models were estimated using the Tobit model that accounts for the clustering of zeros due to non-participation. However, a major limitation with the Tobit model is that it assumes that the same set of parameters and variables determine both the probability of market participation and the level of transactions. A two-step model however relaxes these assumptions by allowing different mechanisms to determine the discrete probability of participation and the level of participation. These models allow for a separation between the initial decision to participate $(y > 0 \ vs \ y = 0)$ and the decision of how much y given $(y > 0)$. In this case, it is assumed that some RHS variables may affect differently the decision to participate at all and the decision on the level of participation.

The first step in a two-tier model involves a Probit estimation while the second stage can take different functional distributions. The simplest two step model for a corner solution outcome assumes that conditional on $y > 0$, $y \mid x$ follows a lognormal distribution (second stage).

[3] Not possible to collect wage data on all persons of working age since some were not working at the time of the survey.

[4] See details of this discussion in Wooldridge (2002) pp 562-3.

$$P(y = 0 \mid x) = 1 - \Phi(x\alpha) \tag{2.1}$$

$$\mathrm{Log}(y) \mid (x, y > 0) \sim Normal\ (x\beta, \delta) \tag{2.2}$$

A most commonly used two tier model is the double hurdle of Craig (1971). In this model, the second stage is defined by a truncated normal distribution instead of the lognormal distribution described above. The main advantage of the truncated normal distribution over the lognormal is that it nests the usual Tobit Model thus allowing us to test the restrictions implied by the Tobit hypothesis against the two step model (Wooldridge, 2002, pp 536-38). The double hurdle model can thus be denoted by:

$$P(y = 0 \mid x) = 1 - \Phi(x\alpha) \tag{2.3}$$

$$\mathrm{Log}(y|x, \theta) = 1(y = 0) \ln\left[\Phi\left(\frac{x\beta}{\sigma}\right)\right] + 1(y > 0)\ \{\ \ln\left[\frac{\phi(x\beta)}{\phi\left(\frac{x\beta}{\sigma}\right)}\right] + \ln[\frac{1}{\sigma\sqrt{2\pi}} \exp(-\frac{1}{2\sigma^2}(y - x\delta)^2]\}$$

(2.4)

Tobit hypothesis

$\beta = \delta/\sigma \rightarrow$ Tobit

$\beta \neq \delta/\sigma \rightarrow$ Double Hurdle

The main issue between a sample selection model and a corner solution model is data observability. For corner solution problems, all data is observed and non-participation implies that some economic agents have made the optimal choice of a corner solution i.e. $y = 0$. Examples here include, charity contribution, labour supply decisions, expenditure on research etc. According to Wooldridge (2002) pp 520-21, it is important to avoid emphasizing on the latent variable y^* when dealing with corner solution problems since our variable of interest, y is observed.

In sample selection problems, and more precisely in cases of incidental truncation, some part of the dependent variable is not observed as a result of the outcome of another variable. In this case, it is erroneous to infer a zero for non-participation and any estimation based on the

selected sample would be biased unless we account for those agents who never participated or whose data is missing through the correction term as described above.

From the above discussion and given the nature of the problem in this study, we adopt the two step method advanced by Craig (1971) usually known as the double hurdle model to model market participation decisions. In this, we assume that non participation is a purely economic decision by households not to participate in the market. To account for market participation for both inputs and outputs, we estimate output supply functions and input demand functions separately.

Output supply

The estimated double hurdle model for market supply thus takes the following specification:

$$P(Y_1 = 1) = P(Q_s > 0) = X_1\alpha + \varepsilon \qquad \text{(market participation model)} \qquad (2.5)$$

$$Q_s = Z_1\beta + \mu \qquad \text{(intensity model)} \qquad (2.6)$$

Equation 2.5 defines the market participation model where Y_1 takes the value of one if a household made any positive sales to the market and zero if no sales were made. Q_s is the proportion of quantity sold (or alternatively might represent the quantity sold or value sold) and X_1 and Z_1 define factors that affect the discrete probability of participation and intensity of participation respectively.

Input Demand

$$P(Y_2 = 1) = P(Q_p > 0) = X_2\delta + \eta \qquad \text{(market participation model)} \qquad (2.7)$$

$$Q_p = Z_2\beta + \upsilon \qquad \text{(intensity model)} \qquad (2.8)$$

Equation 2.7 defines the market participation/input adoption model and Y_2 takes the value of one if a household purchased or used the respective input and zero if no purchases were made or no input was used. Q_p is the quantity of input purchased/used and X_2 and Z_2 define factors that affect the discrete probability of input use/adoption and intensity of use, respectively.

2.2.2.2 Variable Descriptions

Factors that may influence a household's participation in output and/or input markets are grouped into five categories: demographic characteristics and human capital; physical and financial resource endowments; distances to markets and information; membership in groups; output and input prices; and agricultural potential. These factors are discussed below, where direct and indirect indicators for transaction costs are printed in bold.

Demographic characteristics and human capital: Included under this category are gender, age, education of household head and dependency ratio.[5] Gender of household head is expected to capture differences in market orientation between males and females with males expected to have a higher propensity to participate in markets than females. Age of household head is an indicator of experience in farming. It is expected that higher age, and therefore, more experience in farming will improve orientation to market participation. On the other hand, experience can also be expected to be negatively associated with market participation, as older household heads (up to a certain maximum) tend to have more dependents and hence more subsistence production activities (Ehui, et al, 2009). The conventional age squared variable is added. Human capital is represented by formal education of household head. Education enhances the skill and ability to better utilize market information, which may reduce marketing costs and make it more profitable to participate in the market. Higher dependency ratio is expected to lower the propensity of a household to participate in markets. Household size may explain a household's family labour supply for production activities. This measure, however, assumes that all household members are actively involved in family labour provision. Dependency ratio, which takes care of the level of burden active household members bear, is, therefore, used in this analysis. It is expected that a higher dependency ratio will result in a household consuming a higher proportion of its produce and hence leaving lower proportions for sale. All of these variables can be considered as indicators of household specific transaction costs.

Physical and financial resource endowments: Included in this category are per capita land size, **ownership of transport equipment** and **ownership of communication equipment**. Both of the latter are further proxies for household specific transaction costs. Ownership of

[5] A household's dependency ratio is calculated by dividing the number of individuals under 15 years of age plus the number of individuals over 64 years of age by the number of individuals from 15 to 64 years.

transport and communication equipment such as telephone, radio and television is expected to have a positive impact on the decision to participate in markets. Land may have indirect positive impacts on market participation by enabling farmers to generate production surpluses, overcome credit constraints, where land can be used as collateral for credit, and allow them to adopt improved technologies that increase productivity. Ownership of transport equipment such as bicycles, motorcycles and vehicles is expected to have a positive impact on market participation by reducing the cost of transporting inputs from the market to the farm and output from the farm to the market. **Access to market information,** which can be a household and/ or location specific transaction cost indicator, is important insofar as marketing decisions are concerned. Quintiles of lagged household income are included in the analysis to capture the effects of household financial resources on market participation. Higher income is expected to stimulate production through adoption of productivity enhancing inputs. Higher production in turn is expected to increase market participation.

Distances to service and infrastructure: **Distance to tarmac road, extension service and fertilizer seller** are included to capture the role of travel costs in influencing market participation. It is expected that longer distances increase travel time and travel costs, which impact negatively on market participation. These are location specific and to a lesser extent household specific measures of transaction costs.

Membership in groups: **Participation in farmer groups increases** a household's access to information important to production and marketing decisions. Many farmer groups also engage in group marketing as well as credit provision for their members. It is expected that membership in groups will positively impact on market participation. This may be a measure of household specific as well as location specific transaction costs.

Output and input prices: District median prices for various crops, milk and fertilizer are used. For crops grouped in one category, the simple average of the district median prices for the individual crops is used. District median prices were constructed from the actual prices reported by the households that sold produce or bought fertilizer. Prices are indirect indicators of location specific transaction costs, reflecting cost of commerce and integration of the local market in the national/ regional market. Prices could also constitute indirect measures of crop specific transaction costs. For instance, crop characteristics such as perishability might make prices of such crops to fluctuate differently from those of storable crops. Higher output price acts as an incentive to sell. Output price is, therefore, expected to

have a positive impact on market participation. Fertilizer price, on the other hand, is expected to have a negative impact on fertilizer use.

Agro-regional zone dummies were included in the analyses to account for differences in agricultural potential across the zones. The Lowlands have the least agricultural potential. Western transitional, Western highlands and Marginal rain shadow can be said to be medium potential while Central highlands and High potential maize zone have the highest agricultural potential. It is expected that market participation would be lower in marginal agricultural potential zones.

To account for variations across the survey years of 2000, 2004 and 2007, year dummies were included using 2000 as the comparison year.

2.2.2.3 Estimation

As discussed earlier, the output supply and input demand functions are estimated using the double hurdle model of Craig (1971) involving a Probit model for the first stage and truncated normal regression for the second stage. We use the value of the log-likelihood to select the truncated regression against the log-normal formulation. The two stages of the double hurdle are estimated separately based on the assumption that the respective error terms (ε and μ; η and υ) are not correlated.

2.2.3 Input and Output Categories

The inputs included in the analyses are inorganic fertilizers and improved seed varieties for all crops. In addition, use of improved maize varieties has been analyzed separately, given the importance of maize as main staple crop and investments that have gone into development of improved maize seed varieties in Kenya in the recent past. Apart from these inputs, access to credit and savings account has also been analysed.

Various crops, animals, animal products and inputs are included in the analyses. The crops are grouped into ten categories: maize; beans; other cereals and pulses; bananas; roots and tubers; vegetables; fruits; tea, coffee and sugar cane; other cash crops; and nappier grass and other feeds. Maize is the main staple crop in Kenya and is produced in virtually all agricultural regions of the country. Among the households in this study, over 98% produced maize between 2000 and 2007. The other cereals category includes wheat, rice, sorghum and millet while roots and tubers are primarily irish and sweet potatoes, cassava and arrow roots.

The category for vegetables includes kales (*sukuma wiki)*, onions, cabbages, tomatoes and cowpeas leaves while in the fruits category are avocadoes, mangoes and pawpaw among others. Other cash crops include tobacco, cotton, sunflower, pyrethrum and khat (*miraa).* Among the categories of crops, maize, beans and other cereals and pulses are not perishable and can be stored for future consumption or marketing. Vegetables and fruits, on the other hand, are highly perishable and must be consumed or sold off a few hours or days after harvesting. This makes market access for vegetables and fruits critical among the producing households. Although roots and tubers are not highly perishable, they cannot be stored for as long as the cereals and pulses hence the need for them to reach markets not long before harvesting. The major cash crops – tea, coffee and sugar cane – have institutional marketing arrangements with cooperatives or commodity companies, which makes marketing less of a problem compared to cereals, fruits, vegetables and roots and tubers.

Production and marketing of cattle, sheep and goats and chicken are analysed. Cattle are separated into two types; indigenous and improved. The separation was deemed necessary since the investments into the production and the quantity of products derived from the two types of livestock differ. Sheep and goats are combined as small ruminants. Production and marketing of two animal products – milk and eggs – are analysed.

3. Data and Sample

The data for this study was drawn from the Tegemeo Agricultural Policy Research and Analysis (TAPRA) panel data set collected by Tegemeo Institute of Egerton University with support from the United States Agency for International Development (USAID). The TAPRA dataset was collected over a ten year period (1997-2007) and was obtained through rural household surveys covering 24 administrative districts, 39 divisions and 120 villages using structured questionnaires. The data was classified into 8 agro-regional zones based on existing agro-ecological zones and population density[6]. Detailed information on land use, crop production, livestock and livestock products, off-farm activities, demographic characteristics, consumption, food security and asset endowment were collected.

This current study is based on 1,275 households and covers the 1999/00, 2003/04 and 2006/07 cropping years (hereafter referred to as 2000, 2004 and 2007, respectively). The distribution of the sampled districts and interviewed households across various agro-regional zones is presented in Table 1. The agro-regional zones represent differing agricultural potential with the Lowlands having the lowest potential, Western transitional and Marginal rain shadow represent medium potential while the Highlands and the High potential maize zone have the highest agricultural potential.

Table 1: Distribution of Sampled Districts by Agro-Regional Zones

Agro-regional zone	Districts	No. of households
Coastal Lowlands	Kilifi, Kwale	75
Eastern Lowlands	Machakos, Mwingi, Makueni, Kitui, Taita-Taveta	145
Western Lowlands	Kisumu, Siaya	153
Western Transitional	Bungoma (lower elevation), Kakamega (lower elevation)	148
Western Highlands	Vihiga, Kisii	129
Central Highlands	Nyeri, Muranga, Meru	242
High-Potential Maize Zone	Kakamega (upper elevation), Bungoma (upper elevation) Trans Nzoia, Uasin Gishu, Bomet, Nakuru, Narok	346
Marginal Rain Shadow	Laikipia	37
Overall sample		**1275**

[6]Refer to Argwings-Kodhek (1997) for a detailed discussion on the sample design

4. Results and Discussion

In depth descriptive analyses on the characteristics of the identified marginalized groups and their participation in input and output markets are presented and discussed in this section. Results of the econometric estimation of market participation are also presented and discussed.

4.1. Descriptive Analysis

4.1.1. Characteristics of Marginalized Groups

This sub-section presents a discussion on the marginal groups of interest, their classification, relationships and socio-economic characteristics. The analysis focuses on three groups of households; female headed households, poor households (income and land poor) and households in the marginal agricultural production areas.

4.1.1.1. Classification and Relationship among Marginalized Groups

Female Headed Households

Female headed households are classified as marginalized given the difficulties they face in terms of access to land and other assets especially in an African context[7]. As indicated in Table 2, the proportion of female headed households consistently rose from 12% to 24% between 2000 and 2007. Further analysis revealed that 87% of the female heads in 2004 and in 2007 were widows, indicating an increasing responsibility of women in caring for families, and suggests increasing need for interventions that economically empower women.

[7] The study team acknowledges that there are some other classifications that could be used to articulate the marginalization of women in particular young single mothers but this was not possible given the nature of the panel dataset used that left very few young heads. In addition, the data collected is mainly at the household level as opposed to individual level and hence it was not possible to include all women in the household. The use of the female head is based on the fact that these heads are assumed to make all critical decisions on behalf of the household.

Table 2: Marginal Groups and their Relationships

Relationships	2000	2004	2007
% of female headed households	11.8	20.3	23.5
% of income poor households	42.3	41.6	37.6
% of land poor households		37.7	37.8
% of households in marginal agricultural areas	32.2	32.2	32.2
% of female headed households that are income poor	54.3	54.4	50.7
% of male headed households that are income poor	40.7	38.4	33.5
% of female headed households that are land poor		32.0	33.7
% of male headed households that are land poor		39.2	39.1
% of female headed households that are both income and land poor		27.4	26.7
% of male headed households that are both income and land poor		21.7	19.6
% of income poor households that are land poor		54.8	56.6
% of land poor households that are income poor		60.5	56.2
% of both income and land poor households		22.8	21.3
% of households in marginal agricultural areas that are female headed	13.9	25.4	29.5
% of households in marginal agricultural areas that are income poor	59.0	48.8	47.3
% of households in marginal agricultural areas that are land poor	37.8	36.1	38.0

Income Poor Households

The level of household income per adult equivalent was used as the basis for defining a household as poor or non-poor. Household income comprised of crop income (gross value of crop production less input costs); livestock income (gross value of livestock products plus sales of live animals less purchases of live animals plus input costs); salaries for all household members; business income for all household members; income from informal labour employment for all household members; and remittances and share dividends received by all household members.

To account for differences in the size of households, adult equivalents (see Annex 1) categorization was used to get household annual income per adult equivalent, which was converted into monthly values by dividing by 12. The resulting monthly income per adult equivalent for each household in each of the three years was compared with nominal poverty threshold for that year: Ksh 1,347/month in 2000; Ksh 1,490/month in 2004; and Ksh 1,598/month in 2007. The nominal poverty lines for the respective years were computed by linear extrapolation of the Kenya rural poverty lines for 1997 (Ksh 1,239) and 2006 (Ksh 1,562) as provided by the Kenya National Bureau of Statistics. A household was defined as income poor in a particular year if its monthly income per adult equivalent was below the

poverty threshold and non poor if its income per adult equivalent was at par with or above the poverty threshold for that year.

On the basis of this, it is observed that the proportion of income poor households declined from 42% to 38% between 2000 and 2007 (Table 2). This declining trend in poverty is generally consistent with that observed at the national level over the same time period.

Land Poor Households

Ideally, there is no universal threshold of land size for use in determining whether a household is or is not land poor. This is partly due to the fact that land has variable quality depending on use, location and fertility, among others. It is recorded in the World Development Report by The World Bank (2008) that the average per capita arable and permanent crop land size in Kenya is 0.2 hectares (approximately 0.4942 acres). Based on this information, a household was considered land poor if its per capita land size was below 0.49 acres and land non-poor if it had a per capita land size of above 0.49 acres. On the basis of this definition, Table 2 indicates that approximately 38% of the households in 2004 and 2007 were land poor[8].

Households in Marginal Agricultural Areas

For the purposes of this analysis, the agro-regional zones as discussed in section 3 were grouped into two: high potential, comprising of the zones with relatively high agricultural potential (Central and Western Highlands, High Potential Maize Zone and Western Transitional); and low potential, comprising of the zones with low agricultural potential (Western, Eastern and Coastal Lowlands and Marginal Rain Shadow). Approximately 32% of the sample households were in the low agricultural potential areas (Table 2). Given that the sample is a balanced panel, this proportion does not change across the years.

On the relationships among the marginalized groups, it is observed that over 50% of the female headed households were income poor between 2000 and 2007, while the proportion of male headed households that was income poor was significantly lower and declined from 41% in 2000 to 34% in 2007. On the contrary, while over 30% of female headed households

[8] The year 2000 is excluded in all the descriptive analyses touching on household land size because this information was not collected in that year.

were land poor, the percentage of land poor male headed households was 39% in 2004 and 2007. This rather unexpected result could arise from the relatively lower average household size observed for female headed households as compared to their counterparts (Table 3b). Approximately 27% and 20-22% of female and male headed households, respectively, were both income poor and land poor between 2004 and 2007, indicating that a larger proportion of female than male headed households are more constrained in terms of land and income.

Over 54% of the income poor households were land poor, while 60% and 57% of land poor households in 2004 and 2007 respectively were also income poor. This implies a positive correlation between income poverty and land poverty.

The proportion of female headed households in the marginal agricultural areas increased from 14% to 30%, while the proportion of the income poor in these areas declined from 59% to 47% between 2000 and 2007. The proportion of the land poor households in the marginal areas, however, remained at 38% in 2007 after the initial decline from 38% to 36% between 2000 and 2004. These results indicate that by 2007, about 30% of the female headed, 47% of the income poor and 38% of the land poor households were also marginalized in terms of agricultural potential, indicating that those that are marginalized in one aspect are also likely to be marginalized in many other aspects.

4.1.1.2 Socio-Economic Characteristics

The proportion of marginal groups and their relationships may only provide a snapshot of the structure of the sample in terms of the defined groups. Understanding the socio-economic characteristics of these households can provide an insight about why they are considered marginalized. This sub-section highlights selected socio-economic characteristics of these households namely education, demography (age and household size), household income, land and asset endowment.

Education

The proportion of household heads under each of the broad education categories is presented in Table 3a. In the overall, over 70% of the households were headed by persons with at least primary level of education. Approximately 20% of the household heads had secondary education while only slightly over 5% of the heads had post-secondary education. The proportion of household heads with no formal education averaged 20% across the three years.

Across the marginalized groups, female headed households have a higher proportion of heads with no formal education compared to the other marginalized groups. In general, land poor households had a closely similar distribution in education as with the general population or average household. Similarly for households in marginal agricultural areas with the exception of the category without formal education which stands out higher than the average household. The largest deviation from the average household was mainly observed with female heads followed by income poor. This reveals the clear disadvantage that women heads have with respect to education.

Table 3a: Proportion of Households by Education Category

		2000	2004	2007
All households	No education	19.5	20.4	19.8
	Primary	53.3	51.9	52.9
	Secondary	21.4	20.2	20.4
	Post-secondary	5.7	7.5	6.9
Female headed households	No education	41.1	41.7	40.7
	Primary	50.3	49.8	52.0
	Secondary	5.3	7.3	5.7
	Post-secondary	3.3	1.2	1.7
Income poor households	No education	27.3	26.4	25.9
	Primary	57.7	56.3	57.0
	Secondary	13.7	15.4	15.0
	Post-secondary	1.3	1.9	2.1
Land poor households	No education		18.3	18.0
	Primary		55.1	57.7
	Secondary		20.6	19.7
	Post-secondary		6.0	4.6
Marginal agricultural households	No education	25.9	26.1	24.6
	Primary	51.0	51.0	52.2
	Secondary	18.3	18.0	18.3
	Post-secondary	4.9	4.9	4.9

Demography

The age of household head increased between 2000 and 2007 (Table 3b). Female household heads were slightly older than the overall sample's average across all the years. As expected, land poor households were headed by slightly younger persons. Overall, the number of persons per household in the entire sample declined from seven to six between 2000 and 2007. The size of income and land poor households was larger than that of female headed households across all the years. Households in marginal agricultural areas were of similar size as those of the average household.

Table 3b: Age of Head and Household Size

	2000	2004	2007
Age of head (years)			
All households	53.7	56.5	58.7
Female headed households	55.4	57.9	60.5
Income poor households	55.0	57.1	58.9
Land poor households		54.1	56.6
Marginal agricultural households	54.0	56.5	58.3
Size (number of people)			
All households	6.6	6.0	5.8
Female headed households	5.6	4.8	4.6
Income poor households	7.2	6.8	6.8
Land poor households		7.1	7.0
Marginal agricultural households	6.5	6.4	5.9
Size (number of adult equivalents)			
All households	7.3	5.2	5.0
Female headed households	6.4	4.0	3.9
Income poor households	7.6	5.8	5.8
Land poor households		6.0	6.0
Marginal agricultural households	7.0	5.4	5.0
Dependency ratio			
All households	0.85	0.77	0.76
Female headed households	0.69	0.75	0.81
Income poor households	0.93	0.88	0.84
Land poor households		0.90	0.87
Marginal agricultural households	0.94	0.86	0.79

Household Income

In the overall, the annual household income increased from Ksh. 159,590 in 2000 to Ksh. 190,984 in 2007 (Table 4), a trend that was observed for all categories of households. However, the marginalized groups had income levels far below the sample average; the income poor households had less than half the average income for the whole sample across all the years. Notably so, male headed households had significantly higher income per adult equivalent than female headed households across the three years. However, female headed households had higher incomes than the income and land poor households, but lower incomes than the households in the agriculturally low potential areas. These results indicate a much deeper marginalization for the income poor with only a per capita income of about Ksh 10,724 in 2007 (72,922/6.8), which is way below the national average. Such households

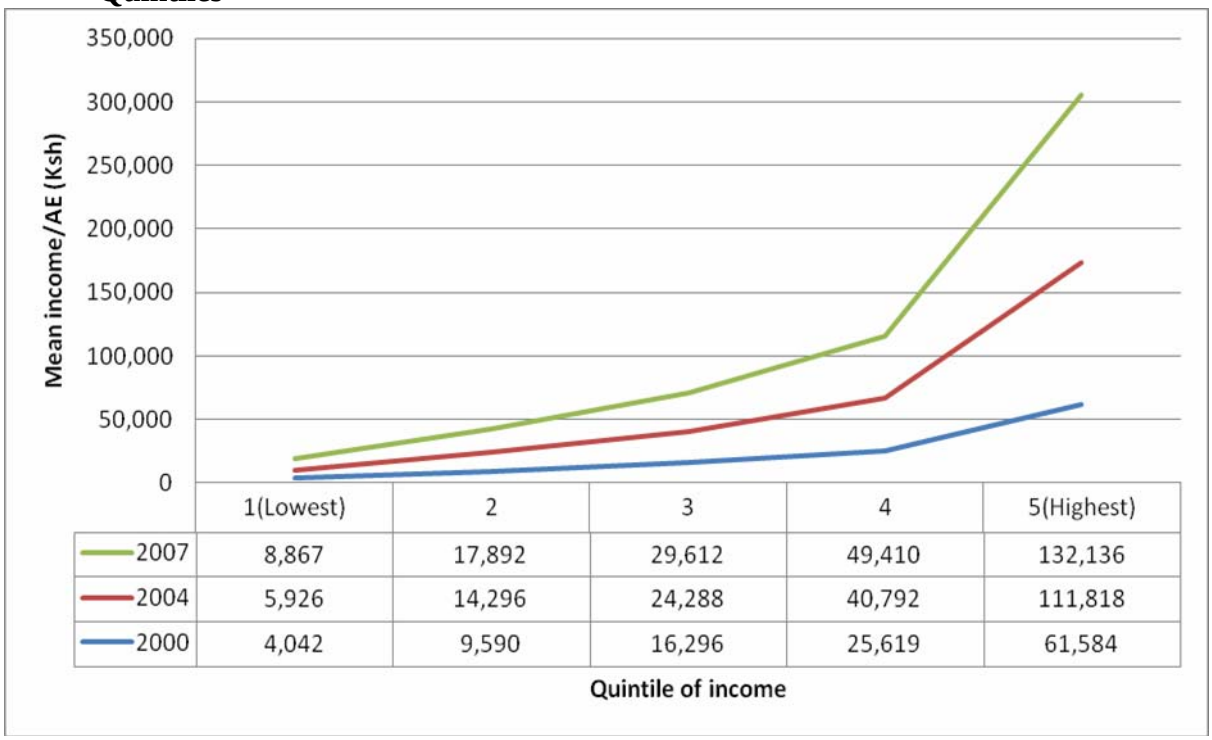
cannot productively engage in farming activities given the limitations in acquiring productivity enhancing inputs.

Table 4: Household Mean Annual Income (Ksh)

	2000	2004	2007
Mean annual income (Ksh)			
All households	159,590	170,612	190,984
Female headed households	103,372	107,263	117,018
Male headed households	167,143	186,761	213,743
Income poor households	55,200	60,035	72,922
Land poor households		115,348	129,700
Marginal agricultural households	108,532	146,350	153,043
Mean annual income per adult equivalent (Ksh)			
All households	23,426	39,464	47,584
Female headed households	18,446	33,631	40,059
Male headed households	24,095	40,952	49,899
Income poor households	7,389	10,784	13,423
Land poor households		21,103	24,816
Marginal agricultural households	16,319	32,793	37,499

Household income per adult equivalent across income quintiles is presented in Figure 1. The quintiles are a classification of the households into five classes based on annual income per adult equivalent, with each quintile consisting of 20% of the households. The income quintiles were constructed separately for each year. It is observed that the absolute growth in income doubled for all the quintiles between 2000 and 2007, suggesting that the income inequality among the quintiles probably did not change much, though the absolute difference between the rich and the poor is much higher; about Ksh. 123,000 in 2007 compared to Ksh. 57,000 in 2000.

Figure 1: Household Mean Annual Income (Ksh) Per Adult Equivalent across Income Quintiles



The distribution of households by gender of household head across the income quintiles is presented in Table 5. The trends show that the proportion of male headed households increases up the income ladder across all the years. Conversely, the distribution of female headed households is skewed towards the lowest income quintiles, with the proportion falling up the income ladder. These results echo those presented in Table 4 and suggest that female headed households are poorer than their male counterparts, emphasizing the need for efforts to expand economic opportunities for women.

Table 5: Distribution of Households by Gender of Head across Quintiles of Income Per Adult Equivalent

Quintile of income per AE	**2000**		**2004**		**2007**	
	Male headed	Female headed	Male headed	Female headed	Male headed	Female headed
	----------% of households----------					
1(Lowest)	18.4	31.8	18.6	25.6	17.4	28.3
2	19.1	26.5	19.2	23.3	19.4	22.0
3	21.0	12.6	20.1	19.8	20.7	17.7
4	20.7	14.6	20.5	18.2	21.1	16.3
5(Highest)	20.7	14.6	21.7	13.2	21.3	15.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

The shares of household income sources, disaggregated by gender of household head, are presented in Table 6. Generally, crops followed by livestock are the largest contributors to household income, signifying the important role of farming to the rural folk. Across gender of the household head, crop enterprises are more important for female than male headed households in terms of contribution to household income. Businesses and informal labour activities, salaries and remittance command a larger share in household income among the male headed households than among the female headed households. It is also observed that for women, business and informal labour activities noticeably increased in importance while the importance of livestock went down.

Table 6: Share (%) of Income Sources in Total Household Income, by Gender of Household Head

Year	Income source	Gender of household head		
		Male	Female	Overall
2000	Crops	48.7	51.4	49.0
	Livestock	17.9	22.8	18.4
	Business and informal labour activities	16.6	12.5	16.1
	Salaries and remittance	16.9	13.3	16.5
2004	Crops	43.8	48.1	44.7
	Livestock	20.1	21.7	20.4
	Business and informal labour activities	15.5	14.0	15.3
	Salaries and remittance	20.5	16.2	19.7
2007	Crops	43.9	50.6	45.4
	Livestock	19.0	18.8	18.9
	Business and informal labour activities	19.1	17.1	18.6
	Salaries and remittance	18.0	13.5	17.0

Across quintiles of income per adult equivalent, the pattern shows that crop enterprises generally account for the largest share in household income (Table 7). However, it is observed that the contribution of crops to household income is highest (between 48% and 54%) among households in the lowest income quintile, and decreases with income. The share of businesses and informal labour activities in household income also generally decreases as income increases. The contribution of salaries and remittance, in the contrary, increases up the income quintiles. These results indicate that low income households derive their livelihood mainly from the farm and the informal rural sector, while their relatively rich counterparts generate quite some income from the formal employment sector.

The contributions of crops and salaries to household income are pretty much the same across quintiles of land size[9]. However, the importance of livestock increases while that of businesses and informal labour activities decreases with increase in land size.

Table 7: Share (%) of Income Sources in Total Household Income, by Quintiles of Income and Land Size

Year	Income source	Quintiles of income per AE					Overall
		1 (Lowest)	2	3	4	5 (Highest)	
2000	Crops	54.2	46.6	46.4	47.6	50.6	49.0
	Livestock	19.3	18.3	20.6	17.3	16.7	18.4
	Business and informal labour activities	17.8	19.4	12.7	15.1	16.1	16.1
	Salaries and remittance	8.7	15.7	20.3	20.0	16.6	16.5
2004	Crops	51.0	44.4	45.4	43.2	40.5	44.7
	Livestock	18.7	21.6	21.9	20.6	19.1	20.4
	Business and informal labour activities	16.0	17.8	14.8	13.6	14.3	15.3
	Salaries and remittance	14.3	16.3	17.9	22.5	26.1	19.7
2007	Crops	47.6	45.7	46.5	45.1	42.8	45.4
	Livestock	16.7	18.7	20.5	20.5	17.9	18.9
	Business and informal labour activities	26.5	20.4	18.6	15.0	14.5	18.6
	Salaries and remittance	9.2	15.2	14.4	19.4	24.7	17.0
		Quintiles of land size					Overall
		1 (Lowest)	2	3	4	5 (Highest)	
2004	Crops	42.3	43.4	45.8	45.7	45.9	44.7
	Livestock	19.9	18.3	18.6	21.3	24.1	20.4
	Business and informal labour activities	17.3	16.3	15.1	14.8	12.9	15.3
	Salaries and remittance	20.5	22.0	20.5	18.2	17.0	19.7
2007	Crops	43.6	46.5	45.3	46.9	44.9	45.4
	Livestock	18.2	16.4	17.0	19.5	23.8	18.9
	Business and informal labour activities	21.7	20.7	18.5	15.8	16.3	18.6
	Salaries and remittance	16.6	16.4	19.2	17.8	15.1	17.0

Household income sources disaggregated by agricultural potential are presented in Table 8. It is observed that farm activities (crops and livestock) account for a higher share of household income in the high potential than in the low potential agricultural areas. The reverse is true for the share of off-farm activities (business/informal labour activities, salaried wage and remittance income). This may be an indication of greater off-farm diversification by households in the low potential agricultural areas as a response to the low agricultural performance.

[9] The quintiles of land size are a classification of the households into five classes based on owned land size in acres, with each quintile consisting of 20% of the sample of households.

Table 8: Share (%) of Income Sources in Total Household Income, by Agricultural Potential

Year	Income source	Agricultural potential		
		Low potential	High potential	Overall
2000	Crops	41.3	52.3	49.0
	Livestock	14.2	20.2	18.4
	Business and informal labour activities	23.0	13.2	16.1
	Salaries and remittance	21.5	14.4	16.5
2004	Crops	34.9	48.8	44.7
	Livestock	14.1	23.1	20.4
	Business and informal labour activities	24.1	11.5	15.3
	Salaries and remittance	26.8	16.6	19.7
2007	Crops	37.7	48.5	45.4
	Livestock	14.1	20.8	18.9
	Business and informal labour activities	26.5	15.5	18.6
	Salaries and remittance	21.6	15.2	17.0

Household Land Size

On average, the sampled households owned six acres of land (Table 9). Generally, the marginalized households owned smaller land sizes than the sample average. It should also be noted that household land size generally declined between 2004 and 2007, indicating increasing pressure on land among these agricultural households, perhaps as a result of frequent sub-division.

Table 9: Mean Household Land Size

	2004	2007
Land size (acres)		
All households	6.1	5.8
Female headed households	4.6	4.5
Income poor households	4.1	3.6
Land poor households	1.9	1.9
Marginal agricultural households	5.1	4.8
Per capita land size (acres)		
All households	1.2	1.3
Female headed households	1.2	1.5
Income poor households	0.7	0.9
Land poor households	0.3	0.3
Marginal agricultural households	1.0	1.2

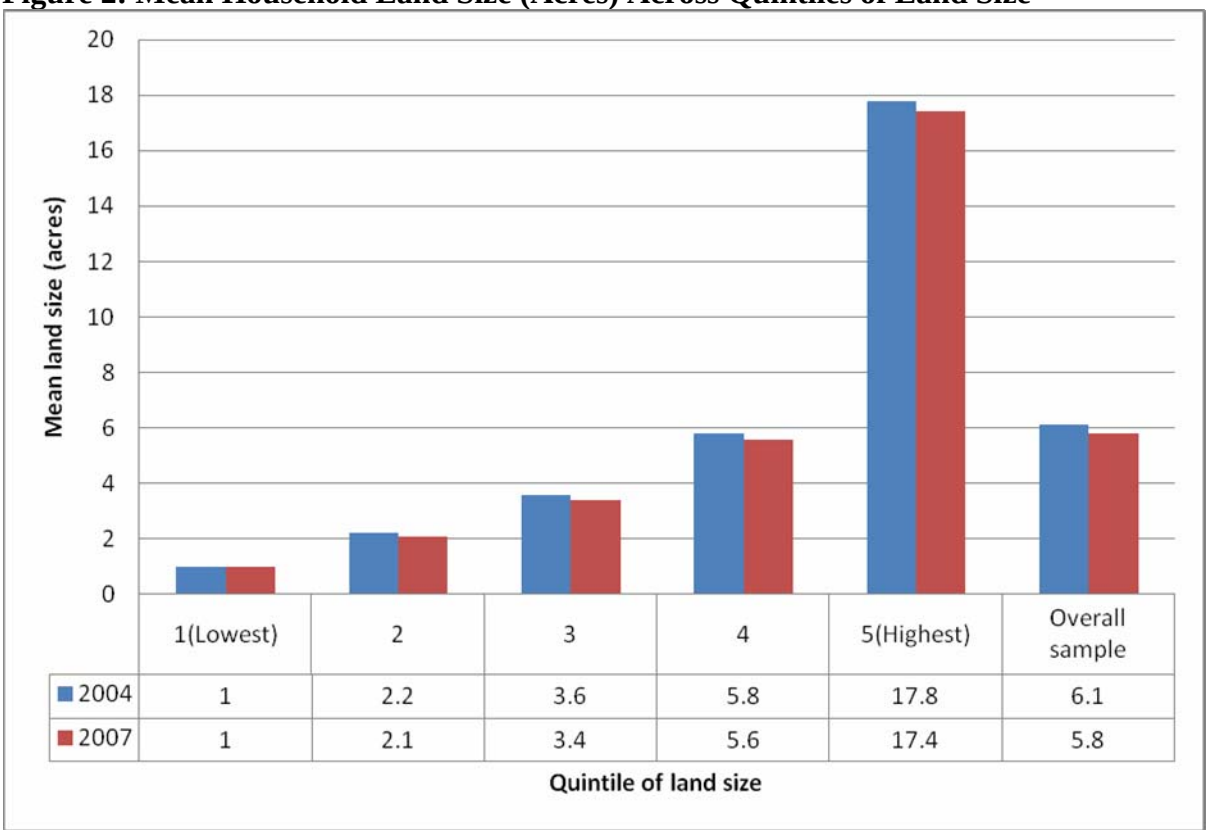
The distribution of female headed households is skewed towards the lowest quintiles of land size, with the proportion falling up the quintiles, indicating that majority of female heads are land constrained (Table 10). The distribution of male headed households does not, however, exhibit a clear pattern.

Table 10: Distribution of Households by Gender of Head across Quintiles of Land Size

Quintiles of land size	2004		2007	
	Male headed	Female headed	Male headed	Female headed
	----------% of households--------			
1(Lowest)	18.9	26.4	18.7	28.3
2	17.6	23.6	20.2	21.7
3	22.4	19.8	21.8	19.3
4	18.6	16.3	17.7	15.3
5(Highest)	22.5	14.0	21.5	15.3
Total	**100.0**	**100.0**	**100.0**	**100.0**

There is a very wide disparity in land size across the household land size quintiles, with households in the highest quintile owning more than 17 times larger pieces of land than their counterparts in the lowest quintile (Figure 2).

Figure 2: Mean Household Land Size (Acres) Across Quintiles of Land Size

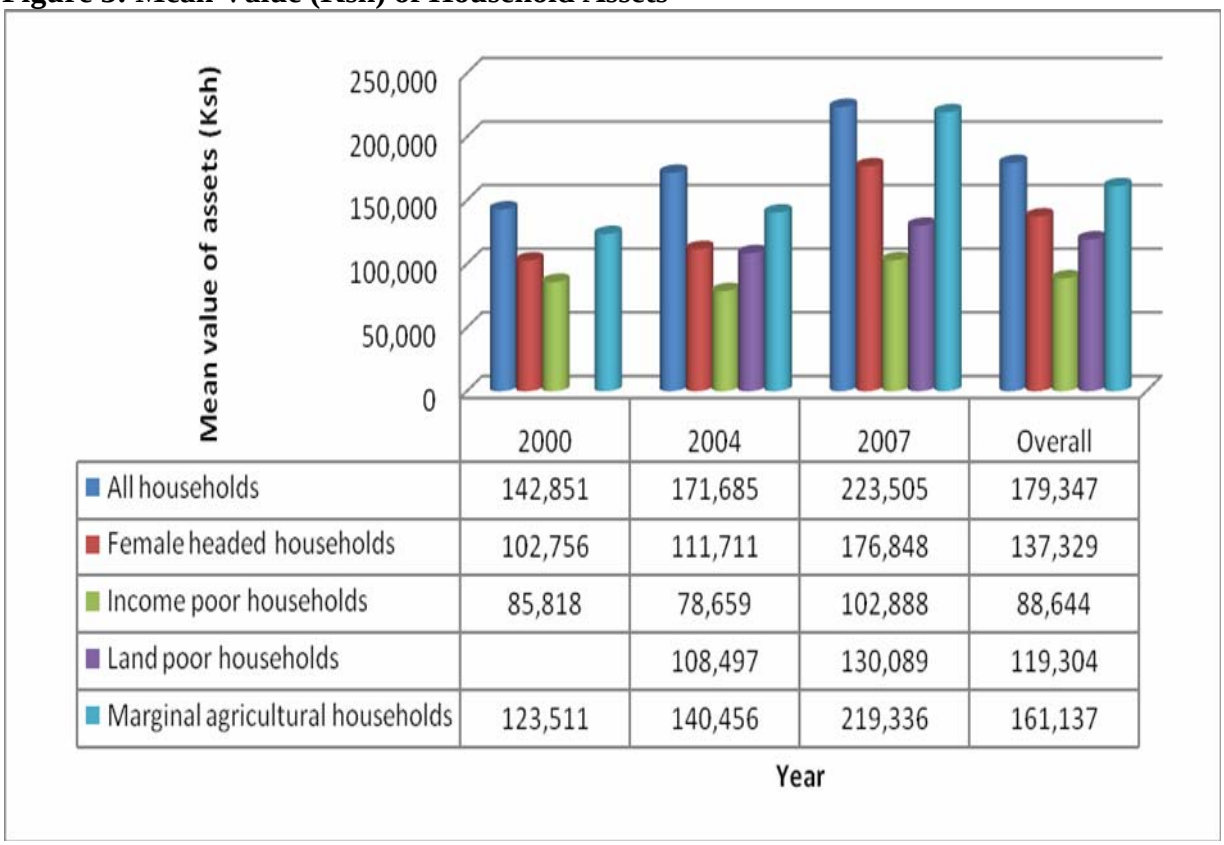


Household Assets

The mean value of household assets disaggregated by marginalized groups is presented in Figure 3. Three observations can be made. First, the value of household assets generally increased between 2000 and 2007 for all households. This increase could imply that households allocated some of their incomes to accumulating assets, given that household

income also increased during this period. Secondly, all categories of marginalized groups had asset values below the sample mean, suggesting that these groups are relatively asset poor compared to their respective counterparts. Finally, households headed by women had higher asset values than income poor and land poor households, but lower asset values than households in the low potential agricultural areas.

Figure 3: Mean Value (Ksh) of Household Assets



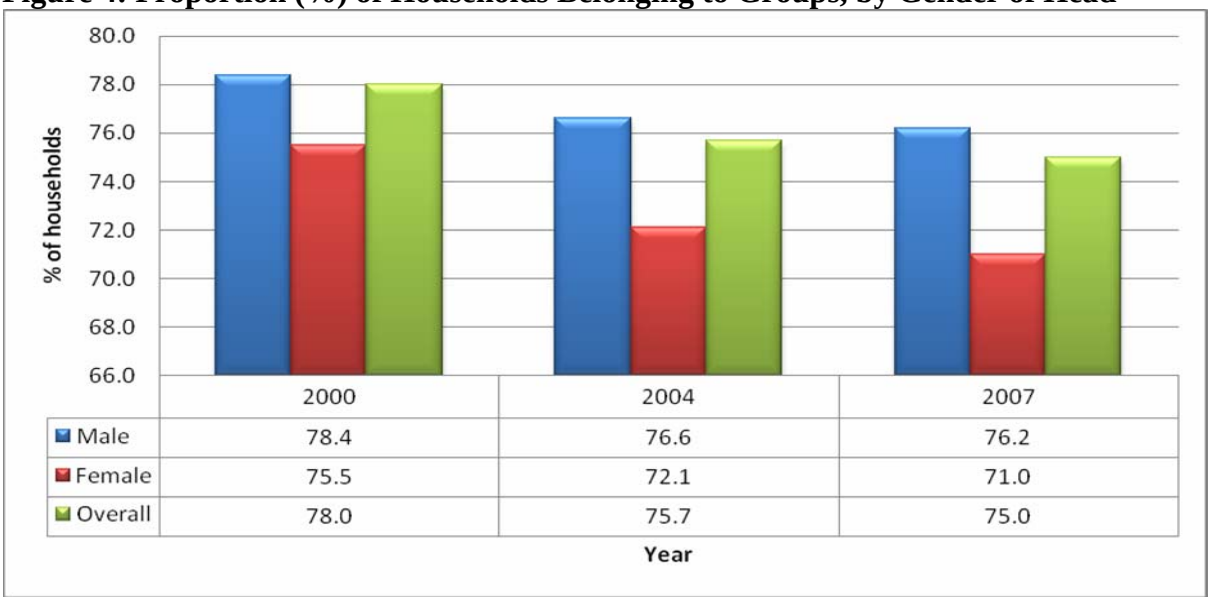
	2000	2004	2007	Overall
All households	142,851	171,685	223,505	179,347
Female headed households	102,756	111,711	176,848	137,329
Income poor households	85,818	78,659	102,888	88,644
Land poor households		108,497	130,089	119,304
Marginal agricultural households	123,511	140,456	219,336	161,137

4.1.1.3 Collective Action and Access to Information and Financial Services

4.1.1.3.1 Collective Action

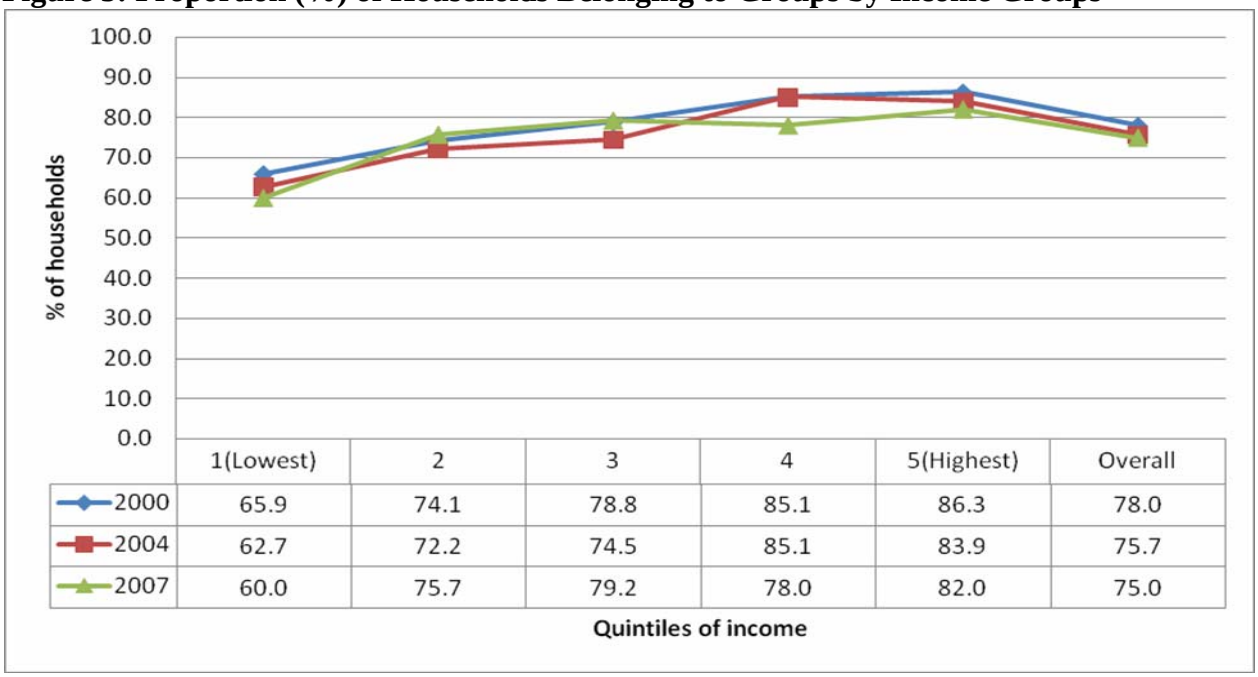
Collective action by farmers can allow stronger bargaining power in the market for inputs and outputs and thus contribute to achieving economies of scale. It also provides a platform for sharing information that may be helpful in production and marketing activities by the farmers. The proportion of households, disaggregated by gender of household head, belonging to groups is presented in Figure 4. Overall, the proportion of households who are members of groups remained considerably high between 2000 and 2007, but with a slight decline across the two years. Across all the years, a slightly higher proportion of male headed than female headed households were members of groups.

Figure 4: Proportion (%) of Households Belonging to Groups, by Gender of Head



The proportion of households belonging to groups generally increased up the income ladder (Figure 5). This may suggest that groups in Kenya are not just about the needy pulling together but also about people with ideas trying to implement them. The causal relationship between social capital, households' income and other factors, however, remains a question for further inquiry in this case.

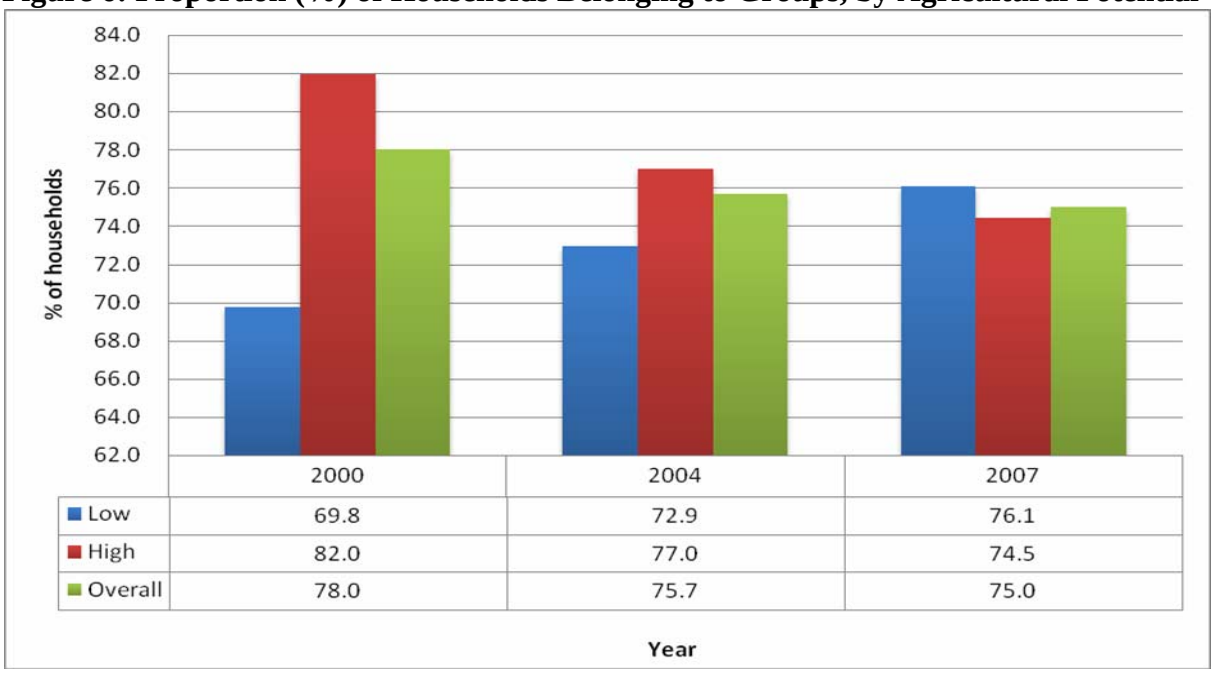
Figure 5: Proportion (%) of Households Belonging to Groups by Income Groups



Across agricultural potential, the proportion of households belonging to groups is over 70% for both the low and high potential areas (Figure 6). However, the low potential areas have

been experiencing an increasing proportion of households belonging to groups while this proportion has been declining in the high potential areas over the years, a scenario calling for further investigation.

Figure 6: Proportion (%) of Households Belonging to Groups, by Agricultural Potential



	2000	2004	2007
Low	69.8	72.9	76.1
High	82.0	77.0	74.5
Overall	78.0	75.7	75.0

4.1.1.3.2 Access to Agricultural Information

Sources of agricultural information disaggregated by gender of household head are presented in Table 11. In the overall, public extension agents, farmers/neighbours/ friends and private extension agents/NGOs were the most common suppliers of agricultural information to the farmers. Farmer organizations/cooperatives and input dealers were the least common sources of agricultural information. Across gender of household head, it is observed that female headed households participate less in formal exchanges outside the farm– input dealers and agricultural shows (10.3% for females versus 17.7% for males). Across income quintiles, the very poorest group is quite distinct from others; more of media and farmers/neighbours/friends and less of public extension agents (Table 12).

Table 11: Sources of Agricultural Information by Gender of Household Head, 2007

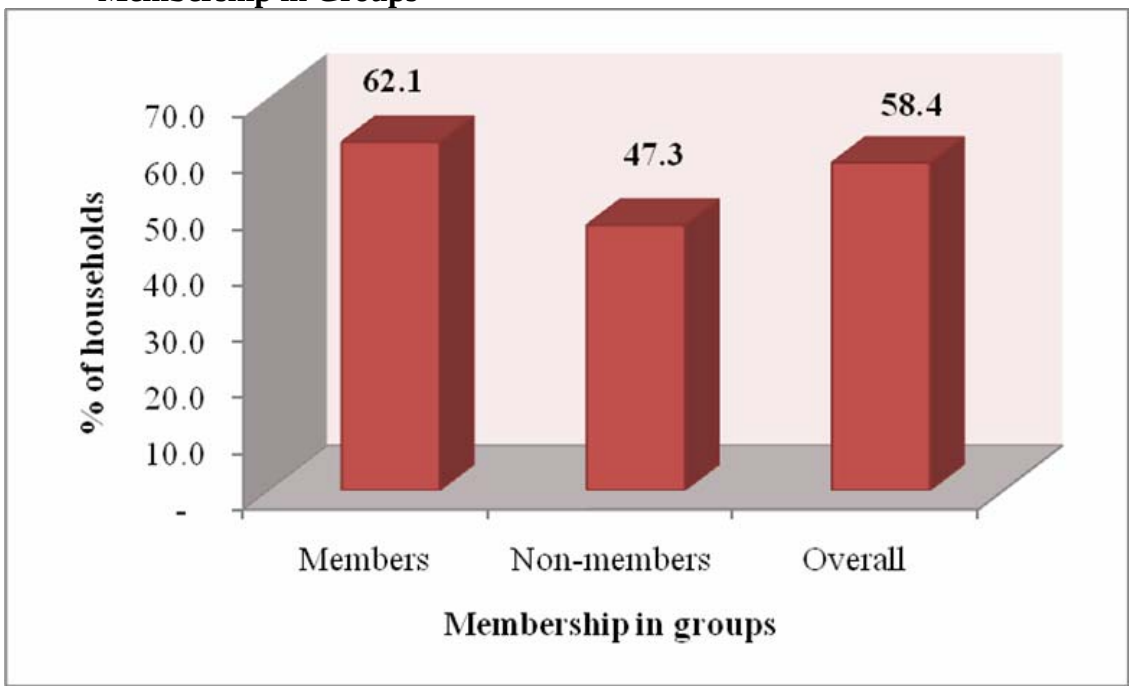
Information source	Male	Female	Overall
	-----% of responses-----		
Public extension agent	37.5	36.0	37.2
Farmers/neighbours/friends	15.5	22.7	16.9
Private extension agents/NGOs	13.6	17.7	14.4
Media	10.0	7.4	9.5
ASK shows/ field days	9.7	3.9	8.6
Traders /input dealers	8.0	6.4	7.7
Farmer orgs /cooperatives	5.7	5.9	5.8
Total	**100.0**	**100.0**	**100.0**

Table 12: Sources of Agricultural Information, by Quintiles of Income and Land Size, 2007

	Public extension agent	Private extension agents/ NGOs	Farmers/ neighbours/ friends	ASK shows/ field days	Traders /input dealers	Media	Farmer orgs /cooperatives
Quintiles of income per AE	----------% of responses----------						
1(Lowest)	27.3	15.7	27.3	4.7	6.4	17.4	1.2
2	45.6	11.2	18.0	6.8	6.8	7.8	3.9
3	34.0	10.4	16.0	11.8	10.4	9.0	8.5
4	41.1	19.3	11.1	8.2	6.3	8.2	5.8
5(Highest)	36.7	15.4	14.3	10.4	8.1	6.9	8.1
Quintiles of land size							
1(Lowest)	34.1	19.4	18.4	4.6	9.2	7.4	6.9
2	38.1	13.8	12.4	10.0	6.7	10.5	8.6
3	40.5	17.6	17.6	6.3	5.9	7.8	4.4
4	37.6	12.7	17.6	10.2	6.8	10.7	4.4
5(Highest)	36.1	8.7	18.3	11.9	9.6	11.0	4.6

The relationship between membership in groups and access to agricultural information is presented in Figure 7. Generally, a higher proportion of group members received agricultural information than non-group members. This is despite farmer organizations/cooperatives being least popular sources of agricultural information. This could indicate the role of collective action in facilitating access to agricultural information from sources other than the groups themselves. It could also be a function of the organizational structure of the extension system and its focus on group based approaches. For instance, the government-run National Agriculture and Livestock Extension Programme (NALEP) uses group approach to deliver extension services to groups of farmers within designated focal areas (Muyanga and Jayne, 2006).

Figure 7: Proportion (%) of Households that Accessed Agricultural Information, by Membership in Groups



4.1.1.3.3 Access to Financial Services

Although collective action and agricultural information services play crucial roles in raising farmers' awareness of and capacity to engage in profitable production and marketing activities, they may not be sufficient without the support of financial services. Consequently, availability of reliable and affordable financial services to farmers is of critical importance in strategies aimed at improving their production and marketing capacity. Table 13 presents patterns of credit access by the sample households over the three years.

The proportion of households that sought credit decreased dramatically between 2000 and 2007. The proportion of credit seeking households that received credit, however, remained high and increased from 92% to 97% during the period. A higher proportion of male than female headed households sought credit. Success rate in acquiring the credit was, however, high (over 80%) for both male and female headed households. The decline in the demand for credit among the sample households can be attributed to limited suppliers of credit to the smallholder farmers. A study by Kibaara (2006) found that few credit providers were willing to lend to agriculture, and that supply of agricultural credit was skewed towards the high potential agricultural regions served by mainly commodity based credit providers and cooperatives.

Table 13: Proportion (%) of Households Seeking and Receiving Credit, by Gender of Head

Year	Gender	% seeking	% of seekers receiving
2000	Male	53.9	92.4
	Female	45.3	86.8
	Overall	**52.9**	**91.8**
2004	Male	40.7	81.1
	Female	33.7	82.6
	Overall	**39.3**	**81.4**
2007	Male	34.8	97.2
	Female	31.8	96.3
	Overall	**34.1**	**97.0**

Across the income groups, the proportion of households that sought and received credit increased up the income ladder (Table 14). It is worth noting that while the proportion of households that received credit did not vary widely between the lowest and highest income group, the proportion of credit seeking households in the highest income group nearly doubled that in the lowest quintile group in 2007. This suggests that the relatively poor households do have constraints that bar them from seeking credit. Across the quintiles of land size, a mixed pattern with no clear trend is observed. However, among the relatively land richest, the proportion of credit seeking households is the lowest. This could be due to the fact that much of the credit is mainly for non-investment purposes (see Table 16 below) and the land rich households may have other sources of income (for instance sale of livestock, given the importance of livestock as observed in Table 7) to accomplish such purposes.

Table 14: Proportion (%) of Households Seeking and Receiving Credit, by Quintiles of Income and Land Size

	2000		**2004**		**2007**	
	% seeking	% of seekers receiving	% seeking	% of seekers receiving	% seeking	% of seekers receiving
Quintile of income per AE						
1(Lowest)	40.0	90.2	27.6	71.4	23.9	95.9
2	45.5	87.1	39.6	71.0	32.9	97.6
3	56.7	93.1	40.6	78.6	32.7	98.2
4	58.4	94.0	42.0	86.0	36.5	95.2
5(Highest)	63.9	93.3	46.9	94.1	44.5	97.8
Overall	**52.9**	**91.8**	**39.3**	**81.4**	**34.1**	**97.0**
Quintile of land size						
1(Lowest)			43.1	83.8	32.0	96.5
2			40.8	79.6	39.1	97.6
3			43.0	85.0	36.9	98.5
4			39.3	82.2	35.6	96.8
5(Highest)			30.3	73.8	27.0	94.9
Overall			**39.3**	**81.4**	**34.1**	**97.0**

As expected, the proportion of households in the low agricultural potential areas that sought credit was lower than in the high potential areas (Table 15). However, a general decline in the proportion of households that sought credit is observed between 2000 and 2007 for both areas. Success rate in acquiring the credit was, high (over 96%) in 2007 for the households in both areas.

The question that begs for answers, therefore, is why households do not seek credit, given that success rate in acquiring credit is over 90%. Cost of credit seeking, availability of alternative income sources and limited credit supply in rural areas may be some of the reasons why majority of households fail to seek credit, but further investigations could shed more light.

Table 15: Proportion (%) of Households Seeking and Receiving Credit, by Agricultural Potential

Year	Agro-potential	% seeking	% of seekers receiving
2000	Low potential	44.5	86.3
	High potential	56.9	93.9
	Overall	**52.9**	**91.8**
2004	Low potential	22.2	58.2
	High potential	47.4	86.5
	Overall	**39.3**	**81.4**
2007	Low potential	28.9	98.3
	High potential	36.6	96.5
	Overall	**34.1**	**97.0**

Uses and amount of credit received by the sample households was analyzed for 2007 only due to data limitations in some years. Results show that household needs, school fees and farming in that order topped the list of activities for which households used credit (Figure 8). The high proportion of credit claimed by household needs indicates that households sought credit mainly for non-investment purposes.

The uses of credit across gender of household head are presented in Figure 9. An important observation made is that a higher proportion of female than male headed households used credit for household needs and farming and a higher share of male headed households used credit to cover school fees.

Figure 8: Uses of Credit by All Households

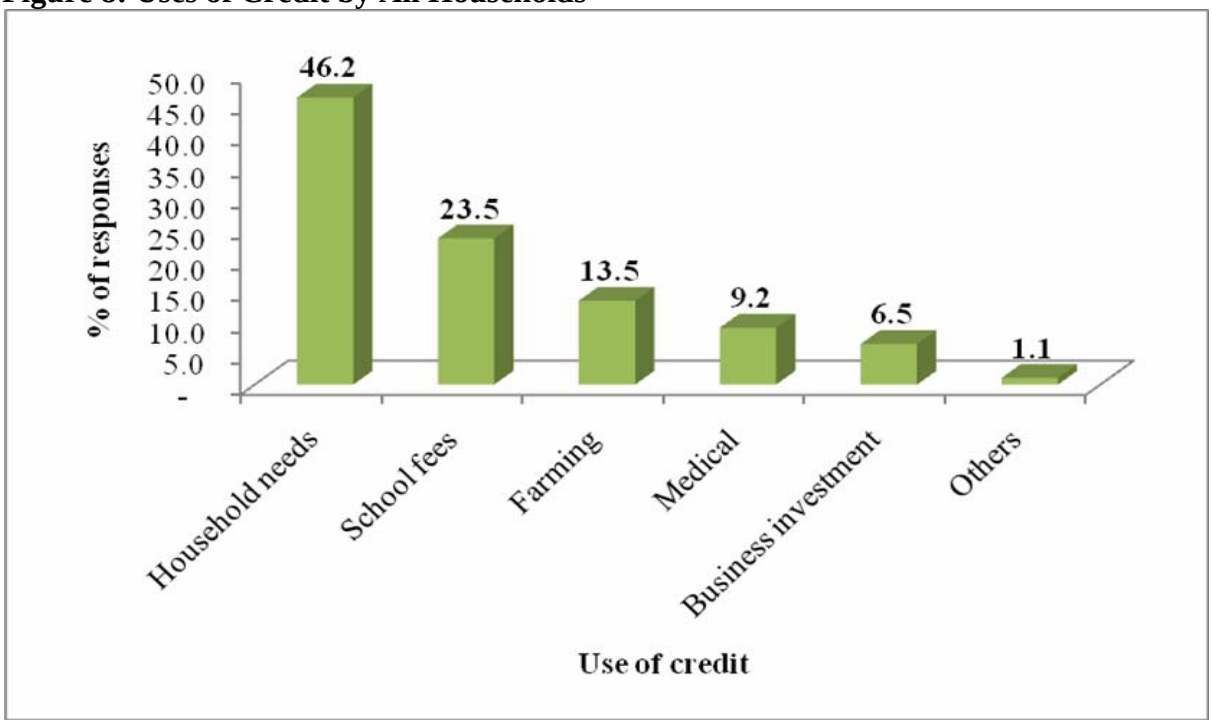
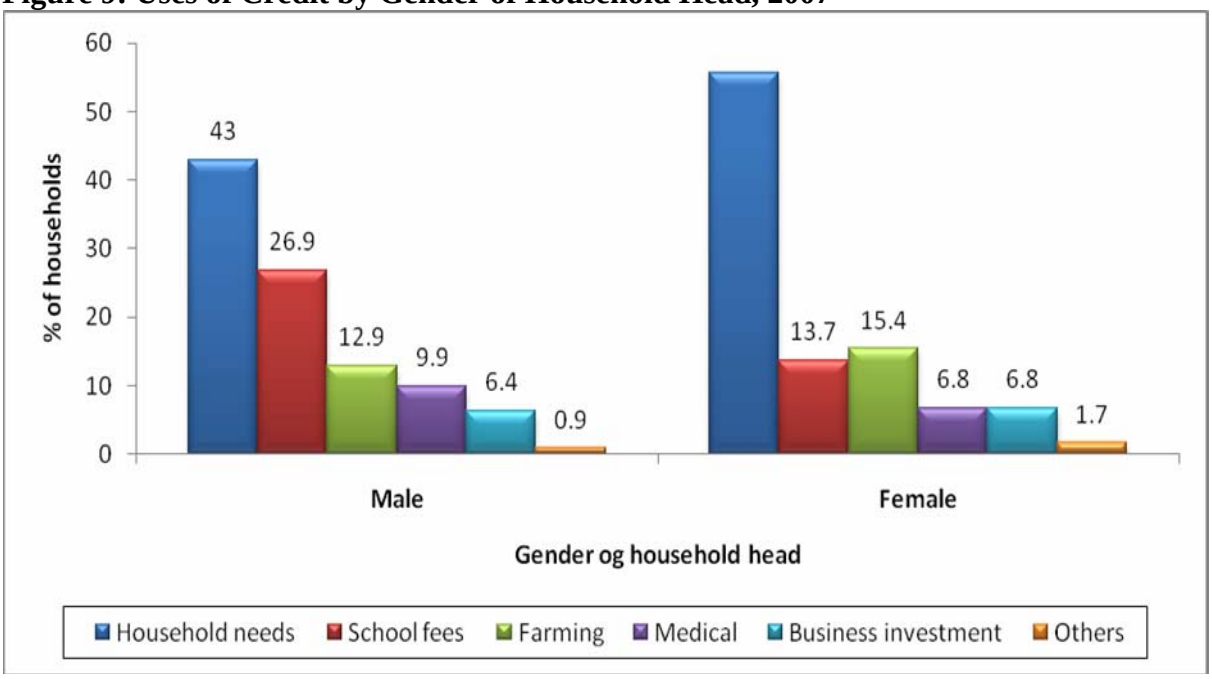


Figure 9: Uses of Credit by Gender of Household Head, 2007



Across income quintiles, the proportion of households in the lowest quintile that used credit for household needs nearly doubled that in the highest income quintile (Table 16). This indicates that majority of the relatively poor households used credit mainly for consumption purposes rather than for investment. The proportion of households that used credit on household needs declined up the quintiles of land size. Conversely, the proportion of

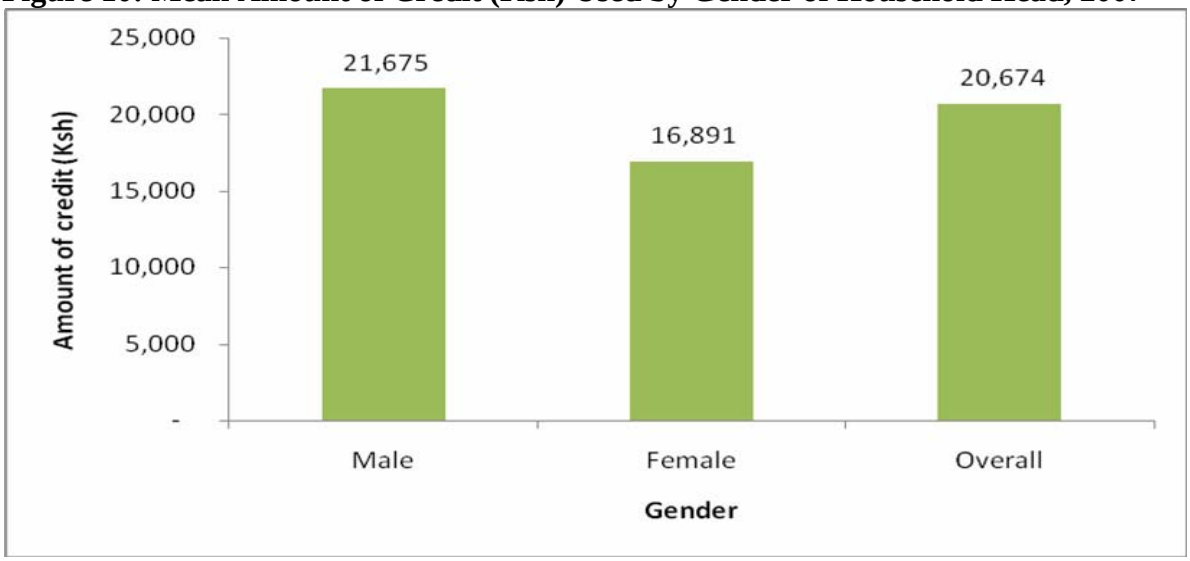
households that used credit on farming increased up the quintiles of land size, an indication that the relatively land wealthier households have an orientation to use credit for productive purposes on their land. Across agricultural potential, it was also observed that household needs dominate the use to which credit is put by households in both low and high potential agricultural areas.

Table 16: Uses of Credit by Quintiles of Income and Land Size, 2007

Use of credit	% of households				
	Quintiles of income per AE				
	1 (Lowest)	2	3	4	5 (Highest)
Household needs	61.4	52.0	45.7	36.6	33.1
Farming	17.8	21.3	20.0	21.6	28.9
School fees	9.9	11.8	17.1	26.1	21.1
Medical	8.9	7.1	9.5	9.0	5.6
Business investment	2.0	6.3	3.8	6.0	9.2
Others	-	-	1.0	2.6	-
	Quintiles of land size				
	1 (Lowest)	2	3	4	5 (Highest)
Household needs	50.4	48.9	39.9	39.8	45.0
Farming	20.0	15.8	22.4	23.7	32.0
School fees	13.0	18.0	22.4	18.6	15.0
Medical	9.6	12.8	6.3	7.6	2.0
Business investment	5.2	3.0	6.3	9.3	5.0
Others	1.7	1.5	2.8	0.8	1.0

The mean amount of credit received by households that acquired credit in 2007 is presented in Figure 10. On average, male headed households received larger amounts of credit than female headed households, although the difference in the means was not statistically significant. This may be an indication of low demand or lack of sufficient collateral (land) as observed earlier among women.

Figure 10: Mean Amount of Credit (Ksh) Used by Gender of Household Head, 2007



As expected, the amount of credit received increased with income and land size (Table 17). This may imply that wealthier households portray a higher ability to repay credit such as through the collateral they possess and hence the capacity to borrow more. They also may have higher demand since they have more assets on which to build off.

Table 17: Mean Amount of Credit (Ksh) Used by Quintiles of Income and Land Size, 2007

Quintiles of income per AE	Amount of credit (Ksh)	Quintiles of land size	Amount of credit (Ksh)
1(Lowest)	6,723	1(Lowest)	9,727
2	8,316	2	9,816
3	15,905	3	23,991
4	20,107	4	24,693
5(Highest)	37,693	5(Highest)	39,080
Overall	**20,674**	**Overall**	**20,674**

4.1.2 Market Participation among Marginalized Groups

4.1.2.1 Input Markets

4.1.2.1.1 Use of Improved Plant Varieties

Seed is among the most important production inputs that greatly affects productivity, and therefore, production and market participation. The use of improved seeds for each household was analyzed as the ratio of the number of improved seed varieties to the total number of seed varieties planted by the household. Results show that between 2000 and 2007, the use of improved seeds generally increased, though quite low at less than 7% in all cases (Table 18). Male headed households had a higher adoption of improved seeds compared to female headed households.

Table 18: Proportion (%) of Improved Seed Varieties in Total Planted Varieties Across Gender,, Quintiles of Income and Land Size and Agricultural Potential

	2000	2004	2007
Gender of household head			
Male	3.9	4.1	5.5
Female	3.0	2.8	3.5
Overall	3.8	3.9	5.1
Quintiles of income per AE			
1(Lowest)	2.8	2.4	3.7
2	3.2	3.0	3.8
3	4.5	3.8	5.6
4	4.0	5.1	5.8
5(Highest)	4.5	5.1	6.4
Overall	3.8	3.9	5.1
Quintiles of land size			
1(Lowest)		2.7	4.0
2		3.0	4.1
3		3.6	5.2
4		4.2	5.2
5(Highest)		5.9	6.6
Overall		3.9	5.1
Agro-potential			
Low potential	1.9	1.6	3.1
High potential	4.7	5.0	6.0
Overall	3.8	3.9	5.1

Across income quintiles, the use of improved seed varieties increased with income. This is consistent with a study by Ayieko et al. (2006) which found that households with higher income had higher adoption rates of improved seeds than households with lower income. The

use of improved seed also increased with increase in land size. As expected, there is a higher adoption of improved plant varieties in the high potential than in the low potential areas. These results indicate the need for more concerted efforts to increase the use of improved seeds to raise agricultural productivity among small holder farmers in general, but with specific emphasis on the marginalized groups. The challenge would be to develop seed production and delivery systems that encourage wider use of improved seeds for crops important to the households in terms of food security and income generation.

The use of the above ratio (proportion of improved seed varieties in total planted varieties) has limitations in that it does not take into account of the weight of each crop in a household's cropping activities. In the light of this limitation, we also consider the adoption trends and patterns for improved maize seed varieties. The choice of maize is informed by its dominance over other crops – it is the only crop produced by over 96% of the sample households across the three years. It is also the most important staple food crop in Kenya, and has attracted a lot of investment in development and multiplication of high yielding varieties. For instance, between 2001 and 2006, 94 new varieties of improved maize were released by the Ministry of Agriculture (Nyoro et al, 2006). Two measures of adoption of improved maize varieties are considered; the proportion of households using the varieties and the proportion of maize area under the improved seed varieties.

Percent of households planting and percent of area planted with improved maize varieties between 2000 and 2007 are presented in Table 20. Results show that in the overall, the percent of households adopting improved seed varieties and the proportion of land planted with these improved varieties generally increased between 2000 and 2007. Across gender of household head, a higher proportion of male than female headed households adopted improved maize varieties across the three years. Conversely, the proportion of maize area under improved varieties was higher for female than male headed households. These results suggest that while more male than female headed households plant improved maize varieties, female headed households planted a higher proportion of their land with the varieties compared to male headed households.

As shown in Table 19, the percent of households planting and the area under improved maize varieties generally increased with increase in income, suggesting the influence of income on household's adoption decision for improved seed varieties. With respect to land size, the pattern shows a tendency for households in the lower quintiles to have a lower adoption of

improved maize varieties compared to their counterparts in the higher quintiles. This pattern is, however, not consistent, especially in 2007.

The percent of households planting and maize area under improved varieties was higher in the high than in the low potential zone. The very low adoption rates of improved maize varieties in the low potential zone, though perhaps a rational decision given low expected returns, may have implications on production levels of maize, which in turn can affect participation in maize market as seen later in the report.

Table 19: Percent of Households Planting and Percent of Area Planted With Improved Maize Variety

	2000		2004		2007	
	% of hh	% of land	% of hh	% of land	% of hh	% of land
Gender of household head						
Male	70.5	53.8	73.4	48.8	78.0	53.9
Female	61.3	65.8	52.7	67.1	62.0	71.3
Overall	**69.4**	**64.4**	**69.2**	**63.4**	**74.2**	**67.2**
Quintile of income per AE						
Lowest	46.9	42.5	48.4	44.6	59.9	53.1
2	63.1	57.7	65.5	59.4	66.4	58.1
3	74.7	68.7	69.0	61.7	79.8	71.4
4	77.9	72.8	78.0	72.1	78.4	72.7
Highest	84.9	80.3	85.2	79.3	86.5	80.8
Overall	**69.4**	**64.4**	**69.2**	**63.4**	**74.2**	**67.2**
Quintile of land size						
Lowest			63.7	57.3	67.7	61.2
2			63.9	57.3	71.7	64.9
3			67.3	59.3	68.7	59.5
4			71.4	66.6	79.3	72.3
Highest			79.5	76.5	85.0	79.8
Overall			**69.2**	**63.4**	**74.2**	**67.2**
Agro-potential						
Low potential	37.5	30.5	38.5	33.1	44.5	33.0
High potential	84.2	80.1	83.6	77.7	88.0	83.1
Overall	**69.4**	**64.4**	**69.2**	**63.4**	**74.2**	**67.2**

4.1.2.1.2 Use of Fertilizer

Farmers use fertilizer as a source of essential plant nutrients added to the soil to replenish the soil reserve for better and proper crop performance. Due to the diminishing land-holdings, many farmers continue to cultivate the same piece of land every year and in some cases grow the same crops. As a result, most of the soils have been experiencing declining fertility status over the years and very few areas can still support crop production without supplementary

nutrients through addition of fertilizers. Adoption of agricultural technologies is influenced by a number of interrelated components within the decision environment in which farmers operate. For instance, Feder et al (1985) identified lack of credit, limited access to information, aversion to risk, inadequate farm size, insufficient human capital, tenure arrangements and absence of adequate farm equipment as key constraints to rapid adoption of innovations in less developed countries. Across all the years, a higher proportion of male than female headed households used fertilizers (Table 20). However, the proportion of households that used fertilizer increased for both male and female headed households during the same period. The proportion of households using fertilizer increased up the income quintiles, indicating increased ability to acquire fertilizer with increased incomes. Fertilizer adoption rate among households in the high agricultural potential areas remained above 90% and consistently increased between 2000 and 2007. In the low potential areas, adoption rate also increased during the period but remained below 40%.

The fact that fertilizer adoption has been increasing even amongst the marginalized groups could be an indication of increased awareness of the benefits of using fertilizer among the smallholder farmers. It could also be a deliberate response by smallholder farmers to increasingly deteriorating soil fertility for the purpose of attaining reasonable productivity levels. This pattern could also be an indicator of increased availability of commercial fertilizer in local markets near the farmers.

On fertilizer use intensity[10], male headed households used fertilizer more intensively than female headed households across all the years, and this difference was statistically significant. This may imply that female headed households still lag behind in productivity gains possible with increased fertilizer use. Fertilizer use intensity increased with income, suggesting the need for interventions geared towards helping the income poor increase fertilizer use to boost agricultural productivity. There is no distinct pattern in fertilizer use intensity across quintiles of land size. Across agricultural potential, the intensity of fertilizer use was significantly higher in the high potential than in the low potential areas. This is consistent with the fact that fertilizer use is more profitable and less risky in the high than low potential areas.

[10] Fertilizer use intensity is defined as kg of fertilizer applied per acre of cultivated land by households that used fertilizer.

Table 20: Fertilizer Adoption and Intensity of Use

	2000		2004		2007	
	% using	Intensity (kg/acre)	% using	Intensity (kg/acre)	% using	Intensity (kg/acre)
Gender of household head						
Male	71.2	74	75.0	67	79.3	66
Female	59.6	52	59.7	55	65.3	52
Overall	**69.8**	**72**	**71.9**	**65**	**76.0**	**63**
Quintiles of income per AE						
Lowest	42.7	44	57.6	42	62.4	39
2	60.8	50	65.1	58	65.5	48
3	74.1	65	69.8	61	80.4	61
4	85.1	75	82.0	70	82.4	70
Highest	86.3	105	85.1	83	89.4	88
Overall	**69.8**	**72**	**71.9**	**65**	**76.0**	**63**
Quintile of land size						
Lowest			71.4	67	77.6	63
2			69.8	69	71.8	64
3			74.9	62	75.7	63
4			72.2	66	76.9	67
Highest			71.4	60	78.0	60
Overall			**71.9**	**65**	**76.0**	**63**
Agro-potential						
Low potential	25.9	20	30.0	13	38.3	18
High potential	90.6	79	91.8	73	93.9	72
Overall	**69.8**	**72**	**71.9**	**65**	**76.0**	**63**

It is observed that the intensity of fertilizer use has been generally declining over the years while the proportion of households using fertilizer has been on the rise during the same period. While expansion in fertilizer use suggests better reach of markets by the smallholder farmers through a denser network of agro-dealers, the declining intensity of fertilizer use suggests that the capacity to purchase fertilizer remains a challenge to majority of the smallholders. The productivity gains possible with increased intensity of fertilizer use may remain unachievable if the challenges with respect to fertilizer use facing these farmers are not addressed.

4.1.2.1.3 Use of Hired Labour

The proportion of households that hired labour and the mean value of hired labour across gender of household head, quintiles of income and land size and agricultural potential are presented in Table 21. While a higher proportion of female headed households hired labour, the amount of money spent on hired labour by male headed households was significantly higher than that spent by female headed households. Across the quintiles, the proportion of households that hired labour and the value of labour hired increased with income and land

size. As expected, the high potential agricultural areas compared to the low potential areas had higher proportion of households hiring labour and higher expenditure on hired labour.

Table 21: Proportion (%) of Households that Hired Labour and Value

Gender	2004		2007	
	% hiring	Value hired (Ksh)	% hiring	Value hired (Ksh)
Male	60.3	2,815	60.3	2,730
Female	62.4	1,839	61.0	1,780
Overall	**60.7**	**2,617**	**60.5**	**2,506**
Quintile of income per AE				
Lowest	39.2	662	36.1	799
2	52.5	1,417	48.6	1,049
3	59.2	1,963	60.8	2,176
4	69.0	3,066	71.4	3,270
Highest	83.5	5,996	85.5	5,242
Overall	60.7	2,617	60.5	2,506
Quintile of land size				
Lowest	43.5	1,052	42.4	879
2	54.5	1,586	54.1	1,456
3	58.8	1,933	58.0	1,789
4	66.7	2,912	65.5	2,539
Highest	80.0	5,600	82.4	5,872
Overall	60.7	2,617	60.5	2,506
Agro-potential				
Low potential	55.9	2,132.4	54.1	1,650.51
High potential	63.0	2,846.0	63.5	2,901.50
Overall	60.7	2,617.1	60.5	2,505.45

4.1.2.2 Output Markets

4.1.2.2.1 Production and Marketing of Crop Enterprises

4.1.2.2.1.1 Production of Crops

Kenya's agro-ecological conditions are varied and this dictates the kinds of crop enterprises in which farmers can profitably engage. The proportion of the sampled households, disaggregated by gender of household head, engaged in various crop enterprises, volume of production and the importance of each enterprise in a household's total value of crop production across the three years are presented in Table 22. Generally, maize and beans are produced by over 90% of the households, indicating the importance of these enterprises to the majority of Kenyan rural households. Vegetables, fruits, bananas and roots and tubers are produced by over 75% of the households. It is, however, observed that there is little variation in the proportion of male headed versus female headed households engaged in various crops enterprises.

On the volume of production, the general pattern indicates that male headed households produce higher volumes than female headed households for the majority of crops, and the difference in volume produced is particularly large for maize and roots and tubers. The difference in volume produced between these two groups of households may be influenced by household land size, where female headed households have smaller land holdings compared to their male counterparts. The value of production for various crops by gender of household head is presented in Annex 2.

Various crop enterprises have various weights in terms of their contribution to total value of crop production. Maize has been the most important crop enterprise in terms of contribution to total value of crop production by both male and female headed households. The contribution of maize has been rising between 2000 and 2007; from 28% to 33% for male and 30% to 36% for female headed households. The contribution by tea, coffee and sugarcane is second although it has been falling, while that by vegetables ranks third. The contribution of bananas to households' value of crop production was quite substantial; 7% for male and 9% for female headed households in 2007. Despite these small variations, the contribution of various crops to household value of crop production seems rather equitable across gender of household head, implying that there may not be specific crops for males or females

Table 22: Percent of Households Producing Various Crops, Volume of Production and Percent Contribution Total Value of Crop Production, by Gender of Household Head

Year	Crop category	Male			Female		
		% producing	Volume (kg) produced	% contribution to total value of production	% producing	Volume (kg) produced	% contribution to total value of production
2000	Maize	96.4	1,991	28.4	94.0	1,162	30.1
	Other cereals and pulses	73.7	149	4.3	76.4	275	6.8
	Beans	90.8	197	6.8	87.8	163	7.8
	Bananas	85.2	1,645	8.1	82.6	1,848	8.8
	Roots and tubers	82.9	1,121	7.5	77.4	650	6.3
	Vegetables	89.3	1,185	10.4	80.7	1,314	8.6
	Fruits	85.4	1,018	6.4	83.0	926	7.7
	Tea, coffee, and sugarcane	83.1	12,021	19.9	83.3	10,554	15.2
	Napier and other feeds	59.1	4,557	2.8	53.8	4,764	2.1
	Other cash crops	59.0	2,351	5.0	54.3	2,045	4.5
2004	Maize	98.6	1,975	31.8	97.7	1,094	30.8
	Other cereals and pulses	78.5	177	4.6	80.5	136	7.0
	Beans	92.8	211	7.5	89.5	165	8.5
	Bananas	84.0	1,092	6.0	80.6	1,602	8.6
	Roots and tubers	88.0	1,055	7.4	87.2	554	7.3
	Vegetables	96.9	1,312	12.6	95.7	705	12.3
	Fruits	90.8	949	5.9	90.3	763	7.7
	Tea, coffee, and sugarcane	73.1	8,700	14.4	67.1	7,187	11.6
	Napier and other feeds	72.9	9,641	4.3	71.0	5,004	2.7
	Other cash crops	63.8	1,761	5.4	56.9	1,673	3.5
2007	Maize	98.3	2,169	32.8	98.7	1,449	35.8
	Other cereals and pulses	65.8	159	4.1	72.3	155	6.5
	Beans	91.5	184	7.4	93.7	132	8.7
	Bananas	79.6	1,006	6.9	79.1	907	9.0
	Roots and tubers	74.3	825	5.7	75.1	475	4.7
	Vegetables	93.6	1,161	11.2	93.6	587	10.3
	Fruits	90.2	666	4.9	88.0	619	5.4
	Tea, coffee, and sugarcane	71.4	8,375	16.4	70.3	8,456	12.7
	Napier and other feeds	83.2	4,838	5.0	82.5	3,659	3.6
	Other cash crops	61.4	1,591	5.0	59.5	684	3.0

Across the income quintiles, the proportion of households producing vegetables, fruits and tea, coffee and sugarcane increased with income (Table 23). The volume of production generally increases up the quintiles for all the crops across all the years. The value of production for various crops across the income quintiles is presented in Annex 3.

The general pattern shows that maize, followed by vegetables are the largest contributors to value of crop production by the households in the lowest income quintile. Among the households in the highest income quintile, cash crops (tea, coffee and sugarcane) followed by maize are the most important enterprises in terms of contribution to value of crop production,

suggesting that cash crops play an important role in enhancing these households' income. The contribution by vegetables ranks third in this income group.

The prevalence of tea, coffee and sugarcane in terms of the percent of households engaged in their production declined up the quintiles of land size (Table 24), indicating that the major cash crops - tea, coffee and sugarcane - are mainly suitable for the high potential areas that are densely populated with small farm sizes. The prevalence of other crops seems to have expanded across all the quintiles, and this also applies to income quintiles.

The volume of production generally increases up the quintiles of land size for all the crops across all the years. The value of production for the various crops by quintiles of land size is presented in Annex 4.

Table 23: Percent of Households Producing Various Crops, Volume of Production and Percent Contribution to Total Value of Crop Production, by Income Quintiles

Year	Crop category	Quintiles of income per AE														
		1 (Lowest)			2			3			4			5 (Highest)		
		% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value
2000	Maize	92.9	539	30.8	95.7	1,033	33.8	97.6	1,197	27.6	98.0	2,139	29.4	96.5	4,522	21.2
	Other cereals and pulses	79.1	124	9.6	77.0	101	5.3	72.5	137	3.8	68.1	190	2.8	71.2	335	1.6
	Beans	85.6	98	8.6	85.6	169	8.3	90.4	148	6.6	94.8	200	6.4	95.6	335	4.9
	Bananas	77.7	784	9.6	83.5	1,042	9.4	88.3	2,026	10.1	86.3	1,295	5.7	88.1	2,916	6.0
	Roots and tubers	72.2	424	8.8	74.6	484	6.4	85.4	802	7.1	88.6	1,103	7.5	89.4	2,239	7.0
	Vegetables	79.9	290	8.4	86.5	521	9.1	86.6	1,060	11.1	92.2	1,398	11.1	96.1	2,488	11.4
	Fruits	77.6	527	9.4	85.2	741	7.5	87.4	920	5.4	87.6	1,009	5.3	87.8	1,764	5.0
	Tea, coffee, and sugarcane	61.0	1,631	6.7	77.6	4,214	13.5	89.1	7,058	19.2	87.9	14,312	24.1	91.5	22,966	33.1
	Napier and other feeds	34.3	1,473	1.3	52.2	2,449	2.4	63.1	3,316	3.1	62.8	5,046	3.3	68.3	7,150	3.5
	Other cash crops	53.3	894	5.2	56.4	923	3.7	60.9	1,003	4.9	56.4	2,003	4.4	64.4	5,834	6.4
2004	Maize	96.5	655	35.4	98.4	1,157	34.2	100.0	1,503	30.9	99.6	2,101	30.4	97.6	3,560	27.0
	Other cereals and pulses	78.1	81	7.8	76.9	150	5.6	84.5	160	5.2	76.9	235	3.9	78.1	250	2.7
	Beans	84.8	75	7.4	93.1	135	7.7	93.6	207	8.4	96.0	243	8.2	93.3	331	6.8
	Bananas	75.7	460	7.5	83.0	839	7.6	85.4	812	5.8	82.9	927	5.6	89.4	2,672	6.2
	Roots and tubers	81.9	354	7.8	87.5	491	6.7	89.2	779	7.7	91.3	979	7.1	89.0	2,070	7.7
	Vegetables	94.4	419	13.6	96.5	697	12.3	96.1	1,013	12.0	98.4	1,498	13.1	98.0	2,275	11.8
	Fruits	85.7	376	7.8	93.2	638	6.5	90.0	876	6.9	90.2	872	5.1	94.3	1,748	5.1
	Tea, coffee, and sugarcane	49.7	1,746	5.2	72.2	4,352	11.9	74.2	8,223	15.5	78.4	7,570	17.3	83.4	16,500	19.2
	Napier and other feeds	58.9	2,270	2.5	71.2	4,013	3.4	73.4	5,881	3.5	77.2	10,839	4.9	76.5	15,655	5.5
	Other cash crops	58.8	474	4.9	65.7	1,149	4.1	64.1	1,265	4.0	64.4	1,607	4.3	61.3	3,846	7.9
2007	Maize	98.8	1,051	42.9	98.0	1,329	34.8	99.2	1,770	33.9	97.2	2,430	29.7	98.4	3,423	26.1
	Other cereals and pulses	69.1	115	7.0	77.8	154	6.9	69.4	141	3.9	64.0	221	3.7	52.5	188	1.9
	Beans	92.9	88	8.5	93.6	129	8.9	91.9	160	8.0	90.4	200	7.2	91.3	281	5.9
	Bananas	73.2	422	7.6	78.5	927	9.3	78.9	958	7.0	84.6	1,170	7.0	81.9	1,345	6.1
	Roots and tubers	69.9	383	4.8	71.8	424	5.5	75.0	684	5.7	74.9	943	5.4	80.5	1,192	5.9
	Vegetables	91.7	425	11.7	95.3	570	11.2	95.3	827	10.2	91.7	1,282	10.4	94.1	2,031	11.4
	Fruits	88.3	417	6.1	89.0	534	6.3	90.0	636	4.8	91.6	911	4.8	89.5	770	3.3
	Tea, coffee, and sugarcane	45.4	1,743	3.6	67.8	3,496	9.9	75.2	9,450	17.9	80.7	9,009	20.2	82.6	13,381	26.2
	Napier and other feeds	75.4	1,760	3.2	78.8	2,288	3.8	84.1	3,536	4.7	86.3	4,957	5.3	86.2	7,884	6.6
	Other cash crops	64.0	644	4.2	55.8	683	3.5	60.8	1,395	3.4	53.3	1,667	5.3	71.8	2,416	6.3

Table 24: Percent of Households Producing Various Crops, Volume of Production and Percent Contribution to Total Value of Crop Production, by Quintiles of Land Size

Year	Crop category	Quintiles of land size														
		1 (Lowest)			2			3			4			5 (Highest)		
		% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value	% of hh	Volume (kg)	% in total value
2004	Maize	98.5	606	31.5	96.7	825	29.2	98.9	1,275	28.7	100.0	1,732	29.5	98.1	4,444	39.0
	Other cereals and pulses	74.0	74	4.6	82.9	111	5.9	77.5	156	5.2	80.8	170	4.4	79.5	300	5.2
	Beans	93.3	88	7.9	91.3	134	6.9	91.2	189	8.0	93.3	225	7.5	91.9	366	8.4
	Bananas	87.4	634	8.4	85.8	815	6.9	82.4	1,150	6.2	85.3	1,642	6.9	75.1	1,964	4.2
	Roots and tubers	89.6	635	8.0	85.8	787	8.8	88.8	921	7.1	87.0	1,035	7.2	87.9	1,405	5.8
	Vegetables	95.4	557	13.1	97.1	1,077	13.0	97.8	1,477	12.6	96.5	1,411	13.4	96.6	1,405	10.7
	Fruits	92.5	459	7.2	90.2	643	6.1	91.3	1,107	6.9	91.0	1,004	6.6	88.0	1,425	4.7
	Tea, coffee, and sugarcane	78.9	1,583	11.1	73.1	3,304	16.1	74.9	9,033	17.5	72.3	12,028	16.5	53.2	27,750	8.1
	Napier and other feeds	76.4	4,996	4.3	78.7	6,689	5.2	73.2	10,538	3.7	73.4	11,955	3.7	60.1	12,091	2.9
	Other cash crops	56.5	200	3.8	52.7	313	1.9	58.6	602	4.2	62.5	1,583	4.4	75.4	3,682	11.0
2007	Maize	98.1	746	32.5	98.9	1,094	30.6	98.5	1,351	34.3	97.7	2,226	30.7	98.4	4,724	39.3
	Other cereals and pulses	65.0	92	3.7	69.1	117	5.9	77.8	166	5.3	66.7	163	4.7	57.6	257	3.7
	Beans	95.4	91	8.1	94.0	131	8.0	90.9	162	7.7	91.1	194	6.7	88.5	295	8.0
	Bananas	84.3	643	10.7	80.0	871	7.9	81.9	1,026	7.9	79.8	1,000	6.1	69.6	1,569	4.3
	Roots and tubers	74.0	670	7.0	80.8	767	5.9	76.7	684	5.7	68.6	780	5.1	71.0	843	3.6
	Vegetables	90.6	639	12.2	93.9	873	10.6	95.9	1,256	10.8	94.5	1,094	12.3	93.3	1,271	9.0
	Fruits	91.1	404	5.4	89.5	518	5.8	91.8	728	4.7	89.5	842	4.9	85.6	877	4.4
	Tea, coffee, and sugarcane	77.3	1,146	12.9	75.4	4,006	17.4	73.7	6,217	15.5	62.1	14,300	20.6	62.0	27,004	11.5
	Napier and other feeds	84.1	2,421	5.0	89.7	4,336	4.0	81.9	4,107	4.5	80.3	6,104	4.6	78.1	7,104	5.4
	Other cash crops	50.0	239	1.8	60.2	390	4.0	61.2	645	3.5	53.8	1,145	4.2	72.2	3,189	9.1

Maize, cash crops (tea, coffee and sugarcane) and vegetables are generally the largest contributors to value of crop production among households in the lowest quintile, and are also the most important crops among the relatively land rich households.

In order to provide an indication of how pro-poor each commodity is, we constructed ratios of mean volume of production for the lowest income quintile to that of the highest quintile for each commodity and for both income and land. The higher the ratio, the more pro-poor is the commodity. Based on this definition, it is observed that other cereals, fruits, beans, maize, bananas and roots and tubers appear to be the most pro-income poor (Table 25). On the other hand, roots and tubers, vegetables, fruits and bananas and other cereals and fodder appear to be the most pro-land poor.

Table 25: Quintile Ratios of the Mean Volume of Production

	Crop category	2000	2004	2007
Quintile of income per AE	Maize	0.12	0.18	0.31
	Other cereals and pulses	0.37	0.32	0.61
	Beans	0.29	0.23	0.31
	Bananas	0.27	0.17	0.31
	Roots and tubers	0.19	0.17	0.32
	Vegetables	0.12	0.18	0.21
	Fruits	0.30	0.22	0.54
	Tea, coffee, and sugarcane	0.07	0.11	0.13
	Napier and other feeds	0.21	0.15	0.22
	Other cash crops	0.15	0.12	0.27
Quintile of land size	Maize		0.14	0.16
	Other cereals and pulses		0.25	0.36
	Beans		0.24	0.31
	Bananas		0.32	0.41
	Roots and tubers		0.45	0.79
	Vegetables		0.40	0.50
	Fruits		0.32	0.46
	Tea, coffee, and sugarcane		0.06	0.04
	Napier and other feeds		0.41	0.34
	Other cash crops		0.05	0.07

4.1.2.2.1.2 Marketing of Crops

The proportion of households in the whole sample that sold various crops/crop categories, respective sales volumes and the proportion of marketed production are presented in Table 26. There is a general increase in the proportion of households that sold crops across the years. As expected, cash crops such as tea, coffee and sugar cane were marketed by over 80% of the producing households. This proportion is less than 100% due to some farmers not at all selling coffee or selling less than the amount produced. A study by Kibaara et al (2008)

indicate that several factors such as production costs, declining coffee prices, high transaction costs due to mismanagement of coffee institutions, and high costs of production have reduced coffee profitability and led to the abandonment of coffee production by most farmers. Some farmers were thus harvesting whatever they could from the unattended trees but did not sell. Over 60% and approximately 50% of the households producing vegetables and fruits respectively had sales. Generally, cereals, roots and tubers were sold by less than half of the producing households. These results show that market orientation for higher value crops is greater than for cereals, roots and tubers among these smallholder agricultural producers. This is consistent with our expectations as majority of these cereals form the main staples for most of the households and hence are produced primarily for home consumption. This scenario could also arise due to constraints in accessing markets for some of these commodities.

The volume of marketed production generally declined between 2000 and 2007. This decline was observed across all the crop enterprises. Cash crops, maize, vegetables and bananas in that order accounted for the highest volumes of household crop sales, while the volume sold of pulses and other cereals was the lowest. The mean volumes sold for maize, vegetables and bananas significantly declined between 2000 and 2007.

The proportion of households marketing various enterprises and the average volume marketed may mask important information about the degree of participation by the households in the markets for various enterprises. The degree of market participation could also be captured by looking at the proportion of the quantity produced that ended up being sold for each enterprise. Generally, the proportion of the produce sold increased between 2000 and 2007 from 25% to 28%. A statistical test showed that this increase was significant. Most of the cash crops produced were sold, as is expected, while just about a third of the vegetables produced were sold. For fruits and bananas, less than third of the production was sold in 2007. The proportion of roots and tubers, cereals and pulses sold generally remained below 25% between 2000 and 2007, indicating that these crops are mainly produced for subsistence. Commercialization of food crops, therefore, is very low among the smallholder farmers.

Table 26: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production

Enterprise	2000			2004			2007		
	% of hhs	Volume (kg) of sales	% of production marketed	% of hhs	Volume (kg) of sales	% of production marketed	% of hhs	Volume (kg) of sales	% of production marketed
Maize	39.9	900	17.2	46	866	20.2	47.6	882	20.0
Other cereals and pulses	30.4	41	11.2	38.5	49	15.5	35.1	38	13.6
Beans	29.6	61	13.4	36	70	17.0	32.7	38	15.1
Bananas	44.8	797	22.6	46.6	625	25.8	52.8	538	31.6
Roots and tubers	38.7	435	17.4	40.8	408	18.8	43.4	326	22.7
Vegetables	61.9	811	33.8	68	742	33.0	64.1	677	34.4
Fruits	52.5	395	24.8	56.8	452	26.8	58	351	31.3
Tea, coffee, and sugarcane	84.9	11,781	76.8	83.4	8,268	75.5	84.8	8,307	80.4
Napier and other feeds	12.1	311	7.0	13	873	7.7	12.2	301	8.0
Other cash crops	78.2	1,907	60.3	83.6	1,502	68.6	81.5	1,262	66.9

Market concentration, defined as the distribution of the total volume sold across the sample households, is presented in Table 27. Generally, it is observed that between 61% and 87% of all marketed volumes for the various commodities were sold by top 20% of households across the three years. The bottom 20% of the households sold less than 2% of the marketed volumes for most of the commodities. For maize, other cereals and pulses, between 69-79% of the marketed volumes was sold by top 20% of the households while the bottom 20% sold less than 1.5%. For tea, coffee and sugar cane, over 80% of the marketed volumes was sold by top 20% of the households, while the bottom 20% of the households sold less than 0.3%. These results indicate that agricultural commodity market participation among the smallholder farmers is dominated by a minority of households.

Table 27: Distribution of Marketed Volumes of Various Commodities Across the Sample

Year	Crop category	Lowest 20%	20%	20%	20%	Highest 20%	Total
2000	Maize	0.5	2.8	4.3	13.3	79.1	100.0
	Other cereals and pulses	1.1	2.6	7.3	15.6	73.4	100.0
	Beans	1.7	4.4	8.8	16.5	68.7	100.0
	Bananas	0.8	2.3	5.7	13.9	77.3	100.0
	Roots and tubers	1.1	3.1	6.4	13.3	76.1	100.0
	Vegetables	0.6	1.9	5.1	14.4	78.0	100.0
	Fruits	0.9	2.7	6.4	13.6	76.4	100.0
	Tea, coffee, and sugarcane	0.1	0.7	2.5	9.2	87.4	100.0
	Napier and other feeds	1.0	2.8	10.1	25.5	60.7	100.0
	Other cash crops	0.3	1.4	4.2	15.4	78.7	100.0
2004	Maize	1.3	3.3	8.5	15.3	71.7	100.0
	Other cereals and pulses	1.1	3.0	6.9	18.5	70.5	100.0
	Beans	1.6	4.6	10.3	21.5	62.0	100.0
	Bananas	0.9	2.6	4.9	11.4	80.2	100.0
	Roots and tubers	1.3	3.3	6.7	14.1	74.6	100.0
	Vegetables	0.6	2.1	5.6	15.1	76.5	100.0
	Fruits	0.9	3.1	6.1	12.6	77.3	100.0
	Tea, coffee, and sugarcane	0.2	0.8	2.8	9.9	86.3	100.0
	Napier and other feeds	0.4	2.2	5.1	11.9	80.3	100.0
	Other cash crops	0.4	3.0	8.2	20.7	67.6	100.0
2007	Maize	1.4	4.3	7.4	14.8	72.1	100.0
	Other cereals and pulses	1.3	4.0	8.7	16.8	69.2	100.0
	Beans	2.0	6.4	10.6	19.8	61.3	100.0
	Bananas	1.6	4.1	8.3	17.2	68.7	100.0
	Roots and tubers	1.8	5.4	8.8	18.8	65.2	100.0
	Vegetables	0.8	3.1	6.0	12.8	77.3	100.0
	Fruits	1.7	4.8	10.0	17.6	65.9	100.0
	Tea, coffee, and sugarcane	0.2	1.0	3.4	10.5	84.8	100.0
	Napier and other feeds	2.7	4.3	11.6	22.2	59.3	100.0
	Other cash crops	0.5	1.9	6.4	22.2	68.9	100.0

The proportion of households that sold various crops, volume sold and proportion of production marketed, disaggregated by gender of household head, are presented in Table 28. There appears to be little variation in the patterns of market participation exhibited by male and female headed households. However, Chi-square test using the 2007 data showed that a significantly higher proportion of male headed households than female headed households sold maize, vegetables and roots/tubers crops. Also for cash crops other than tea, coffee and sugar cane, a higher proportion of male than female headed households participated in marketing.

Table 28: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production, by Gender of Household Head

Year	Enterprise	Male			Female		
		% of hh	Volume (kg)	% of prodn	% selling	Volume (kg)	% of prodn
2000	Maize	39.3	971	17.1	44.4	357	17.5
	Other cereals and pulses	29.4	41	11.0	37.2	45	13.2
	Beans	29.4	63	13.5	31.8	42	12.8
	Bananas	44.3	822	22.4	48.4	589	24.6
	Roots and tubers	38.7	465	17.4	38.7	193	16.6
	Vegetables	62.0	810	34.0	61.2	818	31.5
	Fruits	52.2	395	24.5	55.4	390	27.1
	Tea, coffee, and sugarcane	84.8	11,935	76.8	85.7	10,495	77.3
	Napier and other feeds	12.5	333	7.4	7.1	82	2.6
	Other cash crops	78.6	1,910	59.7	73.7	1,866	66.5
2004	Maize	46.6	971	20.6	43.4	445	18.4
	Other cereals and pulses	36.8	52	15.0	44.6	41	17.2
	Beans	36.5	75	17.5	33.9	48	14.9
	Bananas	46.5	541	25.7	46.7	989	26.2
	Roots and tubers	42.1	471	20.1	35.3	143	13.5
	Vegetables	70.4	836	34.8	58.4	365	26.1
	Fruits	57.0	469	26.7	56.3	386	26.9
	Tea, coffee, and sugarcane	83.1	8,524	75.0	85.0	7,074	77.7
	Napier and other feeds	13.4	973	8.0	10.9	337	6.1
	Other cash crops	84.0	1,507	69.8	81.1	1,471	61.2
2007	Maize	49.0	978	20.8	43.1	571	17.3
	Other cereals and pulses	34.8	41	14.0	36.0	30	12.6
	Beans	33.0	58	15.5	31.6	33	13.7
	Bananas	53.0	556	31.5	52.4	476	32.2
	Roots and tubers	45.7	380	24.2	35.6	146	17.7
	Vegetables	66.6	791	36.6	55.8	302	27.2
	Fruits	59.3	353	32.0	53.7	344	28.9
	Tea, coffee, and sugarcane	85.2	8,276	80.8	83.6	8,427	78.8
	Napier and other feeds	12.5	329	8.4	11.0	179	6.6
	Other cash crops	84.4	1,405	69.1	68.2	594	56.6

On marketed volumes, several observations are made. First, in general, male headed households marketed higher volumes than female headed households for most of the enterprises. Secondly, the volume marketed for vegetables greatly reduced between 2000 and 2007. Thirdly, there are unexpectedly high fluctuations in the volume marketed for bananas. Fourth, marketed volumes for other cash crops declined greatly for female headed households. Finally, fodder crops, roots and maize appear to be marketed more by male headed households.

Compared to 2000 and 2004, a higher proportion of production for majority of enterprises was marketed in 2007. In 2007 (the most recent), male headed households generally marketed a higher proportion of their production than female headed households did for majority of the enterprises. Across the quintiles of income and land size, a higher proportion of households in the highest quintiles compared to their counterparts in the lowest quintiles participated in marketing most of the crops, except for fodder where market participation was higher in the lowest quintiles than in the highest quintiles (Tables 29 & 30). The volumes marketed as well as the proportion of marketed production also generally rose up the income quintiles and quintiles of land size for the majority of the enterprises. It is, however, observed that fodder is a cash crop for some of the income and land poorer households, but not for the rich. These results suggest that income and land richer households are more commercialized, most likely because they are able to produce a higher marketable surplus compared to their poor counterparts.

Table 29: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production, by Income Quintiles

Year	Enterprise	Quintiles of income per AE														
		1(Lowest)			2			3			4			5(Highest)		
		% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg) sold	% of prodn	% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg)	% of prodn
2000	Maize	24.1	81	7.2	36.4	293	12.8	34.4	396	14.1	49.2	885	23.0	54.7	2,814	28.1
	Other cereals and pulses	25.4	11	6.8	23.2	16	7.8	33.6	36	12.7	35.7	67	14.4	39.6	107	18.4
	Beans	19.2	14	8.3	28.0	37	11.1	27.4	32	11.8	32.9	55	14.9	39.1	156	20.0
	Bananas	43.1	297	22.3	41.3	394	19.8	42.5	960	20.7	45.1	448	20.9	50.8	1,725	28.6
	Roots and tubers	29.3	70	10.5	27.3	88	10.3	32.4	322	16.8	43.6	425	19.3	55.9	1,102	26.7
	Vegetables	44.8	121	23.1	57.8	254	28.1	63.9	709	35.5	69.4	932	38.8	70.6	1,854	41.1
	Fruits	45.7	190	19.5	58.5	236	25.8	49.5	283	23.8	52.2	374	24.6	56.3	850	29.6
	Tea, coffee, and sugarcane	76.4	1,578	65.4	82.0	4,143	73.9	83.0	6,988	76.0	84.9	14,224	75.6	91.9	22,856	85.2
	Napier and other feeds	18.9	108	13.8	15.5	199	9.1	12.6	331	8.5	11.9	487	5.1	8.1	255	4.4
	Other cash crops	75.0	558	49.3	86.4	624	63.2	66.0	793	54.4	75.0	1,589	62.9	87.9	5,068	69.1
2004	Maize	28.6	124	8.8	38.6	334	14.2	40.0	610	17.2	54.9	1,025	24.9	67.5	2,231	35.5
	Other cereals and pulses	28.6	10	9.4	37.6	46	15.3	37.2	44	16.0	50.4	61	19.0	42.4	100	19.5
	Beans	26.2	15	10.8	33.3	29	13.3	32.3	71	16.2	39.9	82	19.7	46.8	144	23.9
	Bananas	51.6	203	28.6	50.6	345	26.8	38.6	344	23.3	45.8	383	24.5	46.7	1,696	26.2
	Roots and tubers	26.5	79	12.2	32.9	116	14.3	40.0	239	17.3	46.2	336	21.2	55.7	1,202	27.7
	Vegetables	57.8	197	25.0	67.5	364	30.7	65.7	616	30.2	72.5	927	37.4	75.9	1,572	41.2
	Fruits	47.7	121	20.3	59.8	246	27.0	52.4	428	26.4	58.5	377	28.0	64.8	1,059	31.5
	Tea, coffee, and sugarcane	75.7	1,389	69.7	82.5	4,227	73.2	83.0	8,041	74.8	84.7	7,489	78.0	87.5	16,335	78.6
	Napier and other feeds	12.1	180	8.4	23.9	642	12.5	13.8	533	9.8	10.8	1,414	5.8	7.1	1,099	4.1
	Other cash crops	78.7	346	61.0	84.8	808	69.6	80.0	1,066	64.4	83.9	1,426	68.6	89.5	3,473	77.5
2007	Maize	33.7	204	10.4	39.0	332	12.6	47.8	649	19.3	54.3	1,184	25.1	63.3	2,045	32.5
	Other cereals and pulses	21.4	8	6.2	39.4	31	13.0	37.3	31	13.8	42.0	77	19.9	39.3	66	19.3
	Beans	26.1	15	10.3	30.6	27	13.5	31.1	41	14.3	37.4	58	17.4	37.8	119	19.7
	Bananas	42.5	180	24.3	52.4	483	31.0	57.8	490	34.6	58.0	626	33.5	52.7	839	33.9
	Roots and tubers	30.0	107	15.5	37.6	116	18.8	47.8	268	24.9	46.4	427	23.6	52.5	648	29.3
	Vegetables	51.7	175	24.8	63.0	289	30.0	66.3	527	37.0	66.4	894	35.9	72.8	1,499	44.2
	Fruits	45.6	191	24.2	54.8	235	28.1	59.7	341	32.4	66.8	568	36.5	62.7	416	35.1
	Tea, coffee, and sugarcane	73.4	1,722	68.7	81.2	3,467	76.4	83.9	9,429	79.7	88.5	8,975	82.9	90.1	13,127	86.8
	Napier and other feeds	15.1	146	10.2	16.7	405	11.9	11.6	168	7.5	10.8	387	7.3	9.9	340	5.7
	Other cash crops	83.3	491	63.9	76.7	504	58.5	77.1	1,202	62.6	81.6	1,520	68.8	86.9	2,244	77.1

Table 30: Proportion (%) of Households that Marketed Various Crops, Sales Volume and Proportion of Marketed Production, by Quintiles of Land Size

Year	Enterprise	Quintiles of land size														
		1 (Lowest)			2			3			4			5 (Highest)		
		% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg)	% of prodn	% of hh	Volume (kg)	% of prodn
2004	Maize	29.0	126	9.6	37.2	214	13.3	43.9	469	16.6	48.6	702	22.3	71.1	2,739	38.5
	Other cereals and pulses	28.3	16	14.6	37.9	18	8.9	37.9	45	17.9	38.6	48	15.8	49.1	106	19.0
	Beans	23.3	18	9.9	33.3	21	10.6	34.3	63	18.1	37.6	86	17.7	51.3	157	27.8
	Bananas	44.1	201	20.3	40.2	293	21.2	52.5	457	29.4	49.7	1,084	32.9	46.7	1,345	26.5
	Roots and tubers	29.8	189	12.8	39.4	302	16.6	42.4	418	23.3	45.6	317	17.9	45.9	785	22.7
	Vegetables	58.4	295	24.7	67.6	684	29.6	70.6	928	36.9	76.2	911	35.5	67.2	883	37.7
	Fruits	53.0	188	22.6	56.9	262	24.5	56.8	589	28.8	63.1	415	28.1	54.0	852	30.4
	Tea, coffee, and sugarcane	82.6	1,480	75.2	81.6	3,202	71.1	79.7	8,873	76.2	86.0	11,734	80.7	92.1	27,511	74.0
	Napier and other feeds	14.5	353	10.7	14.8	369	9.9	12.2	1,067	8.0	12.9	2,122	4.3	9.1	654	3.5
	Other cash crops	73.9	98	52.8	75.0	206	49.1	80.8	379	64.8	87.0	1,308	69.7	93.4	3,320	84.9
2007	Maize	33.7	116	8.9	39.9	288	14.5	43.9	381	16.5	53.0	992	25.9	67.7	2,723	35.6
	Other cereals and pulses	23.3	15	10.4	37.0	21	11.7	35.5	24	12.3	37.1	40	16.6	42.1	99	18.1
	Beans	23.6	19	9.8	33.3	26	11.1	32.5	40	14.6	33.5	63	19.1	41.0	120	22.1
	Bananas	50.0	229	27.4	48.0	456	29.9	54.0	615	34.7	58.0	565	32.3	55.2	969	35.0
	Roots and tubers	34.8	273	17.7	38.7	307	20.7	45.5	294	21.8	48.1	361	28.3	50.3	416	27.3
	Vegetables	62.8	351	28.7	63.6	557	32.8	60.8	853	38.0	69.1	762	34.4	63.9	866	38.0
	Fruits	53.4	168	25.3	61.2	265	31.6	56.0	415	36.0	59.1	453	31.5	60.8	516	32.4
	Tea, coffee, and sugarcane	84.8	1,118	78.8	86.7	3,987	81.4	86.6	6,177	84.3	84.3	14,244	78.6	80.0	26,590	77.0
	Napier and other feeds	14.2	248	11.5	9.1	248	10.1	18.0	314	8.2	10.4	292	3.7	8.9	428	4.4
	Other cash crops	78.4	169	50.4	86.4	308	63.2	70.6	470	58.6	78.7	1,008	60.1	90.0	2,917	84.2

Across agricultural potential, marketed volumes and proportion of marketed production for most crop enterprises was higher in the high than in the low potential areas (Table 31). An exception is observed in fruits, where households in the low potential zone sold relatively higher volumes than those in the high potential zones and the proportion marketed was generally similar across the two regions. The proportion of production marketed for majority of enterprises was higher in 2007 than in 2000 and 2004 in both the high and low potential areas. In the low potential areas, market orientation was highest for the cash crops, bananas, fruits and vegetables while in the high potential areas. cash crops, bananas, fruits, vegetables, maize and roots and tubers had the highest market orientation.

Table 31: Marketed Volumes and Proportion of Production Marketed for Various Enterprises, by Agricultural Potential

Year	Enterprise	Low potential		High potential	
		Volume (kg)	% of prodn	Volume (kg)	% of prodn
2000	Maize	127	5.9	1,232	22.0
	Other cereals and pulses	36	7.5	45	13.8
	Beans	43	8.5	67	15.2
	Bananas	554	19.1	885	23.8
	Roots and tubers	197	15.0	527	18.2
	Vegetables	465	26.4	950	36.7
	Fruits	701	24.9	247	24.7
	Tea, coffee, and sugarcane	6,762	47.0	12,896	83.4
	Napier and other feeds	602	11.8	251	6.0
	Other cash crops	1,343	32.3	2,292	79.4
2004	Maize	146	9.1	1,194	25.2
	Other cereals and pulses	50	10.7	48	18.7
	Beans	44	11.6	80	19.1
	Bananas	645	27.1	618	25.3
	Roots and tubers	419	13.0	403	21.2
	Vegetables	588	28.3	811	35.1
	Fruits	667	26.7	346	26.8
	Tea, coffee, and sugarcane	7,178	45.3	8,521	82.5
	Napier and other feeds	607	7.2	930	7.8
	Other cash crops	517	59.6	2,064	73.7
2007	Maize	174	8.8	1,210	25.2
	Other cereals and pulses	44	8.9	33	17.7
	Beans	30	9.3	62	17.5
	Bananas	580	31.2	524	31.8
	Roots and tubers	146	16.4	398	25.3
	Vegetables	641	26.2	694	38.3
	Fruits	478	31.2	287	31.3
	Tea, coffee, and sugarcane	7,557	50.2	8,443	85.9
	Napier and other feeds	313	6.9	298	8.2
	Other cash crops	711	58.6	1,664	73.0

The distribution of the marketed volumes for various commodities across income and land quintiles is presented in Tables 32 and 33. Generally, it is observed that over half of all the marketed volumes for all the crop enterprises were sold by 40% wealthiest households (Table 32). The remaining 60% of the households accounted for less than 50% of the marketed volumes, with the 10% least wealthy households accounting for less than 8% of the marketed volumes for all the crops except fruits in 2007. Across quintiles of land size, the relatively land rich accounted for the largest share of marketed volumes of various enterprises (Table 33). However, the 20% land poorest households accounted for over 10% of the marketed volumes for Napier and other feeds (20%), roots and tubers (17%), fruits (11%), vegetables (11%) and bananas (10%) in 2007.

Table 32: Distribution (%) of Total Marketed Volume of Various Crops Across Income Quintiles

Year	Enterprise	Quintiles of income per AE					Total
		1 (Lowest)	2	3	4	5 (Highest)	
2000	Maize	1.7	6.5	8.9	20.1	62.7	100.0
	Other cereals and pulses	6.9	8.8	16.8	28.1	39.3	100.0
	Beans	4.3	11.7	10.5	19.1	54.4	100.0
	Bananas	6.3	9.4	24.2	12.2	47.8	100.0
	Roots and tubers	2.7	3.6	15.3	21.7	56.7	100.0
	Vegetables	2.7	6.1	17.1	24.1	50.0	100.0
	Fruits	9.0	11.8	14.1	19.7	45.4	100.0
	Tea, coffee, and sugarcane	1.5	6.0	13.3	28.0	51.2	100.0
	Napier and other feeds	2.7	9.6	25.0	39.1	23.5	100.0
	Other cash crops	4.9	6.0	9.2	15.3	64.5	100.0
2004	Maize	2.8	7.7	14.3	23.9	51.2	100.0
	Other cereals and pulses	4.7	20.4	18.9	21.2	34.9	100.0
	Beans	3.8	8.4	20.9	24.3	42.6	100.0
	Bananas	5.8	11.0	10.9	12.4	59.8	100.0
	Roots and tubers	3.4	5.7	12.0	17.4	61.5	100.0
	Vegetables	5.1	9.8	16.6	25.5	43.0	100.0
	Fruits	5.0	11.3	18.7	16.8	48.1	100.0
	Tea, coffee, and sugarcane	2.2	10.3	19.2	20.9	47.4	100.0
	Napier and other feeds	2.3	13.7	12.1	38.4	33.5	100.0
	Other cash crops	4.2	9.7	13.9	20.8	51.5	100.0
2007	Maize	4.7	7.5	14.9	26.5	46.5	100.0
	Other cereals and pulses	5.0	20.2	16.3	36.3	22.2	100.0
	Beans	5.5	10.7	15.7	22.1	46.0	100.0
	Bananas	6.1	17.9	17.4	24.3	34.4	100.0
	Roots and tubers	5.9	6.9	16.6	26.3	44.2	100.0
	Vegetables	5.1	8.7	15.9	25.8	44.5	100.0
	Fruits	10.7	13.5	19.3	32.4	24.1	100.0
	Tea, coffee, and sugarcane	2.4	7.5	25.1	25.0	40.0	100.0
	Napier and other feeds	6.2	21.7	11.5	30.1	30.5	100.0
	Other cash crops	7.5	6.9	18.4	23.7	43.6	100.0

Table 33: Distribution (%) of Total Marketed Volume of Various Crops Across Quintiles of Land Size

Year	Enterprise	Quintiles of land size					Total
		1 (Lowest)	2	3	4	5 (Highest)	
2004	Maize	3.0	4.6	11.9	15.0	65.6	100.0
	Other cereals and pulses	5.7	7.3	20.2	17.9	48.9	100.0
	Beans	5.3	5.5	19.6	22.7	47.0	100.0
	Bananas	7.6	9.0	16.7	30.8	36.0	100.0
	Roots and tubers	9.5	13.7	23.2	13.8	39.8	100.0
	Vegetables	8.0	17.3	27.8	22.2	24.7	100.0
	Fruits	9.2	11.2	30.0	16.8	32.8	100.0
	Tea, coffee, and sugarcane	4.6	7.8	28.2	24.8	34.6	100.0
	Napier and other feeds	9.6	8.8	28.0	42.3	11.4	100.0
	Other cash crops	0.9	2.1	4.0	18.7	74.3	100.0
2007	Maize	2.8	6.7	9.2	19.1	62.2	100.0
	Other cereals and pulses	7.2	11.6	15.8	17.7	47.8	100.0
	Beans	8.0	10.4	16.0	20.5	45.0	100.0
	Bananas	10.1	18.1	26.3	17.2	28.4	100.0
	Roots and tubers	17.4	20.9	20.0	17.4	24.2	100.0
	Vegetables	10.5	17.0	27.2	19.6	25.6	100.0
	Fruits	10.8	16.0	26.7	21.2	25.3	100.0
	Tea, coffee, and sugarcane	3.4	11.3	17.5	25.1	42.8	100.0
	Napier and other feeds	19.6	18.2	21.2	15.4	25.7	100.0
	Other cash crops	1.5	4.9	7.8	13.5	72.4	100.0

In order to understand which crop enterprises are more pro-poor, quintile ratios of volumes marketed for various crops were computed. The ratios were computed as the mean marketed volume for the lowest quintiles to that for the highest quintile. The higher the ratio, the more pro-poor is the enterprise. Table 34 shows that fruits and maize appear to be more pro-income poor while vegetables, bananas, fodder and maize show higher levels of being pro-land poor.

Table 34: Quintile Ratios of Mean Volumes of Marketed Crops

	Crop category	2000	2004	2007
Quintile of income per AE	Maize	0.03	0.11	0.43
	Other cereals and pulses	0.10	0.10	0.12
	Beans	0.09	0.10	0.13
	Bananas	0.17	0.12	0.10
	Roots and tubers	0.06	0.07	0.17
	Vegetables	0.07	0.16	0.21
	Fruits	0.22	0.13	0.46
	Tea, coffee, and sugarcane	0.07	0.09	0.13
	Napier and other feeds	0.42	0.06	0.12
	Other cash crops	0.11	0.10	0.22
Quintile of land size	Maize		0.05	0.33
	Other cereals and pulses		0.15	0.15
	Beans		0.11	0.16
	Bananas		0.15	0.58
	Roots and tubers		0.24	0.24
	Vegetables		0.33	0.66
	Fruits		0.22	0.06
	Tea, coffee, and sugarcane		0.05	0.04
	Napier and other feeds		0.54	0.41
	Other cash crops		0.03	0.04

4.1.2.2.1.3 Price Analysis for Selected Crop Enterprises

Prices of selected crops received by households disaggregated by gender of household head are presented in Table 35. On average, commodity prices received by male and female headed households showed no significant variation for all the years. While prices for dry maize have remained relatively stable between 2000 and 2007, prices for beans and bananas have increased during the period.

Table 35: Mean Prices (Ksh/Kg) for Maize, Beans and Bananas Received by Households by Gender of Household Head

Year	Enterprise	Gender		
		Male	Female	Overall
2000	Dry maize	12.6	13.1	12.7
	Beans	22.4	22.2	22.4
	Bananas	5.5	5.1	5.5
2004	Dry maize	13.4	13.3	13.4
	Beans	23.9	22.3	23.7
	Bananas	5.8	5.7	5.8
2007	Dry maize	12.6	12.5	12.6
	Beans	29.0	30.5	29.3
	Bananas	8.0	7.7	8.0

Prices received by the 20% income rich households were higher than those received by the 20% income poor households for all the three crops and in all the years, indicating that the

higher income households have a competitive advantage in negotiating for prices at the market (Table 36). Across the quintiles of land size, prices for the three crops do not exhibit a distinct pattern.

Table 36: Mean Prices (Ksh/Kg) for Maize, Beans and Bananas Received by Households across Quintiles of Income and Land Size

Year	Enterprise	Quintiles of income per AE					
		1 (Lowest)	2	3	4	5 (Highest)	Overall
2000	Dry maize	11.6	11.8	12.2	13.2	13.5	12.67
	Beans	21.4	19.9	21.2	23.0	24.7	22.41
	Bananas	4.9	5.0	5.6	5.3	6.2	5.47
2004	Dry maize	12.3	13.5	13.3	13.6	13.7	13.41
	Beans	24.2	22.4	23.8	22.7	25.0	23.66
	Bananas	4.7	5.3	6.3	6.1	6.5	5.78
2007	Dry maize	11.9	12.9	12.2	12.4	13.3	12.62
	Beans	26.8	28.6	28.7	28.7	32.5	29.34
	Bananas	7.3	7.5	8.1	8.0	8.5	7.91
		Quintiles of land size					
		1 (Lowest)	2	3	4	5 (Highest)	Overall
2004	Dry maize	14.1	13.0	13.8	13.2	13.3	14.1
	Beans	22.0	22.5	23.5	25.0	24.2	22.0
	Bananas	5.2	5.4	6.0	6.0	6.3	5.2
2007	Dry maize	12.6	12.7	12.8	12.6	12.5	12.6
	Beans	25.7	29.8	27.9	29.1	33.0	25.7
	Bananas	7.8	8.2	8.0	7.5	8.0	7.8

4.1.2.2.2 Livestock Production and Marketing

Descriptive results on participation in livestock markets are discussed in this sub-section. Participation in markets for live domestic animals – cattle, sheep and goats and chicken – is discussed first. This is followed by a discussion on participation in markets for livestock products; milk and eggs.

4.1.2.2.2.1 Live Animals

Smallholder farmers in Kenya rarely depend on only one type of enterprise for their livelihood. More often than not, these farmers engage in a range of enterprises including crops and livestock as a way of diversification. There are various kinds/types of livestock that smallholder farmers keep, ranging from cattle to small ruminants and poultry. In addition, some farmers keep indigenous types while others keep improved breeds of these livestock. For the purposes of this discussion, improved cattle were separated from indigenous cattle. The percent of households keeping improved cattle and the mean size of the herd kept are

presented in Table 37. It is observed that a lower proportion of households headed by women had improved cattle as compared to their male counterparts. In addition, the mean herd size for women headed households was lower than that for the male headed households.

Across quintiles of income and land size, the percent of households with improved cattle as well as the mean herd size increased up the quintiles. Households in the lowest income quintile had less than half the heads of improved cattle owned by households in the highest income quintile. The difference in herd size was much bigger across quintiles of land size where households in the lowest quintile had just about a quarter the number of heads of improved cattle owned by those in the highest quintile. A higher proportion of households in the high potential agricultural areas compared to those in the low potential areas kept improved cattle and had larger herd sizes. These results suggest minimal adoption of improved cattle breeds by the marginalized groups.

Table 37: Percent of Households Keeping Improved Cattle and Mean Size of Herd

	2000		2004		2007	
	% of hh	**herd size**	**% of hh**	**herd size**	**% of hh**	**herd size**
Gender of household head						
Male	51.1	5.2	58.1	4.9	57.3	4.9
Female	36.4	3.9	41.7	3.9	40.7	4.2
Overall	**49.3**	**5.1**	**54.7**	**4.7**	**53.4**	**4.8**
Quintile of income per AE						
Lowest	24.7	3.7	26.7	3.2	27.1	2.5
2	37.6	3.7	44.7	3.2	42.4	2.8
3	53.7	4.3	53.7	3.7	53.7	4.3
4	59.2	5.2	70.2	4.9	65.1	5.1
Highest	71.4	6.7	78.4	6.7	78.8	6.8
Overall	**49.3**	**5.1**	**54.7**	**4.7**	**53.4**	**4.8**
Quintile of land size						
Lowest			50.4	2.3	47.2	2.4
2			46.7	3.0	47.3	2.7
3			51.3	3.0	47.6	3.4
4			61.5	4.2	59.4	4.6
Highest			64.2	9.6	67.2	9.3
Overall			**54.7**	**4.7**	**53.4**	**4.8**
Agro-potential						
Low potential	18.0	3.5	23.2	3.7	19.8	3.8
High potential	64.2	5.3	69.7	4.9	69.4	4.9
Overall	**49.3**	**5.1**	**54.7**	**4.7**	**53.4**	**4.8**

The proportion of households that sold cattle (among those keeping improved cattle) and the proportion of the number sold to the number in stock are presented in Table 38. Results show that a higher percentage of female than male headed households sold improved cattle. However, the proportion of sales to the stock kept did not significantly differ between the two

groups of households. It is also observed that the proportion of households selling improved cattle increased up the quintiles of income. The pattern of improved cattle sales across quintiles of land is mixed. Across agricultural potential, a higher proportion of households in the high potential areas as compared to those in the low potential areas participated in selling improved cattle.

Table 38: Percent of Households Selling Improved Cattle and Percent of Sales Over Stock Kept

	2000		2004		2007	
	% of hh	**% of sales over stock**	**% of hh**	**% of sales over stock**	**% of hh**	**% of sales over stock**
Gender of household head						
Male	50.2	17.5	47.8	16.2	47.9	19.5
Female	43.6	15.6	42.6	13.7	42.6	17.3
Overall	**49.6**	**17.3**	**47.0**	**15.8**	**47.0**	**19.1**
Quintile of income per AE						
Lowest	27.0	9.5	35.3	11.1	27.5	11.4
2	39.6	16.4	41.2	18.7	35.2	16.0
3	46.7	17.7	48.2	18.2	46.0	20.1
4	55.6	19.6	45.8	14.9	51.2	19.8
Highest	59.9	18.3	54.5	15.0	57.2	22.3
Overall	**49.6**	**17.3**	**47.0**	**15.8**	**47.0**	**19.1**
Quintile of land size						
Lowest			50.4	20.8	43.7	21.2
2			40.2	15.8	44.4	20.7
3			34.3	11.9	51.9	22.6
4			52.1	18.2	45.4	16.9
Highest			55.3	**13.4**	48.8	**15.6**
Overall			**47.0**	**15.8**	**47.0**	**19.1**
Agro-potential						
Low potential	36.5	14.0	30.5	11.8	40.7	15.2
High potential	51.4	17.7	49.6	16.5	47.8	19.7
Overall	**49.6**	**17.3**	**47.0**	**15.8**	**47.0**	**19.1**

The percent of households keeping indigenous cattle and the mean size of the herd kept are presented in Table 39. As opposed to the scenario with improved cattle, a higher proportion of households headed by women compared to male headed households had indigenous cattle. However, female headed households had a smaller mean herd size than their male counterparts. Across quintiles of income, the percent of households with indigenous cattle decreased up the quintiles, while the number of cattle heads decreased with increase in income. On the other hand, both the percent of households with and herd size of indigenous cattle increased with increase in land size. Across agricultural potential, it is observed that a higher proportion of households in the low potential than in the high potential areas kept indigenous cattle, the exact opposite in the case of improved cattle.

Table 39: Percent of Households Keeping Indigenous Cattle and Mean Size of Herd

	2000		2004		2007	
	% of hh	herd size	% of hh	herd size	% of hh	herd size
Gender of household head						
Male	31.0	6.4	30.5	7.1	32.2	5.8
Female	39.1	5.1	38.6	5.1	35.3	4.8
Overall	**31.9**	**6.2**	**32.2**	**6.6**	**32.9**	**5.5**
Quintile of income per AE						
Lowest	39.2	5.8	38.4	4.6	40.4	3.4
2	33.7	5.2	40.8	5.2	40.8	4.8
3	33.7	5.8	34.1	8.7	34.1	4.9
4	29.8	6.6	29.4	5.8	28.6	8.3
Highest	23.1	8.2	18.0	11.3	20.8	8.5
Overall	**31.9**	**6.2**	**32.2**	**6.6**	**32.9**	**5.5**
Quintile of land size						
Lowest			23.1	3.1	25.8	2.9
2			30.0	4.1	32.8	3.0
3			35.5	4.2	32.8	4.3
4			35.1	6.4	37.0	4.3
Highest			37.0	13.1	37.1	11.9
Overall			**32.2**	**6.6**	**32.9**	**5.5**
Agro-potential						
Low potential	49.8	5.4	46.8	8.4	51.5	5.4
High potential	23.5	6.9	25.2	4.9	24.2	5.6
Overall	**31.9**	**6.2**	**32.2**	**6.6**	**32.9**	**5.5**

Percentage of indigenous cattle keeping households that sold and the proportion of the number sold to the number kept are presented in Table 40. While a higher proportion of female headed households kept indigenous cattle and the herd size was larger for male headed households, there is a mixed pattern in the proportion of households selling as well as in the percent of sales over the number kept across the two groups of households. These patterns are also mixed across the quintiles of income and land size. Across agricultural potential, the high potential areas lead in the sales of indigenous cattle despite having a lower proportion of households keeping indigenous cattle.

Table 40: Percent of Households Selling Indigenous Cattle and Percent of Sales Over Stock Kept

	2000		2004		2007	
	% of hh	% of sales over stock	% of hh	% of sales over stock	% of hh	% of sales over stock
Gender of household head						
Male	38.8	15.9	38.1	16.8	39.5	18.1
Female	33.9	13.2	39.0	15.9	32.1	12.9
Overall	**38.1**	**15.5**	**38.3**	**16.6**	**37.6**	**16.8**
Quintile of income per AE						
Lowest	25.0	10.8	33.7	15.5	26.2	11.5
2	39.5	16.5	34.6	14.9	32.7	15.2
3	50.0	17.4	44.8	20.1	48.3	21.4
4	43.4	18.9	44.0	19.6	45.2	19.4
Highest	33.9	14.9	34.8	11.4	41.5	19.1
Overall	**38.1**	**15.5**	**38.3**	**16.6**	**37.6**	**16.8**
Quintile of land size						
Lowest			41.7	23.2	26.1	11.3
2			31.9	15.9	31.4	15.7
3			38.4	19.5	46.1	21.6
4			44.4	18.0	35.8	15.4
Highest			35.7	**9.1**	45.3	18.5
Overall			**38.3**	**16.6**	**37.6**	**16.8**
Agro-potential						
Low potential	32.8	13.1	32.8	12.1	35.5	15.6
High potential	43.3	17.9	43.1	20.6	39.7	18.0
Overall	**38.1**	**15.5**	**38.3**	**16.6**	**37.6**	**16.8**

A higher percentage of male than female headed households kept sheep and goats (Table 41). In addition, male headed households had larger herds than their female headed counterparts. A higher proportion of households in the highest income and land quintiles had sheep and goats and had larger herds than their counterparts in the lowest quintiles. Across agricultural potential, a higher proportion of households in the low potential areas had sheep and goats and had larger herds than those in the high potential areas.

Table 41: Percent of Households Keeping Sheep and Goats and Mean Size of Herd

	2000		2004		2007	
	% of hh	**herd size**	**% of hh**	**herd size**	**% of hh**	**herd size**
Gender of household head						
Male	51.9	8.2	58.7	8.0	60.3	7.9
Female	43.0	6.3	50.2	5.2	58.7	6.6
Overall	**50.8**	**8.0**	**56.9**	**7.4**	**59.9**	**7.6**
Quintile of income per AE						
Lowest	44.7	9.0	46.3	4.6	51.8	5.2
2	50.6	6.2	52.2	8.1	60.4	6.6
3	51.8	7.1	62.0	7.6	67.5	8.1
4	53.3	7.8	61.6	7.1	57.6	10.3
Highest	53.7	10.2	62.7	9.3	62.4	7.4
Overall	**50.8**	**8.0**	**56.9**	**7.4**	**59.9**	**7.6**
Quintile of land size						
Lowest			44.2	3.2	51.7	4.3
2			49.2	4.6	54.6	5.4
3			53.0	6.3	59.0	6.4
4			66.7	8.3	65.3	7.8
Highest			72.1	12.4	70.3	12.7
Overall			**56.9**	**7.4**	**59.9**	**7.6**
Agro-potential						
Low potential	58.5	9.3	66.6	9.4	68.0	9.8
High potential	47.2	7.3	52.4	6.3	56.1	6.3
Overall	**50.8**	**8.0**	**56.9**	**7.4**	**59.9**	**7.6**

On marketing, the pattern is mixed (Table 42)[11]. However, a lower proportion of households in the lowest quintiles of income and land size compared to their counterparts in the highest quintiles that kept sheep and goats had sales. They also had a lower percentage of sales over stock kept. Just as in the case of indigenous cattle sales, participation in sheep and goats market was higher in the high potential agricultural areas despite the areas having lower proportions of households keeping sheep and goats and in small stocks compared to the low potential areas.

[11] Information on sales for sheep, goats and chicken was available only for 2000 and 2007 years

Table 42: Percent of Households Selling Sheep and Goats and Percent of Sales Over Stock Kept

	2000		2007	
	% of hh	% of sales over stock	% of hh	% of sales over stock
Gender of household head				
Male	26.1	12.2	48.1	23.5
Female	32.3	18.5	41.5	17.7
Overall	**26.7**	**12.9**	**46.6**	**22.2**
Quintile of income per AE				
Lowest	17.5	8.2	40.2	20.6
2	27.9	14.9	51.9	25.6
3	28.8	14.0	49.4	21.9
4	28.7	14.0	49.7	24.2
Highest	29.2	12.6	40.9	18.6
Overall	**26.7**	**12.9**	**46.6**	**22.2**
Quintile of land size				
Lowest			39.9	20.9
2			43.4	22.7
3			41.3	20.6
4			53.1	23.8
Highest			53.9	22.8
Overall			**46.6**	**22.2**
Agro-potential				
Low potential	18.8	8.3	42.7	18.1
High potential	31.4	15.6	48.9	24.5
Overall	**26.7**	**12.9**	**46.6**	**22.2**

The percentage of households keeping chicken is generally over 80% across the different categories of households (Table 43). It is, however, observed that female headed households and households in the lowest quintiles of income and land size had fewer chicken than the male headed households and those in the highest quintiles. Across agricultural potential, a slightly higher proportion of households in the low than in the high potential areas kept chicken but the flock sizes did not differ much. It is important to note that the majority of the chicken kept was indigenous; only 49 out of 1176 cases (i.e. 4.2% of the cases) had exotic breeds of chicken.

Table 43: Percent of Households Keeping Chicken and Mean Size of Flock

	2000		2004		2007	
	% of hh	flock size	% of hh	flock size	% of hh	flock size
Gender of household head						
Male	83.5	19.7	85.8	16.2	84.8	19.0
Female	75.5	16.0	86.5	12.9	83.3	12.6
Overall	**82.6**	**19.2**	**86.0**	**15.5**	**84.5**	**17.5**
Quintile of income per AE						
Lowest	82.0	15.3	83.1	10.7	81.2	12.0
2	79.2	16.4	86.7	13.3	88.2	13.8
3	82.4	15.6	85.1	13.6	84.3	14.9
4	84.3	17.4	87.5	19.0	84.3	14.6
Highest	85.1	31.1	87.5	20.9	84.3	32.5
Overall	**82.6**	**19.2**	**86.0**	**15.5**	**84.5**	**17.5**
Quintile of land size						
Lowest			81.2	9.7	80.9	10.8
2			83.3	10.8	82.8	12.2
3			86.7	14.0	83.8	16.6
4			88.3	19.5	88.1	15.4
Highest			90.2	23.1	87.5	31.8
Overall			**86.0**	**15.5**	**84.5**	**17.5**
Agro-potential						
Low potential	87.6	18.3	88.5	17.1	87.1	16.1
High potential	80.2	19.7	84.7	14.8	83.2	18.1
Overall	**82.6**	**19.2**	**86.0**	**15.5**	**84.5**	**17.5**

A surprising result is that a lower proportion of households sold chicken compared to the proportion that sold sheep, goats and cattle (Table 44). This indicates that the sample households do not consider chicken enterprise in a commercial sense, but engage in it mainly for subsistence. This notion is further strengthened by the mixed patterns exhibited by the percentage of households that sold chicken and the percentage of sales over the stock held. However, it is observed that chicken sales increased between 2000 and 2007 for all the households, including female headed, those in the low income groups and those in the low agricultural potential areas, suggesting that chicken enterprise is gaining importance among the marginalized group of households.

Table 44: Percent of Households Selling Chicken and Percent of Sales Over Stock Kept

	2000		2007	
	% of hh	% of sales over stock	% of hh	% of sales over stock
Gender of household head				
Male	12.8	6.1	32.8	14.9
Female	12.3	11.0	24.8	10.9
Overall	**12.7**	**6.7**	**30.9**	**14.0**
Quintile of income per AE				
Lowest	6.7	2.2	26.6	12.7
2	14.4	7.8	29.3	13.2
3	10.5	7.0	37.2	17.6
4	16.7	7.7	32.6	13.2
Highest	15.2	8.6	28.8	13.1
Overall	**12.7**	**6.7**	**30.9**	**14.0**
Quintile of land size				
Lowest			30.6	16.3
2			28.6	11.7
3			28.6	12.7
4			31.6	13.4
Highest			35.3	15.7
Overall			**30.9**	**14.0**
Agro-potential				
Low potential	5.3	2.4	28.6	10.6
High potential	16.6	8.9	32.1	15.6
Overall	**12.7**	**6.7**	**30.9**	**14.0**

4.1.2.2.2.2 Animal Products

This sub-section presents descriptive results on the participation of households in the milk and eggs markets. The proportion of households that produced the products; the amount of the products produced; and the proportion of marketed production by the various categories of households between 2000 and 2007 are discussed.

The proportion of households that produced milk averaged 69% across the three years (Table 45). A higher proportion of male headed households than female headed households produced milk. While the proportion of male headed households that produced milk rose from 68% to 72% between 2000 and 2007, the proportion of female headed households producing milk declined during the same period from 68% to 58%. Statistical tests showed that the mean volume of milk produced[12] by the male headed households remained significantly higher than by the female headed households across the three years. Across the quintiles of income, the proportion of households that produced milk as well as the amount of milk produced increased up the quintiles, suggesting that dairy farming could be a preserve of

[12] The mean amount of milk produced are only for those households that did produce positive amounts

the relatively wealthy households. The proportion of milk producing households and the amount of milk produced increased with land size. Households in the highest land quintile produced more than three times the amount of milk produced by those in the lowest land quintile. Across agricultural potential zones, it is observed that a higher proportion of households in the high potential areas produced milk and in larger quantities than their counterparts in the low potential areas. This can be associated with the more improved cattle breeds in the high potential areas relative to the low potential areas.

Table 45: Proportion (%) of Households that Produced Milk and Mean Volume (in Litres) of Milk Produced

	2000		2004		2007	
	% of hh	Quantity produced	% of hh	Quantity produced	% of hh	Quantity produced
Gender of head						
Male	69.2	1,464	70.9	1,843	71.9	1,735
Female	67.6	973	61.2	1,057	57.7	1,047
Overall	69.0	1,406	68.9	1,684	68.6	1,573
Quintile of income per AE						
1 (Lowest)	49.0	340	42.4	311	45.5	345
2	59.2	630	63.9	685	60.8	676
3	72.9	1,189	70.2	1,276	69.4	1,272
4	76.9	1,521	81.6	1,926	79.2	2,060
5 (Highest)	87.1	3,349	86.7	4,223	87.8	3,512
Overall	69.0	1,406	68.9	1,684	68.6	1,573
Quintiles of land size						
1 (Lowest)			53.7	710	57.7	762
2			65.5	1,057	61.2	921
3			69.8	1,490	67.8	1,263
4			74.5	1,890	75.3	1,765
5 (Highest)			81.2	3,274	80.8	3,155
Overall			68.9	1,684	68.6	1,573
Agro-potential						
Low potential	51.7	505	48.8	712	47.8	551
High potential	77.2	1,833	78.5	2,145	78.4	2,057
Overall	69.0	1,406	68.9	1,684	68.6	1,573

The proportion of households[13] that sold milk and the proportion of milk sold by gender of the household head and quintiles of income and land size are presented in Table 46. Overall, over 54% of households sold milk in 2007 up from 51% in 2000. The proportion of milk sold generally increased from 28% in 2000 to 31% in 2007. A higher proportion of male headed households than female headed households sold milk. There was, however, no significant difference in the proportion of milk sold by male and female headed households. The proportion of households that sold milk generally increased with income. The proportion of

[13] The proportion of households that sold milk was computed from those that reported milk production

milk sold also increased up the income quintiles, with households in the highest income quintile selling four times higher proportion of milk than their counterparts in the lowest income quintile. A similar pattern is observed across quintiles of land size, where the proportion of households selling milk as well as the proportion of milk sold increased with increase in land size. It is also observed that participation in milk market is higher in the high potential than in the low potential agricultural areas. These results suggest that dairying is accessible to many types of households, but those with low income or small farms and those in low potential agricultural areas struggle to produce much; they produce mainly for home consumption.

Table 46: Proportion (%) of Households that Sold Milk and Proportion (%) of Milk Sold

	2000		2004		2007	
	% of hh	% of milk sold	% of hh	% of milk sold	% of hh	% of milk sold
Gender of head						
Male	51.5	28	53.9	31	57.9	33
Female	45.7	25	46.1	26	44.7	25
Overall	50.8	28	52.3	30	54.8	31
Quintile of income per AE						
1 (Lowest)	26.3	14	24.3	12	26.3	13
2	36.1	19	41.6	21	41.6	23
3	54.1	27	52.9	30	55.3	30
4	62.8	35	63.5	37	69.0	39
5 (Highest)	74.9	43	79.2	48	81.6	52
Overall	50.8	28	52.3	30	54.8	31
Quintiles of land size						
1 (Lowest)			37.3	20	41.6	22
2			47.8	25	48.2	26
3			51.8	29	51.0	29
4			58.4	34	62.8	36
5 (Highest)			66.3	40	70.2	43
Overall			52.3	30	54.8	31
Agro-potential						
Low potential	28.0	15	30.5	17	30.7	17
High potential	61.6	34	62.7	36	66.1	38
Overall	**50.8**	**28**	**52.3**	**30**	**54.8**	**31**

On eggs, it is observed that a higher proportion of male than female headed households did produce eggs (Table 47). Also, the proportion of households producing eggs was higher in the highest quintile than in the lowest quintile of income and land size across all the years. There appeared to be not much difference in egg production and sales between the high and low potential agricultural areas. While generally between 67% and 86% of the households produced eggs, only 17-36% of those producing had any sales, with the proportion of produced eggs marketed ranging from 8% to 15% during the three years. The reason for low

market participation by the households is because majority of the households did not engage in egg production as an enterprise since most of the eggs were left for hatching. Again, it is worth noting that majority of the chicken kept was indigenous, and therefore not meant for commercial eggs production.

Table 47: Percent of Households Producing and Selling Eggs and Percent of Produced Eggs Marketed

	2000			2004			2007		
	% producing	% selling	% of sales over production	% producing	% selling	% of sales over production	% producing	% selling	% of sales over production
Gender of household head									
Male	77.0	26.9	12.6	80.5	27.3	9.7	80.3	29.5	13.1
Female	68.9	26.1	14.3	72.2	24.2	11.3	78.0	30.4	10.8
Overall	**76.0**	**26.2**	**12.8**	**78.8**	**24.8**	**10.0**	**79.8**	**30.2**	**12.6**
Quintile of income per AE									
Lowest	67.1	19.3	9.5	66.7	23.5	8.9	73.3	23.0	8.3
2	75.7	27.5	12.3	80.4	19.0	8.1	83.1	28.8	12.3
3	79.2	27.2	12.7	81.6	24.5	9.2	81.2	28.0	11.0
4	77.6	26.8	12.8	79.2	30.2	13.2	81.2	34.3	13.5
Highest	80.4	29.3	15.9	86.3	26.4	10.2	80.0	36.3	17.3
Overall	**76.0**	**26.2**	**12.8**	**78.8**	**24.8**	**10.0**	**79.8**	**30.2**	**12.6**
Quintile of land size									
Lowest				72.7	20.6	8.3	76.8	25.4	11.4
2				75.0	17.2	6.0	74.8	26.0	11.0
3				80.3	22.8	9.3	81.2	30.9	13.2
4				81.0	24.6	11.5	80.4	32.4	12.1
Highest				84.9	36.4	13.9	85.9	35.9	14.9
Overall				**78.8**	**24.8**	**10.0**	**79.8**	**30.2**	**12.6**
Agro-potential									
Low potential	77.8	19.7	9.3	80.0	14.9	5.9	84.4	23.4	9.7
High potential	75.1	29.4	14.5	78.3	29.5	11.9	77.6	33.7	14.1
Overall	**76.0**	**26.2**	**12.8**	**78.8**	**24.8**	**10.0**	**79.8**	**30.2**	**12.6**

4.1.2.3 Market Participation and Transitioning out of Poverty

Based on the previous definition of income poverty, households were classified into various categories based on their income poverty status in order to explore the relationship between market participation and transitioning out of poverty. The always poor households were those that remained in poverty while the always non poor were those that remained above the poverty line in all the three survey years. The households that exited poverty were those that were poor in 2000 or in both 2000 and 2004 then rose above the poverty line in 2007. On the other hand, households that were not poor in 2000 or in both 2000 and 2004 but were poor in 2007 were classified as having descended into poverty. The oscillators were those households that moved in and out of poverty or vice versa in the survey years. The interest here is to explore trends in input and output market participation by the households that exited poverty to give insight of the role market participation could play in poverty reduction.

Selected market related characteristics of the households by income poverty status are presented in Table 48. It is observed that the proportion of poverty exiting households receiving credit, with membership in groups and using fertilizer increased tremendously between 2000 and 2007. On the other hand, these proportions declined or increased less among the other groups of households. However, proportion of oscillators that received credit increased more than among those that exited poverty. It is also observed that the proportion of households with membership in groups increased only among those that exited and those that oscillated in and out of poverty, but the increase is higher among those that exited. While the proportion of households using fertilizer increased among all the categories of households, the increase was highest among the households that exited poverty. These results indicate the positive relationship between access to credit and inputs in transitioning out of poverty.

Table 48: Selected Market-Related Characteristics of Households by Income Poverty Status

Poverty status	Characteristics	2000	2007	Change (2007-2000)
All households	% receiving credit	48.6	51.5	2.9
	% with savings account		41.3	
	% with membership in groups	78.0	75.0	-3.1
	% using fertilizer	69.8	76.0	6.2
Always poor	% receiving credit	36.3	37.6	1.3
	% with savings account		33.3	
	% with membership in groups	67.1	63.3	-3.8
	% using fertilizer	48.9	54.0	5.1
Always non poor	% receiving credit	60.3	62.7	2.4
	% with savings account		80.9	
	% with membership in groups	88.6	82.9	-5.7
	% using fertilizer	86.8	90.6	3.7
Exited	% receiving credit	41.4	45.4	4.0
	% with savings account		59.5	
	% with membership in groups	72.2	76.2	4.0
	% using fertilizer	55.1	67.0	11.9
Descended	% receiving credit	48.5	44.9	-3.6
	% with savings account		40.7	
	% with membership in groups	75.4	65.9	-9.6
	% using fertilizer	76.0	77.8	1.8
Oscillated	% receiving credit	44.7	55.3	10.6
	% with savings account		51.6	
	% with membership in groups	75.5	77.1	1.6
	% using fertilizer	63.3	72.9	9.6

Participation in output markets by household poverty status is presented in Tables 49 and 50. On crops market participation, it is observed that households that exited poverty registered tremendous increases in both the proportion selling and the marketed proportion (Table 49). The increase in the marketed proportion is particularly huge for fruits, bananas, other cash crops, roots and tubers, maize, other cereals and pulses, beans and vegetables in that order. Among the households that descended into poverty, market participation declined for most of the crops. The marketed proportions increased but in a small way only for bananas, roots and tubers and fruits. These results reveal a strong relationship between output (crop) market participation and exiting poverty.

Table 49: Participation in Crops Markets by Poverty Status

Poverty status	Crop	% producing			% of producers selling			% of production sold		
		2000	2007	Change (2007-2000)	2000	2007	Change (2007-2000)	2000	2007	Change (2007-2000)
All households	Maize	96.2	98.4	2.2	39.9	47.6	7.7	17.2	20.0	2.8
	Other cereals and pulses	74.0	67.4	-6.6	30.4	35.1	4.7	11.2	13.6	2.4
	Beans	90.4	92.0	1.6	29.6	32.7	3.0	13.4	15.1	1.7
	Bananas	84.9	79.5	-5.5	44.8	52.8	8.1	22.6	31.6	9.0
	Roots and tubers	82.3	74.5	-7.8	38.7	43.4	4.7	17.3	22.7	5.4
	Vegetables	88.3	93.6	5.4	61.9	64.1	2.2	33.7	34.4	0.7
	Fruits	85.1	89.7	4.6	52.5	58.0	5.4	24.8	31.3	6.5
	Tea, coffee, and sugarcane	83.1	71.2	-11.9	84.9	84.8	0.0	76.8	80.4	3.6
	Napier and other feeds	58.6	83.0	24.4	11.9	12.2	0.4	7.0	8.0	1.0
	Other cash crops	58.6	61.0	2.5	78.2	81.5	3.3	60.3	66.9	6.6
Always poor	Maize	94.9	98.7	3.8	30.4	32.5	2.1	9.3	10.1	0.8
	Other cereals and pulses	74.9	74.4	-0.5	26.1	26.9	0.8	7.4	7.7	0.3
	Beans	86.3	94.3	7.9	26.2	25.7	-0.5	10.4	10.1	-0.3
	Bananas	83.9	77.1	-6.8	44.1	43.2	-0.9	22.2	25.1	2.9
	Roots and tubers	80.8	74.2	-6.6	26.9	26.6	-0.3	9.9	12.8	2.9
	Vegetables	83.4	94.5	11.1	51.8	52.3	0.5	26.6	22.8	-3.8
	Fruits	81.7	89.4	7.8	48.0	47.7	-0.3	19.5	24.1	4.6
	Tea, coffee, and sugarcane	71.4	58.8	-12.6	82.4	74.3	-8.1	69.6	70.3	0.8
	Napier and other feeds	42.7	78.6	35.9	18.2	21.0	2.8	10.2	14.1	3.9
	Other cash crops	62.7	68.7	6.0	78.6	91.3	12.7	53.6	72.8	19.2
Always non poor	Maize	97.4	98.5	1.1	51.0	60.0	9.0	25.2	28.7	3.5
	Other cereals and pulses	68.3	58.0	-10.3	32.8	37.4	4.6	13.9	18.2	4.3
	Beans	94.7	92.0	-2.7	32.2	34.0	1.8	15.4	16.8	1.5
	Bananas	87.1	84.0	-3.0	43.6	51.1	7.5	23.0	30.9	7.9
	Roots and tubers	89.1	79.1	-10.0	47.6	53.6	6.0	22.4	28.4	6.0
	Vegetables	94.3	94.3	0.0	72.3	69.7	-2.6	41.1	42.1	1.1
	Fruits	88.1	89.5	1.4	52.8	62.4	9.6	26.9	34.3	7.4
	Tea, coffee, and sugarcane	88.7	80.5	-8.2	87.9	87.9	-0.1	79.9	84.1	4.2
	Napier and other feeds	65.8	86.1	20.3	8.6	11.2	2.6	4.6	7.2	2.5

Poverty status	Crop	% producing			% of producers selling			% of production sold		
		2000	2007	Change (2007-2000)	2000	2007	Change (2007-2000)	2000	2007	Change (2007-2000)
	Other cash crops	57.0	60.1	3.2	82.2	82.1	-0.1	67.8	70.4	2.6
Exited	Maize	93.8	97.8	4.0	25.6	42.8	17.2	9.1	18.0	8.9
	Other cereals and pulses	79.7	70.3	-9.4	22.2	43.0	20.7	6.1	14.9	8.8
	Beans	86.8	90.5	3.6	16.2	31.2	14.9	6.8	14.5	7.7
	Bananas	79.0	76.1	-2.8	37.4	54.5	17.1	18.1	32.6	14.5
	Roots and tubers	63.9	72.6	8.7	27.1	37.7	10.7	10.1	19.2	9.1
	Vegetables	80.9	92.9	12.0	51.1	66.5	15.4	26.1	33.7	7.5
	Fruits	80.6	91.5	10.9	48.8	66.3	17.5	20.6	36.1	15.5
	Tea, coffee, and sugarcane	74.6	77.0	2.5	80.2	87.2	7.0	74.9	81.3	6.3
	Napier and other feeds	49.6	84.3	34.8	12.3	12.4	0.1	8.3	8.2	-0.1
	Other cash crops	49.4	65.1	15.7	80.5	85.2	4.7	59.4	69.6	10.1
Descended	Maize	98.8	97.0	-1.8	42.7	44.1	1.4	18.8	16.6	-2.2
	Other cereals and pulses	73.7	63.5	-10.2	39.6	31.0	-8.6	16.6	11.4	-5.2
	Beans	90.6	89.4	-1.3	37.9	37.1	-0.9	18.2	16.6	-1.5
	Bananas	86.1	75.7	-10.4	51.6	57.8	6.2	26.9	34.7	7.8
	Roots and tubers	84.5	65.8	-18.7	40.5	41.2	0.7	19.1	22.9	3.8
	Vegetables	91.0	92.2	1.2	59.2	59.1	-0.1	34.9	30.9	-4.1
	Fruits	86.4	85.7	-0.7	55.1	51.6	-3.5	26.5	28.1	1.5
	Tea, coffee, and sugarcane	88.5	54.0	-34.5	84.0	80.3	-3.7	75.8	74.9	-0.8
	Napier and other feeds	61.9	73.2	11.3	18.3	9.9	-8.5	11.8	6.9	-4.9
	Other cash crops	73.6	54.7	-18.9	71.8	62.1	-9.7	53.9	47.3	-6.6
Oscillated	Maize	95.2	99.5	4.3	38.5	45.5	6.9	15.2	16.6	1.4
	Other cereals and pulses	76.3	74.4	-1.9	35.3	37.1	1.8	14.3	15.4	1.1
	Beans	89.1	93.4	4.4	35.6	36.3	0.7	15.5	16.3	0.8
	Bananas	86.5	78.2	-8.3	50.0	63.1	13.1	22.6	37.8	15.1
	Roots and tubers	86.5	73.0	-13.5	37.7	44.6	7.0	17.6	23.5	6.0
	Vegetables	86.2	93.1	6.9	61.1	66.9	5.7	30.3	34.2	3.9
	Fruits	86.3	91.4	5.1	58.9	55.6	-3.3	28.8	30.1	1.3
	Tea, coffee, and sugarcane	83.6	69.0	-14.7	83.5	85.0	1.5	76.9	80.5	3.6
	Napier and other feeds	55.9	83.9	28.0	13.6	10.1	-3.5	8.1	6.3	-1.7
	Other cash crops	57.4	53.2	-4.3	70.4	76.0	5.6	56.0	59.8	3.7

On dairy, it is only among the households that exited poverty and those that remained non-poor that an increase in the proportion of producers was observed, but the increase was less among the always non-poor (Table 50). Similarly, the households that exited poverty registered the highest and huge increase in the proportion selling milk and the proportion of milk marketed. On the other hand, a decline in both the proportion that sold and the proportion of marketed milk was observed among the households that descended into poverty.

Increased participation in output markets by poverty exiting households and a decline in market participation by households that descended into poverty suggest the important role expansion of market participation by smallholders can play in households' transitioning out of poverty.

Table 50: Participation in Dairy Market by Poverty Status

Poverty status	% producing			% of producers selling			% of production sold		
	2000	2007	Change (2007-2000)	2000	2007	Change (2007-2000)	2000	2007	Change (2007-2000)
All households	69.0	68.5	-0.5	73.6	79.9	6.2	40.2	45.9	5.7
Always poor	50.2	49.4	-0.8	47.9	53.0	5.1	24.0	26.0	2.0
Always non poor	84.2	84.6	0.4	85.9	91.2	5.3	48.1	54.1	6.0
Exited	61.7	66.1	4.4	60.7	82.0	21.3	32.7	48.7	16.0
Descended	66.5	58.1	-8.4	75.7	71.1	-4.5	39.6	38.3	-1.4
Oscillated	67.0	66.0	-1.1	73.0	74.2	1.2	40.1	41.6	1.4

4.1.2.4 Output Market Participation and Credit Access

Marketed volume and proportion of production marketed for various crop enterprises by access to credit is presented in Table 51. First, it is observed that households that received credit sold higher volumes of the major cash crops (tea, coffee and sugar cane), bananas and vegetables than households that did not receive credit. Secondly, households that received credit registered increased sales volumes for maize, beans, nappier and other feeds, other cereals and pulses and vegetables between 2000 and 2007. Households that did not receive credit experienced a decline in the volumes sold for all crops but fruits. Lastly, there was marked increase in the proportion of production marketed for all crops between 2000 and 2007 by the households that received credit. For the households that did not receive credit, the proportion of production marketed declined for all crops except for major cash crops and other cereals and pulses. These results imply some positive association between access to credit and market participation for the crops enterprises.

Table 51: Volume and Proportion of Production Marketed for Various Enterprises, by Access to Credit

Year	Enterprise	Without credit		With credit	
		Volume (Kg)	% of prodn	Volume (Kg)	% of prodn
2000	Maize	1,438	20.3	322	13.7
	Other cereals and pulses	48	12.2	33	10.0
	Beans	86	16.5	36	10.4
	Bananas	782	23.6	811	21.6
	Roots and tubers	479	18.0	392	16.7
	Vegetables	847	32.6	775	34.9
	Fruits	377	25.9	412	23.7
	Tea, coffee, and sugarcane	8,946	68.2	13,368	81.6
	Napier and other feeds	361	6.2	284	7.4
	Other cash crops	2,438	66.7	1,116	50.7
2004	Maize	934	21.7	728	17.0
	Other cereals and pulses	47	14.0	55	19.3
	Beans	78	17.6	54	15.7
	Bananas	604	26.5	658	24.8
	Roots and tubers	418	18.4	388	19.6
	Vegetables	663	32.6	902	33.9
	Fruits	555	27.9	266	24.8
	Tea, coffee, and sugarcane	5,917	58.8	10,217	89.3
	Napier and other feeds	1,149	7.4	573	8.0
	Other cash crops	1,651	72.9	995	53.8
2007	Maize	1,194	22.9	591	17.3
	Other cereals and pulses	41	12.0	35	15.1
	Beans	51	16.8	53	13.6
	Bananas	485	29.3	578	33.4
	Roots and tubers	264	21.0	376	24.1
	Vegetables	510	32.6	826	36.1
	Fruits	395	31.3	316	31.3
	Tea, coffee, and sugarcane	5,816	67.4	9,553	86.9
	Napier and other feeds	249	7.4	332	8.4
	Other cash crops	1,529	68.8	980	64.9
% change (2007-2000)	Maize	-17.0	2.5	83.6	3.5
	Other cereals and pulses	-15.3	-0.2	6.9	5.1
	Beans	-40.4	0.3	48.1	3.2
	Bananas	-38.0	5.7	-28.8	11.8
	Roots and tubers	-44.8	3.0	-4.2	7.4
	Vegetables	-39.7	0.0	6.6	1.2
	Fruits	4.9	5.4	-23.3	7.6
	Tea, coffee, and sugarcane	-35.0	-0.9	-28.5	5.3
	Napier and other feeds	-31.0	1.2	16.7	1.0
	Other cash crops	-37.3	2.1	-12.2	14.2

4.2 Econometric Results

In this section, we discuss the econometric results of market participation for various crops, milk, fertilizer and financial services. On the output supply side, determinants of market participation (whether a household sold) and extent of participation (the proportion of produce sold) are discussed for crops and milk. On the input demand side, determinants of adoption (whether a household used chemical fertilizer) and intensity of use (amount applied per acre) are discussed. For credit, we look at the determinants of access (defined as whether a household received credit). Only variables of interest (gender of household head, land size, membership in farmer groups, ownership of transport and communication equipment, distance variables, household income, output and input prices and agricultural potential) which will inform conclusions for this study are discussed. For detailed results including other variables, refer to Annex 5.

4.2.1 Determinants of Participation in Markets for Selected Crops

Food crops

Probit results on the decision to participate in markets and truncated regression analysis on the extent of market participation for food crops (maize, beans, other cereals and pulses, bananas, vegetables, fruits and roots and tubers) are presented in Tables 52 and 53, respectively.

The first striking result is that female-headed households have a greater likelihood of participation in maize, beans, other cereals and pulses markets than male-headed households (Table 52). Male headed households, on the other hand, have a higher probability of participation in vegetable markets, controlling for other factors such as farm size. After the decision to participate in the market has been made, the extent of participation does not differ any significantly between female headed and male headed households for most of the commodities, except bananas where female headed households sell significantly more than male headed households and roots and tubers where male headed households sell significantly more than female headed households (Table 53).

The larger the per capita land size, the higher the likelihood of the household's participation in markets for maize, beans, other cereals and pulses, roots and tubers. In addition to positively impacting on the market participation decision, per capita land size also positively

and significantly influences marketed volumes for these commodities as well as for fruits and vegetables. These results indicate the constraints the land poor face in accessing markets. This could probably be due to inability to produce marketable surplus.

Generally, households in the lowest income quintile compared to those in the third income quintile have a significantly lower probability of participating in the markets for maize, beans, vegetables and roots and tubers. Those in the highest income quintile have a significantly higher propensity to participate in the fruits and roots and tubers markets compared to the households in the third quintile. For most of the food crops, households in the highest income quintile sell significantly more while those in the lowest income quintile sell significantly less than those in the third income quintile. These results suggest that poorer households participate less in markets for food crops than the less income poor households.

Ownership of transport equipment has a positive and significant influence on probability of market participation for maize and roots and tubers, but, surprisingly, a negative and significant influence on the probability of participation for fruits. After the decision to participate is made, ownership of transport equipment has no influence on the amount of roots and tubers sold, but a significant and positive influence on the amount sold for maize. Ownership of communication equipment has a positive and significant influence on the decision to participate in the maize market and a positive and significant influence on the amount sold for maize, bananas and fruits.

Membership in groups positively and significantly influences the decision to participate in maize, beans, vegetables and fruits markets. After the decision to participate in the market has been made, membership in group does not have significant influence on the amount sold. These results underscore the importance of social capital in accessing markets for food crops by smallholder farmers.

Table 52: Probit Estimates of Determinants of Decision to Participate in Markets for Food Crops

Variable	Maize	Beans	Other cereals & pulses	Bananas	Vegetables	Fruits	Roots &tubers
Gender of household head (1=male)	-0.17*** (2.71)	-0.16** (2.34)	-0.13* (1.65)	-0.05 (0.66)	0.14** (2.22)	0.02 (0.39)	0.04 (0.64)
Per capita land size (acres)	0.10*** (6.09)	0.05*** (3.24)	0.10*** (4.81)	0.01 (0.63)	0.00 (0.25)	0.00 (0.12)	0.04** (2.49)
Membership in farmer group (1=yes)	0.15*** (2.65)	0.22*** (3.61)	0.07 (0.91)	-0.02 (0.26)	0.23*** (4.05)	0.15** (2.48)	0.07 (1.10)
Ownership of transport equipment (1=yes)	0.08* (1.67)	0.08 (1.56)	0.06 (0.87)	0.09 (1.50)	0.05 (0.95)	-0.09* (1.71)	0.17*** (3.06)
Ownership of communication equipment (1=yes)	0.18** (2.37)	-0.02 (0.22)	-0.13 (1.41)	-0.08 (0.95)	0.10 (1.26)	0.12 (1.56)	-0.03 (0.33)
Distance to tarmac road (km)	0.01*** (2.88)	0.01** (2.02)	0.01*** (3.92)	-0.00 (0.90)	-0.01* (1.68)	-0.01*** (2.62)	-0.00 (0.91)
Crop price (Ksh/kg)	-0.06*** (3.57)	-0.05*** (7.14)	0.01** (2.51)	-0.03 (1.55)	0.03*** (6.05)	-0.01 (0.68)	0.01 (0.60)
Income quintile1 (quintile1_lag=1)	-0.21*** (2.79)	-0.27*** (3.29)	-0.08 (0.87)	-0.13 (1.52)	-0.41*** (5.40)	-0.05 (0.70)	-0.29*** (3.46)
Income quintile2 (quintile 2_lag=1)	-0.04 (0.54)	-0.13* (1.75)	0.02 (0.21)	-0.06 (0.78)	-0.15** (2.09)	-0.07 (0.99)	-0.07 (0.93)
Income quintile4 (quintile 4_lag=1)	0.05 (0.75)	-0.07 (0.90)	0.05 (0.47)	-0.03 (0.37)	-0.03 (0.44)	0.03 (0.34)	0.09 (1.23)
Income quintile5 (quintile 5_lag=1)	0.23*** (3.23)	0.09 (1.21)	0.06 (0.62)	0.04 (0.44)	0.09 (1.22)	0.17** (2.21)	0.23*** (2.91)
Coastal lowlands dummy	-0.54*** (4.00)	-0.09 (0.47)	-0.18 (0.84)	-0.32** (2.27)	-0.58*** (4.99)	-0.07 (0.64)	-0.20 (1.61)
Eastern lowlands dummy	-0.11 (1.34)	0.48*** (4.99)	0.34* (1.79)	0.48*** (5.11)	-0.23*** (2.65)	0.44*** (5.15)	-0.36*** (3.72)
Western lowlands dummy	-0.21** (2.21)	0.78*** (7.02)	0.71*** (3.82)	0.06 (0.50)	0.14 (1.44)	0.11 (1.16)	-0.11 (0.98)
Western transitional dummy	0.35***	0.68***	0.85***	0.60***	0.44***	0.07	0.46***

Variable	Maize	Beans	Other cereals & pulses	Bananas	Vegetables	Fruits	Roots &tubers
	(4.05)	(6.85)	(4.41)	(5.79)	(4.81)	(0.81)	(4.24)
High potential maize zone dummy	0.83*** (11.31)	1.08*** (12.74)	0.29 (1.62)	0.02 (0.17)	0.12 (1.63)	0.01 (0.11)	-0.30*** (3.22)
Western highlands dummy	0.40*** (4.63)	1.12*** (11.41)	0.94*** (5.15)	0.88*** (9.45)	0.46*** (5.01)	0.26*** (2.95)	-0.53*** (4.53)
Marginal rain shadow dummy	-0.19 (1.24)	0.73*** (4.79)	0.07 (0.27)	-1.24*** (3.56)	-0.12 (0.81)	-0.32* (1.79)	-0.58*** (3.71)
Year of survey (1=2004)	0.11** (2.00)	0.31*** (5.15)	0.24*** (3.33)	0.07 (1.11)	0.20*** (3.61)	0.12** (2.11)	0.10* (1.69)
Year of survey (1=2007)	0.06 (0.89)	0.48*** (5.92)	0.00 (0.03)	0.28*** (3.30)	0.04 (0.62)	0.12** (2.03)	0.16** (2.47)
Observations	3724	3404	2161	2627	3535	3076	2920

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 53: Truncated Regression Estimates of Determinants of Extent of Participation in Markets for Food Crops

Variable	Maize	Beans	Other cereals & pulses	Bananas	Vegetables	Fruits	Roots &tubers
Gender of household head (1=male)	-0.02 (1.07)	0.01 (0.29)	-0.02 (0.46)	-0.04** (2.01)	0.03 (1.63)	-0.02 (1.34)	0.06*** (2.58)
Per capita land size (acres)	0.02*** (6.59)	0.01*** (3.00)	0.01* (1.76)	0.01 (1.59)	0.01* (1.94)	0.01** (2.55)	0.02*** (3.96)
Membership in farmer group (1=yes)	-0.02 (0.98)	-0.01 (0.67)	-0.01 (0.36)	-0.00 (0.00)	0.02 (0.96)	0.01 (0.36)	-0.00 (0.19)
Ownership of transport equipment (1=yes)	0.02* (1.73)	0.02 (1.09)	0.01 (0.24)	0.01 (0.65)	0.01 (1.07)	-0.00 (0.03)	0.01 (0.40)
Ownership of communication equipment (1=yes)	0.05** (1.99)	0.05 (1.62)	0.12*** (2.62)	0.02 (0.86)	0.01 (0.57)	0.06** (2.55)	0.01 (0.30)
Distance to tarmac road (km)	-0.00*** (3.26)	0.00 (1.05)	0.00* (1.89)	0.00 (1.22)	0.00 (0.29)	-0.00* (1.80)	0.00*** (2.83)
Crop price (Ksh/kg)	0.00 (0.60)	-0.01*** (2.91)	-0.00 (0.10)	-0.02*** (4.21)	-0.00 (1.03)	-0.01** (2.14)	-0.02*** (3.40)
Income quintile1 (quintile1_lag=1)	-0.07*** (3.09)	-0.04 (1.54)	-0.09** (2.00)	-0.02 (1.04)	-0.07*** (3.13)	-0.01 (0.29)	-0.04 (1.48)
Income quintile2 (quintile 2_lag=1)	-0.04* (1.78)	-0.04* (1.86)	-0.06 (1.48)	0.00 (0.01)	-0.06*** (2.91)	-0.01 (0.57)	-0.00 (0.04)
Income quintile4 (quintile 4_lag=1)	0.02 (1.17)	0.02 (0.69)	-0.01 (0.21)	-0.00 (0.05)	-0.01 (0.29)	-0.03 (1.26)	-0.01 (0.67)
Income quintile5 (quintile 5_lag=1)	0.05*** (2.80)	0.04* (1.84)	-0.06 (1.43)	0.06*** (2.58)	0.05*** (2.89)	0.05** (2.39)	0.05** (2.17)
Coastal lowlands dummy	-0.12** (2.06)	-0.10 (1.06)	-0.13 (1.13)	0.06 (1.17)	-0.14*** (3.48)	-0.09** (2.37)	-0.02 (0.49)
Eastern lowlands dummy	-0.11*** (3.57)	-0.07* (1.88)	-0.34*** (3.60)	0.15*** (5.95)	-0.06*** (2.69)	-0.00 (0.01)	-0.05 (1.59)
Western lowlands dummy	-0.11*** (2.99)	0.11** (2.42)	-0.46*** (4.83)	0.06* (1.82)	-0.04 (1.60)	0.00 (0.11)	-0.07* (1.71)
Western transitional dummy	-0.02	0.02	-0.18*	0.06**	-0.05**	-0.04	0.01

Variable	Maize	Beans	Other cereals & pulses	Bananas	Vegetables	Fruits	Roots &tubers
	(0.72)	(0.65)	(1.92)	(2.14)	(2.09)	(1.64)	(0.44)
High potential maize zone dummy	0.14*** (6.72)	0.11*** (3.53)	-0.16* (1.80)	0.07*** (2.60)	-0.07*** (3.81)	0.02 (0.96)	-0.03 (0.96)
Western highlands dummy	-0.13*** (4.61)	0.07** (1.97)	-0.15* (1.74)	0.11*** (4.73)	-0.04 (1.56)	-0.01 (0.24)	-0.08* (1.89)
Marginal rain shadow dummy	-0.06 (1.06)	-0.11** (1.97)	-0.13 (0.99)	0.22 (1.30)	0.09** (2.18)	0.01 (0.24)	-0.23*** (3.71)
Year of survey (1=2004)	0.01 (0.38)	0.04** (2.03)	0.03 (0.99)	0.05*** (2.96)	-0.06*** (3.83)	-0.01 (0.46)	0.02 (1.12)
Year of survey (1=2007)	-0.01 (0.67)	0.06** (2.27)	0.03 (0.63)	0.17*** (7.10)	0.01 (0.37)	0.07*** (4.05)	0.09*** (4.87)
Observations	1659	1116	751	1259	2290	1718	1193

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Distance to tarmac road, which is an indicator of travel time and cost to the market, shows mixed results both in the model for decision to participate in the markets and in the extent of participation. It has a positive and significant influence on the decision to participate in maize, beans, other cereals and pulses markets and a negative and significant influence – as expected - on the decision to participate in vegetables and fruits markets. This puzzling result can be explained by the characteristics of the crops, where perishability may possibly be influencing farmers to specialize depending on the relative advantages of their location. After decision to sell has been made, distance to tarmac negatively and significantly influences the amount sold for maize and fruits and positively and significantly influences the amount sold for bananas and roots and tubers.

Contrary to expectations, prices for maize and beans have a negative and significant influence on the decision to sell. For other cereals and pulses and vegetables, the influence of prices on the decision to sell is positive and significant, as expected. The influence of prices on the amount sold is significant and negative for beans, bananas, fruits and roots and tubers. A possible explanation for the unexpected behavior of price on market participation could be that many of the households are actually net buyers of food crops and a high price may encourage them to keep as much on the farm as possible to avoid making significant expenditures to buy more food

In comparison to the Central highlands, households in the low agricultural potential zones, mainly the lowlands, generally have a lower propensity to participate in maize and vegetable markets. Households in the Eastern and Western lowlands, however, have a higher likelihood of selling beans, other cereals and pulses and bananas compared to those in the Central highlands. These results suggest that the lowlands may be productive in pulses, cereals other than maize and bananas such that their production levels allow for marketable surplus. Efforts in improving the production of such crops in the lowland regions may be desirable in enhancing greater market participation by the households. The amount of crops sold is generally significantly higher in the Central highlands than in the Lowlands and the Marginal rain shadow, except for beans and bananas where the amount sold is significantly higher in the Western lowlands and for vegetables where the amount sold is significantly higher in the Marginal rain shadow.

Cash crops and animal feeds

Probit results on the decision to participate in markets and truncated regression analysis on the extent of market participation for cash crops and animal feeds are presented in Table 54. Results show no significant difference in the likelihood of selling cash crops and the amount sold between female and male headed households. This finding is consistent with our expectations given that these crops are grown primarily for the market and hence the lack of gender influence on marketing. Male headed households have a greater and significant likelihood of selling animal feeds but do not necessarily sell higher amounts than female headed households.

Households in the lowest income quintile compared to those in the third income quintile have a significantly lower probability of participating in the markets for tea, coffee and sugar cane. Conversely, households in the highest income quintile have a significantly higher propensity to sell tea, coffee and sugar canes compared to the households in the third quintile. The amounts of the cash crops to sold, however, do not significantly differ across the income quintiles. For animal feeds, the highest income quintile households tend to sell significantly higher amounts than households in the third income quintile

Contrary to expectations, ownership of transport equipment has a negative and significant influence on probability of market participation for animal feeds. Membership in groups positively and significantly influences the decision to sell tea, coffee and sugarcane but has no influence on deciding the amount sold. This could be due to the farmers producing these crops (irrespective of their production levels) being members of the respective commodity-based cooperatives or outgrower companies through which they sell their produce.

Prices for tea, coffee and sugarcane have a positive and significant influence on the decision to sell and the amount sold. For other cash crops, prices have the unexpected negative and significant influence on the decision to sell.

Table 54: Determinants of Decision to Participate and Extent of Participation in Markets for Cash Crops and Animal Feeds

Variable	Determinants of decision to participate			Determinants of extent of participation		
	Tea, Coffee & Sugarcane	Other cash crops	Napier grass and other feeds	Tea, Coffee & Sugarcane	Other cash crops	Napier grass and other feeds
Gender of household head (1=male)	0.03 (0.25)	0.24 (1.32)	0.27** (2.15)	0.00 (0.11)	0.01 (0.47)	0.07 (0.75)
Per capita land size (acres)	0.05 (1.03)	-0.02 (0.66)	0.03 (1.00)	0.00 (0.40)	0.00 (0.11)	-0.00 (0.11)
Membership in farmer group (1=yes)	0.43*** (3.52)	0.03 (0.17)	0.02 (0.18)	0.01 (0.58)	0.02 (1.12)	-0.03 (0.34)
Ownership of transport equipment (1=yes)	-0.05 (0.47)	0.13 (0.97)	-0.24** (2.46)	0.00 (0.32)	-0.01 (0.36)	-0.10 (1.36)
Ownership of communication equipment (1=yes)	-0.07 (0.44)	-0.19 (0.94)	-0.11 (0.74)	-0.02 (1.50)	0.03 (1.16)	0.07 (0.73)
Distance to tarmac road (km)	-0.00 (0.54)	-0.03** (2.53)	-0.01 (1.31)	0.00** (2.18)	0.00 (1.47)	0.01 (1.27)
Crop price (Ksh/kg)	0.09*** (10.90)	-0.00*** (2.90)	-0.01 (0.10)	0.00*** (5.91)	-0.00 (0.07)	-0.09 (1.17)
Income quintile1 (quintile1_lag=1)	-0.31** (2.22)	-0.20 (0.93)	-0.01 (0.07)	-0.01 (1.01)	0.04 (1.59)	0.05 (0.59)
Income quintile2 (quintile 2_lag=1)	0.08 (0.56)	-0.18 (0.89)	0.14 (1.16)	0.01 (0.50)	0.04 (1.54)	0.05 (0.64)
Income quintile4 (quintile 4_lag=1)	0.12 (0.90)	0.12 (0.62)	-0.15 (1.21)	0.00 (0.14)	0.04* (1.66)	0.00 (0.03)
Income quintile5 (quintile 5_lag=1)	0.23* (1.65)	-0.11 (0.59)	-0.34** (2.54)	0.00 (0.33)	0.01 (0.63)	-0.04 (0.37)
Coastal lowlands dummy	-1.14*** (3.71)	0.28 (1.32)	-4.91 (.)	-0.43*** (5.93)	-0.19*** (6.60)	
Eastern lowlands dummy	-0.21 (1.39)	-0.32 (1.19)	0.03 (0.24)	-0.22*** (12.75)	0.09* (1.74)	-0.13 (1.21)
Western lowlands dummy	1.05***	0.79***	0.70**	0.05**	0.09**	0.38*

Variable	Determinants of decision to participate			Determinants of extent of participation		
	Tea, Coffee & Sugarcane	**Other cash crops**	**Napier grass and other feeds**	**Tea, Coffee & Sugarcane**	**Other cash crops**	**Napier grass and other feeds**
	(4.50)	(2.85)	(2.18)	(2.33)	(2.51)	(1.96)
Western transitional dummy	1.93*** (8.98)	6.07 (.)	-0.07 (0.37)	0.11*** (6.50)	0.25* (1.84)	0.24* (1.80)
High potential maize zone dummy	-0.12 (0.79)	1.19*** (5.56)	-0.36** (2.26)	-0.02 (1.45)	0.13*** (4.93)	0.08 (0.61)
Western highlands dummy	0.80*** (5.20)	-0.29 (0.46)	0.38*** (3.11)	0.02* (1.70)	0.02 (0.13)	-0.03 (0.33)
Marginal rain shadow dummy	-0.31 (0.97)	0.55 (0.85)	-0.02 (0.06)	-0.38*** (7.03)	-0.39*** (4.71)	0.04 (0.19)
Year of survey (1=2004)	0.17 (1.54)	0.15 (0.97)	0.16 (1.47)	0.02* (1.91)	0.06*** (3.10)	0.04 (0.58)
Year of survey (1=2007)	-0.21* (1.81)	0.44** (2.46)	0.16 (1.33)	0.04*** (4.29)	0.07*** (3.41)	0.20** (2.04)
Observations	1783	722	1727	1505	596	214

Absolute value of z statistics in parentheses
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

For tea, coffee and sugarcane, households in the Western lowlands, transitional and highlands zones have a significantly higher probability of selling while those in the Coastal lowlands have a significantly lower probability of selling compared to their counterparts in the Central highlands. The amount sold of tea, coffee and sugarcane is significantly higher in the Western lowlands, transitional and highlands and significantly lower in the Coastal and eastern lowlands, and marginal rain shadow compared to the Central highlands. The higher likelihood and higher amount of sales of tea, coffee and sugarcane in the zones in the western region compared to the Central highlands is mainly because of sugarcane enterprises in the Western lowlands and Western transitional and tea in the Western highlands. Households in the Western lowlands and High potential maize zone compared to those in the Central highlands have a significantly higher likelihood of selling other cash crops. The amount of other cash crops sold is generally significantly higher in the Eastern lowlands, Western lowlands and transitional areas and high potential maize zone compared to the Central highlands.

4.2.2 Determinants of Participation in Dairy Markets

In Table 55, we present the Probit results on decision to participate in markets and truncated regression analysis on the extent of market participation for milk. Female-headed households have a significantly greater likelihood of selling milk than their male counterparts. There is, however, no significant difference in the amount of milk sold. It is noteworthy that per capita land size has a positive and significant effect on both the decision to sell milk and the amount of milk sold.

Households in the lowest income quintile compared to those in the third income quintile have a significantly lower probability of participating in the milk market. Those in the highest income quintile have a significantly higher propensity to sell milk and sell significantly more milk than those in the third quintile. There is no significant difference in milk market participation or the amount of milk sold between households in the third quintile compared to those in the second or fourth income quintiles.

Table 55: Determinants of Decision to Participate and Extent of Participation in Milk Market

Variable	Determinants of decision to participate	Determinants of extent of participation
Gender of household head (1=male)	-0.14* (1.67)	0.00 (0.21)
Per capita land size (acres)	0.03** (2.04)	0.01*** (4.47)
Membership in farmer group (1=yes)	0.19*** (2.61)	0.01 (0.62)
Ownership of transport equipment (1=yes)	0.02 (0.31)	0.01 (0.75)
Ownership of communication equipment (1=yes)	0.36*** (3.53)	-0.02 (0.97)
Distance to tarmac road (km)	-0.03*** (5.53)	-0.00*** (4.19)
Milk price (Ksh/kg)	0.05*** (5.18)	-0.00 (0.17)
Income quintile1 (quintile1_lag=1)	-0.20** (2.02)	-0.01 (0.91)
Income quintile2 (quintile 2_lag=1)	-0.12 (1.29)	-0.01 (0.59)
Income quintile4 (quintile 4_lag=1)	0.04 (0.44)	0.00 (0.33)
Income quintile5 (quintile 5_lag=1)	0.21** (2.18)	0.02* (1.90)
Coastal lowlands dummy	-0.62* (1.88)	0.09 (1.56)
Eastern lowlands dummy	-1.05*** (7.32)	-0.01 (0.44)
Western lowlands dummy	-1.70*** (12.32)	-0.06** (2.45)
Western transitional dummy	-0.51*** (4.08)	-0.02 (1.38)
High potential maize zone dummy	-0.25*** (2.58)	-0.00 (0.35)
Western highlands dummy	-0.90*** (7.30)	-0.03 (1.39)
Marginal rain shadow dummy	0.53** (2.49)	0.02 (0.96)
Year of survey (1=2004)	0.06 (0.82)	0.02* (1.80)
Year of survey (1=2007)	0.17** (2.26)	0.03*** (2.81)
Observations	2633	2013

Absolute value of z statistics in parentheses
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Ownership of communication equipment and membership in groups positively and significant influence the decision to sell milk, but they have no significant effects on the

amount of milk sold. The probability of selling milk as well as the amount of milk sold declines with increase in the distance to tarmac road, suggesting the negative effects infrastructural remoteness can have on household's participation in markets for perishable commodities such as milk. The price of milk has a positive and significant influence on the decision to sell, but does not significantly affect the amount sold.

In comparison to the Central highlands, households in all the other zones except the Marginal rain shadow have a significantly lower propensity to sell milk. Compared to the Central highlands, only households in the Eastern lowlands sell significantly less milk.

4.2.3 Determinants of Fertilizer Adoption and Intensity of Use

Results from the Probit analysis on fertilizer adoption and truncated regression analysis on the intensity of fertilizer use are presented in Table 56. Male headed households have a significantly higher probability of adopting fertilizer than female headed households. Conditional on adoption, however, fertilizer use intensity does not significantly differ between the male and female headed households.

Per capita land size negatively and significantly affects both the probability of adopting fertilizer and the intensity of fertilizer use. This could be due to deliberate attempts by households with smaller land sizes to increase their production through more intensive use of fertilizer as opposed to area expansion, an opportunity that households with larger land sizes are able to exploit.

Generally households in the two lowest income quintiles compared to those in the third income quintile have a significantly lower probability of adopting fertilizer and use fertilizer less intensively. Those in the highest income quintile have a significantly higher propensity to adopt fertilizer and use fertilizer more intensively than households in the third quintile. These results indicate that income poorer households are more constrained in fertilizer use compared to their less income poor counterparts.

Membership in groups positively and significantly influences fertilizer adoption but has no significant effects on the intensity of use.

Table 56: Determinants of Decision to Adopt and Extent of Use of Fertilizer

Variable	Decision to adopt	Use intensity
	Coefficient	Coefficient
Gender of household head (1=male)	0.19** (2.51)	34.63 (1.58)
Per capita land size (acres)	-0.05*** (3.46)	-10.37** (2.21)
Membership in farmer group (1=yes)	0.37*** (5.28)	30.97 (1.49)
Ownership of transport equipment (1=yes)	0.06 (0.87)	18.28 (1.23)
Ownership of communication equipment (1=yes)	0.10 (1.09)	-8.05 (0.29)
Distance to tarmac road (km)	-0.03*** (6.06)	11.75*** (7.93)
Distance to fertilizer seller (km)	-0.02*** (2.75)	-5.03* (1.71)
Fertilizer price (Ksh/kg)	-0.04*** (2.82)	3.56 (0.69)
Income quintile1 (quintile1_lag=1)	-0.45*** (4.87)	-82.88*** (2.91)
Income quintile2 (quintile 2_lag=1)	-0.35*** (3.85)	-40.83* (1.72)
Income quintile4 (quintile 4_lag=1)	0.02 (0.24)	15.49 (0.79)
Income quintile5 (quintile 5_lag=1)	0.17* (1.68)	70.59*** (3.55)
Coastal lowlands dummy	-3.12*** (16.56)	-4,464.78*** (3.82)
Eastern lowlands dummy	-1.79*** (13.20)	-1,357.67*** (8.07)
Western lowlands dummy	-2.66*** (17.70)	-823.61*** (5.91)
Western transitional dummy	-0.73*** (4.99)	-211.51*** (6.59)
High potential maize zone dummy	-0.32** (2.28)	-148.16*** (6.30)
Western highlands dummy	-0.24 (1.50)	-281.05*** (7.41)
Marginal rain shadow dummy	-2.22*** (12.52)	-618.68*** (5.32)
Year of survey (1=2004)	0.16** (2.10)	-52.66*** (2.81)
Year of survey (1=2007)	0.55*** (4.42)	-57.79 (1.35)
Observations	3814	2739

Absolute value of z statistics in parentheses
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

The probability of adopting fertilizer declines with increase in the distance to tarmac road. However, the distance to tarmac road unexpectedly has a positive and significant influence on

the intensity of fertilizer use. Distance to the fertilizer seller, on the other hand, negatively and significantly influences fertilizer adoption as well as the use intensity. While fertilizer price negatively impacts on adoption as expected, it has no significant effect on the intensity of use.

In comparison to the Central highlands, households in all the other zones except the Western highlands have a significantly lower propensity to adopt fertilizer. Compared to the other zones, fertilizer use intensity is significantly higher in the Central highlands.

4.2.4 Determinants of Access to Financial Services

Access to Credit

Probit results of credit access are presented in Table 57. There is no significant difference in the probability of getting credit between male and female headed households. Membership in groups significantly increases the probability of accessing credit. This suggests the important role social capital can play in provision of credit services to rural households.

Contrary to expectations, per capita land size negatively and significantly affects the probability of credit access while distance to the tarmac road is positively and significantly associated with credit access.

Households in the fourth and fifth income quintiles have a significantly higher propensity to access credit compared to their counterparts in the third income quintile. It may be that income rich households have the ability to meet credit terms hence greater accessibility or it may be that because they are more likely to acquire credit, they take this opportunity and use the credit in productive activities that increase their income. Regionally, households in the Central highlands in comparison to those in the other zones have a significantly greater likelihood of accessing credit.

Table 57: Determinants of Household Credit Access

Variable	Coefficient
Gender of household head (1=male)	-0.03 (0.45)
Per capita land size (acres)	-0.04** (2.55)
Membership in farmer group (1=yes)	0.56*** (9.61)
Ownership of communication equipment (1=yes)	-0.09 (1.24)
Distance to tarmac road (km)	0.02*** (5.76)
Income quintile1 (quintile1_lag=1)	-0.12 (1.58)
Income quintile2 (quintile 2_lag=1)	-0.06 (0.79)
Income quintile4 (quintile 4_lag=1)	0.15** (2.13)
Income quintile5 (quintile 5_lag=1)	0.32*** (4.41)
Coastal lowlands dummy	-1.00*** (8.49)
Eastern lowlands dummy	-1.12*** (12.86)
Western lowlands dummy	-1.07*** (11.99)
Western transitional dummy	-0.39*** (4.67)
High potential maize zone dummy	-1.12*** (15.42)
Western highlands dummy	-0.43*** (4.92)
Marginal rain shadow dummy	-0.91*** (6.66)
Year of survey (1=2004)	-0.47*** (8.49)
Year of survey (1=2007)	0.11* (1.94)
Observations	3823

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Access to Savings Account

Probit results of probability of owning a savings account are presented in Table 58. Male headed households are more likely to have a savings account than female headed households. The probability of owning a savings account increases with age up to a certain point, then decreases. Compared to household of s whose heads have primary education, households

with more educated heads are more likely to have a savings account. Higher dependency ratio in a household significantly decreases a household's propensity to have a savings account.

Per capita land size, membership in farmer groups and credit access positively and significantly influence the probability of having a savings account. The probability of having a savings account increases with income.

Regionally, households in the Central highlands in comparison to those in the other zones have a significantly greater likelihood of having a savings account.

Table 58: Determinants of Ownership of Savings Account

Variable	Coefficient
Gender of household head (1=male)	0.21** (1.98)
Household head age (years)	0.07*** (3.18)
Household head age squared	-0.00*** (2.89)
Education of household head (1=no education)	0.11 (0.23)
Education of household head (1=secondary education)	0.57*** (4.88)
Education of household head (1=post-secondary education)	1.60*** (5.31)
Dependency ratio	-0.11* (1.69)
Per capita land size (acres)	0.06** (2.39)
Membership in farmer group (1=yes)	0.89*** (8.56)
Credit access (1=yes)	0.43*** (4.69)
Ownership of communication equipment (1=yes)	0.25 (1.48)
Distance to tarmac road (km)	0.01 (1.29)
Distance to extension service (km)	0.01 (0.78)
Income quintile1 (quintile1_lag=1)	-0.38*** (2.70)
Income quintile2 (quintile 2_lag=1)	-0.02 (0.17)
Income quintile4 (quintile 4_lag=1)	0.15 (1.10)
Income quintile5 (quintile 5_lag=1)	0.56*** (3.80)
Coastal lowlands dummy	-2.04*** (8.47)
Eastern lowlands dummy	-1.91*** (9.46)

Variable	Coefficient
Western lowlands dummy	-1.02*** (5.10)
Western transitional dummy	-1.58*** (8.02)
High potential maize zone dummy	-1.40*** (7.66)
Western highlands dummy	-1.53*** (7.73)
Marginal rain shadow dummy	-1.36*** (4.87)
Constant	-2.33*** (3.16)
Observations	1275

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

5. Determinants of Agricultural Commercialization by the Marginalized Group of Households

This section focuses on market participation by the marginalized groups; female headed, income poor and land poor households and households in the low potential agricultural areas. The objective is to get a deeper understanding of specific factors that influence these households' participation in markets, with a view to identifying policy and development interventions that can help them access markets. In order to provide insights into which market related factors can help the poor transition out of poverty, determinants of agricultural commercialization by households that exited poverty are explored.

Following Strasberg (1999) and Govereh et al. (1999) a household's commercialization index was constructed as the ratio of the total value of crop sales to the total value of crop production. The index is, therefore, a value bound between 0 and 1, with 0 indicating that a household did not at all participate in the crops output market and 1 indicating that a household is completely commercialized in crops enterprises. Econometric estimation results of determinants of probability of commercialization and degree of commercialization by the female headed, income poor and land poor households are discussed.

5.1 Female Headed Households

Age of the household head, per capita land size and membership in farmer groups positively influence the likelihood of participating in output markets (Table 59). Households headed by females with post secondary education compared to those with primary education are less likely to participate in output markets. Female headed households in the lowest income quintile compared to those in the third quintile are less likely to participate in output markets. Participation in output markets by female headed households is higher in the Central highlands compared to the other zones.

The degree of commercialization by female headed households is significantly and positively affected by land size, membership in farmer groups and credit access.

Table 59: Determinants of Crops Output Commercialization by Female Headed Households

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
Household head age (years)	0.12*** (2.95)	0.00 (0.04)
Household head age squared	-0.00*** (2.97)	-0.00 (0.18)
Education of household head (1=no education)	-0.30 (1.38)	0.02 (0.59)
Education of household head (1=secondary education)	0.42 (1.09)	0.01 (0.23)
Education of household head (1=post-secondary education)	-1.03** (2.04)	-0.17 (1.64)
Dependency ratio	0.00 (0.02)	-0.03 (1.42)
Number of adults in off farm activity	-0.07 (1.00)	-0.01 (0.64)
Per capita land size (acres)	0.20*** (2.90)	0.03*** (3.51)
Membership in farmer group (1=yes)	0.38** (2.32)	0.07** (2.18)
Credit access (1=yes)	-0.15 (0.88)	0.12*** (4.29)
Ownership of transport equipment (1=yes)	0.14 (0.80)	0.02 (0.82)
Ownership of communication equipment (1=yes)	-0.09 (0.46)	0.05 (1.45)
Distance to tarmac road (km)	-0.02** (2.43)	0.00 (0.08)
Distance to extension service (km)	-0.02 (1.28)	-0.00 (0.44)
Income quintile1 (quintile1_lag=1)	-0.66** (2.47)	-0.13*** (3.26)
Income quintile2 (quintile 2_lag=1)	-0.25 (0.89)	-0.04 (1.13)
Income quintile4 (quintile 4_lag=1)	0.12 (0.32)	0.01 (0.17)
Income quintile5 (quintile 5_lag=1)	0.12 (0.28)	0.07 (1.44)
Coastal lowlands dummy	-6.69*** (5.56)	-0.11 (1.16)
Eastern lowlands dummy	-5.90*** (5.26)	-0.21*** (4.07)
Western lowlands dummy	-6.19*** (5.35)	-0.13** (2.56)
Western transitional dummy	-5.52*** (4.79)	0.08* (1.76)
High potential maize zone dummy	-5.64*** (4.90)	0.03 (0.68)
Western highlands dummy	-4.87***	-0.09*

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient (4.09)	Coefficient (1.86)
Marginal rain shadow dummy	-6.92*** (5.66)	-0.27** (2.20)
Year of survey (1=2004)	0.25 (1.24)	-0.03 (1.02)
Year of survey (1=2007)	0.05 (0.23)	-0.02 (0.67)
Constant	4.10 (.)	0.37 (1.61)
Observations	706	616

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

5.2 Income Poor Households

Among the income poor households, those with female heads are less likely to participate in output markets compared to male headed ones (Table 60). Age of the household head and membership in farmer groups positively and significantly influences the likelihood of participating in output markets. The income poor households in the Central highlands are more likely to participate in output markets compared to their counterparts in the other zones.

The degree of commercialization by the income poor households is significantly and positively influenced by membership in farmer groups, access to credit, ownership of transport equipment and ownership of communication equipment. Number of adults in off-farm activity significantly reduces a household's degree of commercialization. This could be due to more off-farm income available to the household for meeting cash needs or a case of labor tradeoff. Income poor households in the High potential maize zone commercialize more while those in the Eastern lowlands commercialize less compared to their counterparts in the Central Highlands.

Table 60: Determinants of Crops Output Commercialization by Income Poor Households

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
Gender of household head (1=male)	0.40*** (3.78)	-0.02 (0.75)
Household head age (years)	0.04* (1.71)	0.00 (0.17)
Household head age squared	-0.00* (1.78)	-0.00 (0.46)
Education of household head (1=no education)	-0.13 (1.03)	0.00 (0.14)
Education of household head (1=secondary education)	0.15 (0.99)	0.00 (0.14)
Education of household head (1=post-secondary education)	-0.16 (0.45)	0.01 (0.16)
Dependency ratio	-0.00 (0.06)	-0.02 (1.29)
Number of adults in off farm activity	0.01 (0.29)	-0.04*** (3.75)
Per capita land size (acres)	0.00 (0.07)	0.01 (1.50)
Membership in farmer group (1=yes)	0.30*** (3.08)	0.07*** (3.00)
Credit access (1=yes)	-0.06 (0.55)	0.11*** (4.92)
Ownership of transport equipment (1=yes)	0.10 (0.99)	0.07*** (2.77)
Ownership of communication equipment (1=yes)	0.09 (0.82)	0.11*** (3.49)
Distance to tarmac road (km)	-0.00 (0.26)	-0.00 (0.93)
Distance to extension service (km)	-0.01 (0.99)	0.00 (1.18)
Coastal lowlands dummy	-1.04*** (3.07)	-0.04 (0.76)
Eastern lowlands dummy	-0.96*** (2.92)	-0.20*** (3.55)
Western lowlands dummy	-1.35*** (4.30)	-0.08 (1.64)
Western transitional dummy	-0.46 (1.35)	0.06 (1.28)
High potential maize zone dummy	-0.85*** (2.68)	0.10** (2.18)
Western highlands dummy	-0.43 (1.30)	0.02 (0.56)
Marginal rain shadow dummy	-1.88*** (4.91)	0.08 (0.94)
Year of survey (1=2004)	0.12 (1.10)	-0.02 (0.60)
Year of survey (1=2007)	0.18	-0.03

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
	(1.47)	(1.23)
Constant	0.51 (0.73)	0.12 (0.70)
Observations	1540	1354

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Estimation results on determinants of agricultural commercialization by households that exited poverty are presented in Table 61. It is observed that poverty exiting households that are headed by women are less likely to participate in output markets compared to their male headed counterparts, suggesting that even among these households female headed households are more disadvantaged in terms of market participation. Age of the household head negatively and significantly influences the likelihood of participating in output markets, while membership in farmer groups increases the poverty exiting households' chance of participating in output markets. Among these households, those in the Central highlands are more likely to participate in output markets compared to their counterparts in the other zones except Western transitional and Western highlands.

The degree of commercialization by the poverty exiting households is significantly and positively influenced by membership in farmer groups and ownership of communication equipment. Number of adults in off-farm activity significantly reduces these households' degree of commercialization. Also, and contrary to expectations, poverty exiting households farther from a tarmac road commercialize less. The poverty exiting households in the High potential maize zone, Western transitional and Western highlands commercialize more while those in the Eastern lowlands commercialize less compared to their counterparts in the Central Highlands.

These results suggest the important role of collective action in facilitating households' participation in markets.

Table 61: Determinants of Crops Output Commercialization by Poverty Exiting Households

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
Gender of household head (1=male)	0.57*** (2.84)	0.06 (1.22)
Household head age (years)	-0.08* (1.88)	-0.00 (0.50)
Household head age squared	0.00 (1.47)	0.00 (0.37)
Education of household head (1=no education)	0.12 (0.67)	-0.04 (0.91)
Education of household head (1=secondary education)	0.11 (0.43)	-0.03 (0.70)
Education of household head (1=post-secondary education)	-0.46 (1.15)	-0.07 (0.77)
Dependency ratio	-0.04 (0.40)	0.02 (0.97)
Number of adults in off farm activity	0.01 (0.16)	-0.03** (2.17)
Per capita land size (acres)	-0.00 (0.04)	0.01 (1.42)
Membership in farmer group (1=yes)	0.49*** (2.78)	0.09** (2.47)
Credit access (1=yes)	-0.23 (1.35)	0.05 (1.54)
Ownership of transport equipment (1=yes)	-0.18 (1.10)	0.00 (0.10)
Ownership of communication equipment (1=yes)	0.17 (0.82)	0.17*** (3.51)
Distance to tarmac road (km)	0.00 (0.13)	0.00* (1.78)
Distance to extension service (km)	-0.01 (0.62)	-0.00 (0.39)
Coastal lowlands dummy	-1.11** (2.17)	0.05 (0.74)
Eastern lowlands dummy	-0.97** (2.00)	-0.21*** (2.94)
Western lowlands dummy	-1.24*** (2.74)	-0.04 (0.62)
Western transitional dummy	-0.27 (0.51)	0.23*** (3.60)
High potential maize zone dummy	-0.99** (2.18)	0.24*** (4.65)
Western highlands dummy	-0.24 (0.40)	0.12** (2.08)
Marginal rain shadow dummy	-1.83*** (3.64)	0.01 (0.15)
Year of survey (1=2004)	0.52*** (2.79)	0.01 (0.28)
Year of survey (1=2007)	0.72***	0.11***

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
	(3.70)	(3.22)
Constant	3.92*** (2.89)	0.09 (0.37)
Observations	677	608

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

5.3 Land Poor Households

Land poor households with membership in farmer groups are more likely to participate in output markets compared to their counterparts without membership in groups (Table 62). Compared to income quintile three, land poor households in the first income quintile have a significantly less probability of participating in output markets. The land poor households in the Central highlands are more likely to participate in output markets compared to their counterparts in the other zones.

Access to credit positively and significantly influences the amount of crops sold among the land poor households. Contrary to expectations, distance to tarmac road positively and significantly influences the degree of crop commercialization among the land poor households. Just as for the income poor households, number of adults in off-farm activity significantly reduces land poor household's degree of commercialization. Land poor households in the first and second income quintiles sold significantly less crop output than their counterparts in the third quintile. Regionally, land poor households in the Western transitional commercialize more while those in the Eastern and Western lowlands commercialize less compared to their counterparts in the Central Highlands.

Table 62: Determinants of Crops Output Commercialization by Land Poor Households

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
Gender of household head (1=male)	0.22 (1.37)	0.05 (1.57)
Household head age (years)	0.03 (1.00)	0.00 (0.60)
Household head age squared	-0.00 (0.94)	-0.00 (0.81)
Education of household head (1=no education)	0.14 (0.57)	-0.04 (0.83)
Education of household head (1=secondary education)	0.28 (1.23)	0.03 (1.17)
Education of household head (1=post-secondary education)	-0.10 (0.30)	0.05 (0.99)
Dependency ratio	0.10 (1.07)	-0.00 (0.17)
Number of adults in off farm activity	0.12 (1.59)	-0.03** (2.24)
Membership in farmer group (1=yes)	0.32** (2.04)	0.05 (1.60)
Credit access (1=yes)	0.21 (1.20)	0.14*** (5.40)
Ownership of transport equipment (1=yes)	-0.11 (0.71)	-0.01 (0.41)
Ownership of communication equipment (1=yes)	0.07 (0.34)	0.04 (0.87)
Distance to tarmac road (km)	-0.01 (0.78)	0.01*** (4.11)
Distance to extension service (km)	0.00 (0.01)	-0.00 (1.37)
Income quintile1 (quintile1_lag=1)	-0.64*** (2.99)	-0.13*** (3.51)
Income quintile2 (quintile 2_lag=1)	-0.01 (0.05)	-0.07** (2.13)
Income quintile4 (quintile 4_lag=1)	0.14 (0.48)	-0.03 (0.93)
Income quintile5 (quintile 5_lag=1)	-0.13 (0.40)	0.06 (1.49)
Coastal lowlands dummy	-1.66*** (3.88)	-0.08 (1.51)
Eastern lowlands dummy	-1.20*** (2.70)	-0.26*** (4.71)
Western lowlands dummy	-1.40*** (3.41)	-0.14*** (2.69)
Western transitional dummy	-0.53 (1.09)	0.09** (2.03)
High potential maize zone dummy	-0.96** (2.33)	0.05 (1.34)
Western highlands dummy	-0.54 (1.26)	-0.06 (1.64)

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
Marginal rain shadow dummy	-1.73*** (3.28)	-0.15 (1.52)
Year of survey (1=2007)	0.11 (0.71)	0.04* (1.78)
Constant	0.92 (0.88)	0.12 (0.63)
Observations	961	882

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

5.4 Households in Marginal Agricultural Areas

Among the households in the marginal agricultural areas, those headed by males are more likely to participate in crops markets than their female headed counterparts (Table 63). The number of adults in a household engaged in off-farm activity raises the likelihood of a household participating in crops markets. Also, households with larger land sizes are more likely to participate in crops markets compared to those with smaller land sizes. Membership in farmer groups also raises the probability of a household's participation in crops markets. Longer distances to tarmac road and extension services reduce the chance of households in the low potential agricultural areas participating in crops markets. Compared to 2004 and 2007, the probability of participation in crops markets by these households was lower in 2000.

On the degree of commercialization, it is observed that households headed by persons with no formal education are less commercial oriented compared to those headed by persons with primary education. Also, the higher the number of adults in a household engaged in off-farm activities in and the longer the distance to the tarmac road the less the degree of commercialization. Access to credit and land size, on the other hand, positively and significantly influences a household's degree of commercialization in the agriculturally low potential areas. Contrary to expectation, distance to extension service has a positive influence on degree of commercialization.

Table 63: Determinants of Crops Output Commercialization by Households in Agriculturally Low Potential Areas

Variable	Determinants of decision to participate	Determinants of extent of participation
	Coefficient	Coefficient
Gender of household head (1=male)	0.52*** (4.72)	-0.01 (0.14)
Household head age (years)	-0.01 (0.55)	-0.01 (0.84)
Household head age squared	0.00 (0.41)	0.00 (0.79)
Education of household head (1=no education)	-0.13 (1.14)	-0.09* (1.87)
Education of household head (1=secondary education)	-0.08 (0.60)	0.07 (1.61)
Education of household head (1=post-secondary education)	-0.06 (0.26)	0.08 (1.07)
Dependency ratio	-0.00 (0.08)	-0.00 (0.14)
Number of adults in off farm activity	0.08* (1.89)	-0.03* (1.72)
Per capita land size (acres)	0.17*** (3.27)	0.05*** (3.75)
Membership in farmer group (1=yes)	0.35*** (3.47)	0.00 (0.08)
Credit access (1=yes)	0.02 (0.22)	0.08** (2.26)
Ownership of transport equipment (1=yes)	-0.08 (0.80)	-0.00 (0.14)
Ownership of communication equipment (1=yes)	0.07 (0.60)	0.08 (1.55)
Distance to tarmac road (km)	-0.01* (1.66)	-0.01*** (4.34)
Distance to extension service (km)	-0.01* (1.69)	0.01*** (3.13)
Year of survey (1=2004)	0.21* (1.86)	0.00 (0.05)
Year of survey (1=2007)	0.35*** (2.95)	-0.02 (0.42)
Constant	0.57 (0.85)	0.26 (1.03)
Observations	1218	1033

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

6. Summary of Key Findings and Conclusion

It has been argued that market-oriented production can achieve welfare gains through comparative advantage, economies of scale and regular interaction and exchange of ideas. Unfortunately, some groups, who in particular would benefit from this kind of welfare boost, may be constrained by several factors in their quest to participate in the market for their goods and services. This study set out to assess the extent of market participation by the vulnerable and marginalized (i.e. women, the poor and those in marginal agricultural areas) smallholder farmers in Kenya with a view to identifying constraints to market participation among and potential market opportunities for these marginalized group of households.

The results from the study reveal differences in market participation across different and commodity groups the marginalized groups. Compared to their counterparts, female headed, income poor and land poor households and households in the marginal agricultural areas have generally lower market participation for majority of the enterprises. Although commercialization is generally low for all food crops, results of the regression analyses indicate that female headed households have a greater likelihood of participating in markets for maize, beans, other cereals and pulses and milk (controlling for all other factors) than their male headed counterparts. On the other hand, income poor and land poor households have less likelihood of participating in markets for these commodities than their non-poor counterparts. In comparison to the high potential agricultural areas, households in the low agricultural potential zones, mainly the lowlands, generally have a lower propensity to participate in maize and vegetable markets. However, these households have a higher likelihood of selling beans, other cereals and pulses and bananas. The amount of crops sold is generally significantly higher in the high than in the low potential areas, except for beans, bananas, and vegetables where the amount sold is significantly higher in the low potential areas.

Some of the characteristics of the marginalized groups of households that could partly explain this low market participation include the following:

- High levels of illiteracy especially among female headed households; over 40% of female household heads have no formal education at all.

- Female headed and land poor households' income levels are far below the sample average. Further, and in contrast to male headed households, the distribution of female

headed households is skewed towards the lowest income quintiles, with the proportion falling up the income ladder. These results emphasize the need for efforts to expand economic opportunities for the marginalized groups of households.

- The marginalized groups of households, especially female headed and the poor, own smaller land sizes. This makes them disadvantaged in terms of producing surplus for the market.

- The marginalized groups also have lower asset values, an indication that they are not only income and land poorer but also experience asset poverty, which may compromise their agricultural productive capacity, and consequently limit their ability to exploit available market opportunities.

- In terms of technology adoption, the marginalized groups of households compared to their male headed and non-poor counterparts and those in high potential agricultural areas lag behind in adoption of productivity enhancing inputs such as fertilizers and improved seeds. This limits their ability to produce surpluses for the market, as observed in the lower volumes they produce and sell.

In terms of factors that could enhance market participation for female headed, income poor and land poor households, we find that land size and membership in farmer groups not only increase the likelihood of overall participation in the market but also the extent of participation. For the households in the low potential agricultural areas, land size and membership in farmer groups increase the likelihood of participation in the market, while land size also impacts significantly and positively on the extent of participation. Access to credit also positively influences the amount that the marginalized groups are able to sell in the market. These results indicate that innovations that enhance the marginalized groups' access to land and credit can be instrumental in raising their ability to exploit market opportunities.

The results of this study also show that a higher proportion of households with membership in farmer groups received agricultural information than non-group members and that membership in groups significantly increases the probability of accessing credit. Both credit and information are critical in accessing market opportunities. In addition, the proportion of households belonging to groups generally increased with income, implying a positive correlation between income and social capital. The causal relationship between social capital, households' income

and other factors, however, remains a question for further inquiry in this case. Increasing social capital for the marginalized groups can, therefore, be of great value in enhancing the households' agricultural commercialization.

Regarding the enterprises in which opportunities may exist for the marginalized group of households, results show that maize, traditional cash crops (tea coffee and sugarcane), fruits and bananas have the highest contribution in total value of production for the female headed households. Apart from cash crops, market orientation is highest for bananas, fruits and vegetables among these households. For the income poor households, maize, vegetables, beans and bananas contribute the highest in total value of crop production, while market orientation is highest for bananas, vegetables and fruits. In the low potential areas, market orientation is highest for the bananas, fruits and vegetables.These results indicate that cereals such as maize and pulses such as beans are important to the households in meeting their food needs but their market orientation is very low. Vegetables, fruits and bananas have substantial market orientation and would hold promise in integrating women, the poor and households in low potential areas in agricultural markets.

On livestock, small ruminants (goats & sheep) and chicken are gaining increased importance in commercialization among both the female headed households and income poor households. Targeting these livestock could also be important in efforts aimed at increasing market participation among women and the poor.

References

Ahikire. J., (Undated). Gender and Poverty in Uganda Today. Department of Women's Studies Makerere University, Kampala Uganda. Available at http://www.fiuc.org/iaup/sap/

Alene, A.D., Manyong, V.M., Omanya, G., Mignouna, H.D., Bokanga, M., Odhiambo, G., 2008. Smallholder market participation under transaction costs: Maize supply and fertilizer demand in Kenya. *Food Policy* 33: 318-328.

Asfaw, S. 2007. Does EurepGAP standard marginalize poor farmers? – Evidence from Kenya. Agriculture and Rural Development, 2/2007: 45-47.

Ayieko, M. W. and Tschirley, L.T. (2006). Enhancing access and utilization of quality seed for food security in Kenya. Tegemeo Institute Working Paper No. 27/2006. Tegemeo Institute of Agricultural Policy and Development, Nairobi.

Barrett, C.B. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. Food Policy 33: 299-317.

Barrett, C.B., Swallow, B.M., 2006. Fractal poverty traps. World Development 34 (1), 1–15.

Bellemare, M.F. and Barrett, C.B. (2006). An ordered Tobit model of market participation: evidence from Kenya and Ethiopia. American Journal of Agricultural Economics 88(2): 324-337.

Bijman, J. G. Ton, G. Meijerink (2007). Empowering Small holder Farmers in Markets: National and International Policy Initiatives. WUR: Wageningen.

Binswanger H.P. and von Braun J. 1991. Technological change and commercialization in agriculture: The effect on the poor. The World Bank Research Observer 6(1):57–80.

Boughton, D., D. Mather, C. Barrett, R. Benfica, D. Abdula, D. Tschirley, B. Cungura. 2007. Market Participation by Rural Households in a Low-Income country: An Asset-Based Approach Applied to Mozambique. *Faith and Economics*, 50:64-101.

Chamberlin, J. 2007. Defining smallholder agriculture in Ghana: Who are smallholders, what do they do and how are they linked with markets? Prepared as part of the Ghana Strategy Support Program and submitted for consideration as an IFPRI Discussion Paper. Available at http://www.ifpri.org/publication/defining-smallholder-agriculture-ghana

de Janvry A., Fafchamps M. and Sadoulet, E. 1991. Peasant household behaviour with missing markets: Some paradoxes explained. *The Economic Journal* 101(409): 1400–1417.

Deininger, K., Okidi, J. (2001). Rural Households: Incomes, Productivity, and Non-farm Enterprises. In Reinikka, R., Collier, P. (Eds.), Uganda's recovery: the role of farms, firms, and government, Washington, DC: The World Bank.

Dercon S. 1996. Risk, crop choice and savings: Evidence from Tanzania. *Economic Development and Cultural Change* 44(3), 485–513.

Diao, X. and Dorosh, P. (2007). Demand Constraints on Agricultural Growth in East and Southern Africa: A General Equilibrium Analysis. *Development Policy Review*, 25 (3): 275-292.

Diao, X., Dorosh, P., and S. Rahman. 2007. Market Opportunities for African Agriculture A General Equilibrium Examination of Demand-Side Constraints on Agricultural Growth in East and Southern Africa. Research Report 154, International Food Policy Research Institute, Washington DC.

Dyer, G.A., Boucher, S., Taylor, J.E., 2006. Subsistence response to market shocks. American Journal of Agricultural Economics 88 (2), 279–291.

Ehui, S., Benin, S. and Paulos, Z (2009), Policy Options for Improving Market Participation and Sales of Smallholder Livestock Producers: A case study of Ethiopia. *Draft prepared for presentation at the 27th Conference of the International Association of Agricultural Economists (IAAE), 16-22 August 2009, Beijing, China.*

Elepu, G. and Nalukenge, I. 2007. Contract Farming, Smallholders and the Commercialization of Agriculture in Uganda: The Case of Sorghum, Sunflower, Rice, and Poultry Contract Schemes, Uganda Programme for Trade Opportunities and Policy (UPTOP)

Ellis, F. (2005). Rural livelihoods and diversity in developing countries. Oxford University Press, Oxford.

Fafchamps M. 1992. Cash crop production, food price volatility, and rural market integration in the third world. American *Journal of Agricultural Economics* 74(l), 90–99.

Feder, G., Just, R. and Zilberman, D. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change* 33(2):225-298.

Freeman, H. and Omiti, J. 2003. "Fertilizer Use in Semi-Arid areas of Kenya: Analysis of Smallholder Farmers' Adoption Behavior under Liberalized Markets." *Nutrient Cycling in Agroecosystem,* 66: 23-31.

Gabre-Madhin E, Barret C.B. and Dorosh P. 2003. Technological change and price effects in agriculture: Conceptual and comparative perspectives. MTID Discussion Paper No. 62, IFPRI, Washington, DC, USA.

Goletti, Francesco. 2005. *Agricultural Commercialization, Value Chains and Poverty Reduction*. Making Markets World Better for the Poor Discussion Paper No.7. Hanoi: Asian Development Bank.

Govereh J, Jayne T.S and Nyoro J. 1999. Smallholder commercialization, interlinked markets and food crop productivity: Cross-country evidence in eastern and southern Africa. Available at http://www.aec.msu.edu/fs2/ag_transformation/atw_govereh.PDF

Hazell, P. (2005). Is there a future for small farmers? *Agricultural Economics, 32(1s),* 93-101.

Heckman, J. J. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47 (1): 153-161.

Heltberg, R. and Tarp, F. (2001). Agricultural supply response and poverty in Mozambique. UNU-WIDER, Helsinki.

Jaleta, M., Gebremedhin, B. and Hoekstra, D. (2009). Smallholder commercialization: Processes, determinants and impact. ILRI Discussion paper No. 18.

Jayne, T.S, Yamano, T. and Nyoro, J. (2004). Interlinked credit and farm intensification: Evidence from Kenya. *Agricultural Economics* 31:209–218.

Jayne, T.S., D. Mather and E. Mghenyi (2005). Smallholder farming in difficult circumstances: Policy issues for Africa. MSU International Development Working Paper No. 86, 2006. Department of Agricultural Economics and the Department of Economics, Michigan State University, East Lansing, Michigan 48824-1039, U.S.A.

Kelly, V., Diagana, B., Reardon, T., Gaye, M. and Crawford, E. 1996. "Cash Crop and Food Grain Productivity in Senegal: Historical View, New Survey Evidence and Policy Implications." MSU International Development Working Paper Series, No. 20.

Kennedy, E.T. and Cogill, B. (1987). Income and nutritional effects of the commercialization of agriculture in southwestern Kenya. International Food Policy Research Institute, Washington.

Key N, Sadoulet E. and de Janvry A. 2000. Transaction costs and agricultural household supply response. *American Journal of Agricultural Economics* 82(2), 245–259.

Kibaara, B. (2006). Rural Financial Services in Kenya: What is Working and Why? Tegemeo Institute Working Paper No. 025, 2006. Tegemeo Institute of Agricultural Policy and Development, Nairobi.

Makhura, M. N., J. Kirsten, C. Delgado. 2001. Transaction Costs and Smallholder Participation in the Maize Market in the Northern Province of South Africa. *Seventh Eastern and Southern Africa Regional Maize Conference*

March, C., Smyth,I. and Mukhopadhyay,M. (1999). A guide to Gender Analysis Frameworks. Oxford: Oxfam GB.

Mathenge and Tschirley (2008): Off-farm work and Farm Production Decisions: Evidence from Maize-Producing Households in Rural Kenya, 2008, Tegemeo Working Paper series No 33/2008, Tegemeo Institute/Egerton University

Muyanga, M. and Jayne, T.S. (2006). Agricultural Extension in Kenya: Practice and Policy Lessons. Tegemeo Institute Working Paper No. 026, 2006. Tegemeo Institute of Agricultural Policy and Development, Nairobi.

Nepali, R., Thapa, G.B. (2009), "Determinants of Agricultural Commercialization and Mechanization in the Hinterland of a City in Nepal", *Applied Geography,* Vol. 29, pp. 377-389

Nyoro, J., Ayieko, M. And Songa, J. (2006). Program for Africa's Seed Systems Country report: Kenya. Unpublished report.

Nyoro, J., Ayieko, M. and Songa, J. 2009. Program for Africa's Seed Systems, Country report: Kenya. Unpublished report.

Okello, J., Narrod, C., and D. Roy. 2008. Smallholder Compliance with International Food Safety Standards is not a Fantasy: Evidence from African Green Bean Producers. Fresh Perspectives: Agrifood standards and pro-poor growth in Africa. Agrifoodstandards.net.

Omiti, J. M., D. J. Otieno, T. O. Nyanamba, E. Mccullough. 2009. Factors Influencing the Intensity of Market Participation by Smallholder Farmers: A Case Study of Rural and Peri-urban areas of Kenya. *Afjare* 3 (1): 57-82.

Pender J and Alemu D. 2007. Determinants of smallholder commercialization of food crops: Theory and evidence from Ethiopia. Discussion Paper No. 75. IFPRI, Washington, DC, USA.

Pingali LP. & Rosegrant M.W. 1995. Agricultural commercialization and diversification: Process and polices. *Food Policy* 20(3), 171–185.

Pingali P, Khwaja Y and Meijer M. 2005. Commercializing small farmers: Reducing transaction costs. FAO/ESA Working Paper No. 05-08. FAO, Rome, Italy.

Place, F., J. Pender, S. Ehui (2006). Key Issues for the Sustainable Development of Smallholder Agriculture in the East African Highlands, In Pender, J., F. Place, and S. Ehui, eds. *Strategies for land management in the East African highlands*. Washington, D.C.: International Food Policy Research Institute

Poulton, C., J. Kydd, and A. Dorward. 2006. Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. *Development Policy Review* 24 (3): 243–277.

Quisumbing, A.R., Brown, L.R., Haddad, L., and Meizen-Dick, R. (1998). The Importance of Gender Issues for Environmentally and Socially Sustainable Rural Development. In: E. Lutz (Ed.), Agriculture and the Environment: Perspectives on Sustainable Rural Development. Washington, D.C: The World Bank.

Renkow, M., Hallstrom, D.G., Karanja, D.D., 2004. Rural infrastructure, transactions costs and market participation in Kenya. Journal of Development Economics 73 (3), 349–367.

Stephens, E.C. and Barrett, C.B. (2009). Incomplete credit markets and commodity marketing behaviour. Pitzer College and Cornell University.

Strasberg, P.J. et al 1999. Effects of Agricultural Commercialization on Food crop input use and productivity in Kenya. MSU International Development, Working Paper No. 71.

Strasberg, Paul J. 1997. Smallholder Cash Cropping, Food-Cropping and Food Security in Northern Mozambique. Ph.D. dissertation, Michigan State University.

Suri, T., Dave, T., Irungu, C., Gitau, R., and Kariuki, D (2007). Poverty, Inequality and Income Dynamics in Kenya, 1997-2007. Tegemeo Institute of Agricultural Policy and Development, Nairobi.

Tipraqsa, P. and Schreinemachers, P. (2009) Agricultural commercialization of Karen Hill tribes in northern Thailand. *Agricultural Economics* 40 (1): 43-53

von Braun, J. (1995). Agricultural commercialization: impacts on income and nutrition and implications for policy, *Food Policy* (20), 187-202.

Wooldridge, J. 2002. *Econometric Analysis of Cross-Section and Panel Data*. Massachusetts: The MIT Press.

World Bank (2008). "Agriculture for Development". *World Development Report 2008*. Washington: World Bank.

Annexes

Annex 1: Conversion Factors for Computing Adult Equivalents

AGE	MALES	FEMALES
Under 1 year	0.33	0.33
1 - 1.99	0.46	0.46
2 - 2.99	0.54	0.54
3 - 4.99	0.62	0.62
5 - 6.99	0.74	0.70
7 - 9.99	0.84	0.72
10 - 11.99	0.88	0.78
12 - 13.99	0.96	0.84
14 - 15.99	1.06	0.86
16 - 17.99	1.14	0.86
18 - 29.99	1.04	0.80
30 - 59.99	1.00	0.82
60 and Over	0.84	0.74

As per the World Health Organization (Jayne and Argwings-Kodhek 1997)

Annex 2: Mean Value (Ksh) of Production for Various Crops by Gender of Household Head

Year	Crop category	Gender of household head		
		Male	Female	Overall
2000	Maize	23,143	13,811	22,060
	Other cereals and pulses	3,263	5,999	3,618
	Beans	4,264	3,468	4,172
	Bananas	7,282	7,329	7,287
	Roots and tubers	6,995	3,821	6,653
	Vegetables	10,039	12,929	10,351
	Fruits	6,383	5,623	6,297
	Tea, coffee, and sugarcane	58,354	36,392	56,007
	Napier and other feeds	5,239	5,288	5,243
	Other cash crops	39,758	51,538	40,656
2004	Maize	21,626	11,839	19,658
	Other cereals and pulses	4,143	3,235	3,945
	Beans	4,901	3,856	4,698
	Bananas	5,763	9,344	6,435
	Roots and tubers	6,846	3,519	6,199
	Vegetables	11,891	6,542	10,819
	Fruits	6,204	4,271	5,809
	Tea, coffee, and sugarcane	40,013	26,474	37,625
	Napier and other feeds	9,297	3,779	8,421
	Other cash crops	27,069	31,214	27,673
2007	Maize	20,532	13,941	18,979
	Other cereals and pulses	4,887	4,683	4,833
	Beans	5,228	3,931	4,922
	Bananas	7,630	7,290	7,554
	Roots and tubers	5,817	3,090	5,189
	Vegetables	13,161	6,534	11,611
	Fruits	4,132	3,266	3,931
	Tea, coffee, and sugarcane	52,878	39,137	50,037
	Napier and other feeds	8,346	5,565	7,818
	Other cash crops	28,357	13,595	25,706

Annex 3: Mean Value (Ksh) of Production for Various Crops by Income Quintiles

Year	Crop category	Quintiles of income per AE					Overall
		1 (Lowest)	2	3	4	5 (Highest)	
2000	Maize	6,340	12,042	13,966	25,275	52,157	22,060
	Other cereals and pulses	2,530	2,128	3,006	4,527	7,370	3,618
	Beans	2,006	3,455	3,251	4,364	7,390	4,172
	Bananas	3,256	4,611	8,706	5,930	12,716	7,287
	Roots and tubers	2,309	2,721	4,833	6,745	14,643	6,653
	Vegetables	2,130	4,052	8,916	11,588	22,870	10,351
	Fruits	2,582	4,304	4,990	6,906	12,075	6,297
	Tea, coffee, and sugarcane	6,081	15,457	29,034	51,331	129,830	56,007
	Napier and other feeds	1,701	2,924	3,599	5,635	8,420	5,243
	Other cash crops	16,045	20,292	18,142	29,145	101,316	40,656
2004	Maize	7,030	12,798	16,434	22,940	38,965	19,658
	Other cereals and pulses	1,900	3,560	3,830	5,308	5,920	3,945
	Beans	1,757	3,166	4,941	5,605	7,578	4,698
	Bananas	2,306	4,245	4,440	5,115	14,790	6,435
	Roots and tubers	1,914	2,804	4,973	6,294	14,184	6,199
	Vegetables	3,461	5,942	8,379	13,873	21,964	10,819
	Fruits	1,994	3,573	5,156	5,630	12,361	5,809
	Tea, coffee, and sugarcane	5,076	16,721	33,502	38,016	75,877	37,625
	Napier and other feeds	2,140	2,981	4,467	8,100	18,107	8,421
	Other cash crops	6,068	13,980	19,157	25,288	66,159	27,673
2007	Maize	10,089	12,748	16,857	23,009	32,261	18,979
	Other cereals and pulses	3,616	4,747	4,487	6,706	5,204	4,833
	Beans	2,512	3,749	4,639	5,757	7,905	4,922
	Bananas	3,069	6,850	7,010	9,017	10,965	7,554
	Roots and tubers	1,958	2,653	4,376	6,831	9,270	5,189
	Vegetables	4,997	6,091	11,008	14,680	21,279	11,611
	Fruits	2,405	3,059	3,981	5,542	4,633	3,931
	Tea, coffee, and sugarcane	6,377	16,574	39,642	53,327	99,580	50,037
	Napier and other feeds	3,098	3,955	5,501	8,121	13,904	7,818
	Other cash crops	10,478	12,196	19,305	33,736	45,402	25,706

Annex 4: Mean Value (Ksh) of Production for Various Crops by Quintiles of Land Size

Year	Crop category	Quintiles of land size					Overall
		1 (Lowest)	2	3	4	5 (Highest)	
2004	Maize	6,802	9,077	13,941	18,731	48,577	19,658
	Other cereals and pulses	1,672	2,592	3,824	3,988	6,927	3,945
	Beans	2,144	3,073	4,439	5,356	8,366	4,698
	Bananas	3,552	4,685	6,188	8,716	10,422	6,435
	Roots and tubers	4,412	5,384	5,932	6,535	8,703	6,199
	Vegetables	4,563	9,337	13,069	13,221	13,722	10,819
	Fruits	2,959	3,851	6,333	6,502	10,180	5,809
	Tea, coffee, and sugarcane	12,900	21,783	35,409	65,446	88,333	37,625
	Napier and other feeds	3,554	4,726	8,153	10,363	19,269	8,421
	Other cash crops	2,532	5,882	7,626	27,936	57,265	27,673
2007	Maize	7,305	10,663	13,102	21,039	44,118	18,979
	Other cereals and pulses	2,799	3,644	5,088	5,211	7,514	4,833
	Beans	2,690	3,767	4,680	5,595	8,284	4,922
	Bananas	5,142	6,995	7,529	7,453	12,060	7,554
	Roots and tubers	5,163	5,553	5,040	5,238	4,923	5,189
	Vegetables	7,328	8,862	12,621	13,748	15,843	11,611
	Fruits	2,261	3,332	4,068	4,936	5,711	3,931
	Tea, coffee, and sugarcane	15,623	32,603	49,593	85,301	107,184	50,037
	Napier and other feeds	3,468	6,310	6,303	9,278	15,816	7,818
	Other cash crops	4,471	7,558	13,300	18,291	56,234	25,706

Annex 5: Econometric Estimation Results of Market Participation

Maize

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	-0.17***	-0.02	0.01
	(2.71)	(1.07)	(0.55)
household head age (years)	-0.02*	-0.01**	-0.00
	(1.76)	(2.11)	(0.75)
household head age squared	0.00	0.00*	0.00
	(1.36)	(1.93)	(0.77)
education of household head (1=no education)	-0.08	-0.02	-0.01
	(1.10)	(1.10)	(0.41)
education of household head (1=secondary education)	0.07	0.01	-0.00
	(1.22)	(0.53)	(0.14)
education of household head (1=post-secondary education)	0.05	0.09***	0.07***
	(0.51)	(3.75)	(3.10)
dependency ratio	-0.05	-0.01	0.00
	(1.47)	(0.59)	(0.21)
per capita land size (acres)	0.10***	0.02***	0.01**
	(6.09)	(6.59)	(2.07)
membership in farmer group (1=yes)	0.15***	-0.02	-0.03*
	(2.65)	(0.98)	(1.75)
ownership of transport equipment (1=yes)	0.08*	0.02*	0.01
	(1.67)	(1.73)	(0.70)
ownership of communication equipment (1=yes)	0.18**	0.05**	
	(2.37)	(1.99)	
distance to tarmac road (km)	0.01***	-0.00***	-0.00***
	(2.88)	(3.26)	(3.46)
distance to extension service (km)	0.00	0.00	0.00
	(0.40)	(0.73)	(0.23)
crop price (ksh/kg)	-0.06***	0.00	0.01
	(3.57)	(0.60)	(1.64)
income quintile1 (quintile1_lag=1)	-0.21***	-0.07***	-0.02
	(2.79)	(3.09)	(0.85)
income quintile2 (quintile 2_lag=1)	-0.04	-0.04*	-0.02
	(0.54)	(1.78)	(1.25)
income quintile4 (quintile 4_lag=1)	0.05	0.02	0.01
	(0.75)	(1.17)	(0.65)
income quintile5 (quintile 5_lag=1)	0.23***	0.05***	0.02
	(3.23)	(2.80)	(0.76)
coastal lowlands dummy	-0.54***	-0.12**	-0.00
	(4.00)	(2.06)	(0.02)
eastern lowlands dummy	-0.11	-0.11***	-0.07***
	(1.34)	(3.57)	(2.67)
western lowlands dummy	-0.21**	-0.11***	-0.04
	(2.21)	(2.99)	(1.12)
western transitional dummy	0.35***	-0.02	-0.07*
	(4.05)	(0.72)	(1.95)
high potential maize zone dummy	0.83***	0.14***	0.02
	(11.31)	(6.72)	(0.27)
western highlands dummy	0.40***	-0.13***	-0.14***
	(4.63)	(4.61)	(3.91)
marginal rain shadow dummy	-0.19	-0.06	-0.02
	(1.24)	(1.06)	(0.43)
year of survey (1=2004)	0.11**	0.01	-0.01
	(2.00)	(0.38)	(0.57)
year of survey (1=2007)	0.06	-0.01	-0.02
	(0.89)	(0.67)	(0.97)
Constant	0.52	0.50***	0.60***
	(1.28)	(4.29)	(5.34)
Observations	3724	1659	3724

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Beans

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	-0.16**	0.01	0.01
	(2.34)	(0.29)	(0.23)
household head age (years)	-0.03***	-0.01***	-0.01
	(2.73)	(2.66)	(1.20)
household head age squared	0.00**	0.00**	0.00
	(2.35)	(2.49)	(1.27)
education of household head (1=no education)	-0.13	-0.05*	-0.04
	(1.54)	(1.74)	(1.29)
education of household head (1=secondary education)	0.11*	-0.01	-0.00
	(1.77)	(0.41)	(0.17)
education of household head (1=post-secondary education)	0.05	0.04	0.04
	(0.52)	(1.41)	(1.41)
dependency ratio	-0.04	-0.01	-0.01
	(1.28)	(0.59)	(0.48)
per capita land size (acres)	0.05***	0.01***	0.01
	(3.24)	(3.00)	(1.18)
membership in farmer group (1=yes)	0.22***	-0.01	-0.01
	(3.61)	(0.67)	(0.16)
ownership of transport equipment (1=yes)	0.08	0.02	0.02
	(1.56)	(1.09)	(0.88)
ownership of communication equipment (1=yes)	-0.02	0.05	
	(0.22)	(1.62)	
distance to tarmac road (km)	0.01**	0.00	0.00
	(2.02)	(1.05)	(0.53)
distance to extension service (km)	0.00	0.00	0.00
	(0.22)	(1.18)	(1.15)
crop price (ksh/kg)	-0.05***	-0.01***	-0.01
	(7.14)	(2.91)	(0.61)
income quintile1 (quintile1_lag=1)	-0.27***	-0.04	-0.04
	(3.29)	(1.54)	(0.69)
income quintile2 (quintile 2_lag=1)	-0.13*	-0.04*	-0.04
	(1.75)	(1.86)	(1.20)
income quintile4 (quintile 4_lag=1)	-0.07	0.02	0.01
	(0.90)	(0.69)	(0.58)
income quintile5 (quintile 5_lag=1)	0.09	0.04*	0.04
	(1.21)	(1.84)	(1.35)
coastal lowlands dummy	-0.09	-0.10	-0.08
	(0.47)	(1.06)	(1.04)
eastern lowlands dummy	0.48***	-0.07*	-0.06
	(4.99)	(1.88)	(0.47)
western lowlands dummy	0.78***	0.11**	0.09
	(7.02)	(2.42)	(0.51)
western transitional dummy	0.68***	0.02	0.02
	(6.85)	(0.65)	(0.14)
high potential maize zone dummy	1.08***	0.11***	0.11
	(12.74)	(3.53)	(0.45)
western highlands dummy	1.12***	0.07**	0.07
	(11.41)	(1.97)	(0.29)
marginal rain shadow dummy	0.73***	-0.11**	-0.08
	(4.79)	(1.97)	(0.43)
year of survey (1=2004)	0.31***	0.04**	0.04
	(5.15)	(2.03)	(0.59)
year of survey (1=2007)	0.48***	0.06**	0.06
	(5.92)	(2.27)	(0.58)
Constant	0.79*	0.74***	0.74***
	(1.93)	(5.66)	(5.03)
Observations	3404	1116	3404

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Other cereals and pulses

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	-0.13*	-0.02	-0.06
	(1.65)	(0.46)	(0.87)
household head age (years)	-0.01	-0.01**	-0.01
	(0.33)	(1.97)	(1.07)
household head age squared	-0.00	0.00*	0.00
	(0.14)	(1.82)	(0.70)
education of household head (1=no education)	-0.15	0.03	-0.05
	(1.63)	(0.62)	(0.66)
education of household head (1=secondary education)	-0.01	-0.00	-0.01
	(0.06)	(0.13)	(0.13)
education of household head (1=post-secondary education)	0.03	0.07	0.06
	(0.23)	(1.31)	(0.73)
dependency ratio	-0.05	-0.04**	-0.05
	(1.19)	(2.08)	(1.49)
per capita land size (acres)	0.10***	0.01*	0.05
	(4.81)	(1.76)	(1.35)
membership in farmer group (1=yes)	0.07	-0.01	0.02
	(0.91)	(0.36)	(0.43)
ownership of transport equipment (1=yes)	0.06	0.01	0.03
	(0.87)	(0.24)	(0.67)
ownership of communication equipment (1=yes)	-0.13	0.12***	
	(1.41)	(2.62)	
distance to tarmac road (km)	0.01***	0.00*	0.01
	(3.92)	(1.89)	(1.42)
distance to extension service (km)	-0.01	-0.00	-0.00
	(0.98)	(0.19)	(0.60)
crop price (ksh/kg)	0.01**	-0.00	0.00
	(2.51)	(0.10)	(0.95)
income quintile1 (quintile1_lag=1)	-0.08	-0.09**	-0.09
	(0.87)	(2.00)	(1.45)
income quintile2 (quintile 2_lag=1)	0.02	-0.06	-0.03
	(0.21)	(1.48)	(0.59)
income quintile4 (quintile 4_lag=1)	0.05	-0.01	0.01
	(0.47)	(0.21)	(0.21)
income quintile5 (quintile 5_lag=1)	0.06	-0.06	-0.01
	(0.62)	(1.43)	(0.21)
coastal lowlands dummy	-0.18	-0.13	-0.20
	(0.84)	(1.13)	(1.21)
eastern lowlands dummy	0.34*	-0.34***	-0.09
	(1.79)	(3.60)	(0.44)
western lowlands dummy	0.71***	-0.46***	0.03
	(3.82)	(4.83)	(0.09)
western transitional dummy	0.85***	-0.18*	0.23
	(4.41)	(1.92)	(0.66)
high potential maize zone dummy	0.29	-0.16*	0.01
	(1.62)	(1.80)	(0.07)
western highlands dummy	0.94***	-0.15*	0.30
	(5.15)	(1.74)	(0.78)
marginal rain shadow dummy	0.07	-0.13	-0.07
	(0.27)	(0.99)	(0.39)
year of survey (1=2004)	0.24***	0.03	0.12
	(3.33)	(0.99)	(1.31)
year of survey (1=2007)	0.00	0.03	0.02
	(0.03)	(0.63)	(0.33)
Constant	-0.90*	0.89***	-0.12
	(1.80)	(3.98)	(0.14)
Observations	2161	751	2161

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Bananas

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	-0.05	-0.04**	-0.05*
	(0.66)	(2.01)	(1.70)
household head age (years)	-0.01	-0.01**	-0.01**
	(0.91)	(2.30)	(1.97)
household head age squared	0.00	0.00**	0.00**
	(1.05)	(2.47)	(2.06)
education of household head (1=no education)	-0.23***	-0.02	-0.07
	(2.62)	(0.62)	(1.10)
education of household head (1=secondary education)	0.08	0.01	0.03
	(1.14)	(0.63)	(0.98)
education of household head (1=post-secondary education)	-0.04	0.01	-0.00
	(0.37)	(0.25)	(0.05)
dependency ratio	0.07**	-0.01	0.01
	(2.01)	(0.62)	(0.49)
per capita land size (acres)	0.01	0.01	0.01
	(0.63)	(1.59)	(1.54)
membership in farmer group (1=yes)	-0.02	-0.00	-0.00
	(0.26)	(0.00)	(0.17)
ownership of transport equipment (1=yes)	0.09	0.01	0.03
	(1.50)	(0.65)	(1.07)
ownership of communication equipment (1=yes)	-0.08	0.02	
	(0.95)	(0.86)	
distance to tarmac road (km)	-0.00	0.00	0.00
	(0.90)	(1.22)	(0.30)
distance to extension service (km)	0.01**	0.00***	0.01*
	(2.17)	(2.62)	(1.90)
crop price (ksh/kg)	-0.03	-0.02***	-0.03***
	(1.55)	(4.21)	(2.79)
income quintile1 (quintile1_lag=1)	-0.13	-0.02	-0.05
	(1.52)	(1.04)	(1.28)
income quintile2 (quintile 2_lag=1)	-0.06	0.00	-0.01
	(0.78)	(0.01)	(0.46)
income quintile4 (quintile 4_lag=1)	-0.03	-0.00	-0.01
	(0.37)	(0.05)	(0.28)
income quintile5 (quintile 5_lag=1)	0.04	0.06***	0.06**
	(0.44)	(2.58)	(2.13)
coastal lowlands dummy	-0.32**	0.06	-0.03
	(2.27)	(1.17)	(0.29)
eastern lowlands dummy	0.48***	0.15***	0.25**
	(5.11)	(5.95)	(2.10)
western lowlands dummy	0.06	0.06*	0.07
	(0.50)	(1.82)	(1.59)
western transitional dummy	0.60***	0.06**	0.19
	(5.79)	(2.14)	(1.29)
high potential maize zone dummy	0.02	0.07***	0.07**
	(0.17)	(2.60)	(2.14)
western highlands dummy	0.88***	0.11***	0.29
	(9.45)	(4.73)	(1.48)
marginal rain shadow dummy	-1.24***	0.22	-0.15
	(3.56)	(1.30)	(0.38)
year of survey (1=2004)	0.07	0.05***	0.06**
	(1.11)	(2.96)	(2.42)
year of survey (1=2007)	0.28***	0.17***	0.21***
	(3.30)	(7.10)	(3.15)
Constant	0.11	0.71***	0.44
	(0.25)	(6.05)	(1.36)
Observations	2627	1259	2627

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Vegetables

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.14**	0.03	0.00
	(2.22)	(1.63)	(0.06)
household head age (years)	-0.02**	-0.01**	-0.00
	(2.01)	(2.18)	(0.73)
household head age squared	0.00	0.00	0.00
	(1.35)	(1.48)	(0.62)
education of household head (1=no education)	-0.11	-0.04	-0.01
	(1.46)	(1.63)	(0.37)
education of household head (1=secondary education)	-0.02	-0.03*	-0.02
	(0.36)	(1.72)	(1.12)
education of household head (1=post-secondary education)	-0.06	-0.00	0.01
	(0.65)	(0.21)	(0.26)
dependency ratio	-0.04	-0.00	0.00
	(1.22)	(0.13)	(0.47)
per capita land size (acres)	0.00	0.01*	0.01
	(0.25)	(1.94)	(1.47)
membership in farmer group (1=yes)	0.23***	0.02	-0.02
	(4.05)	(0.96)	(0.82)
ownership of transport equipment (1=yes)	0.05	0.01	0.01
	(0.95)	(1.07)	(0.34)
ownership of communication equipment (1=yes)	0.10	0.01	
	(1.26)	(0.57)	
distance to tarmac road (km)	-0.01*	0.00	0.00
	(1.68)	(0.29)	(1.03)
distance to extension service (km)	0.00	0.00	0.00
	(0.62)	(1.23)	(0.63)
crop price (ksh/kg)	0.03***	-0.00	-0.01*
	(6.05)	(1.03)	(1.74)
income quintile1 (quintile1_lag=1)	-0.41***	-0.07***	0.01
	(5.40)	(3.13)	(0.23)
income quintile2 (quintile 2_lag=1)	-0.15**	-0.06***	-0.02
	(2.09)	(2.91)	(0.99)
income quintile4 (quintile 4_lag=1)	-0.03	-0.01	0.00
	(0.44)	(0.29)	(0.03)
income quintile5 (quintile 5_lag=1)	0.09	0.05***	0.03
	(1.22)	(2.89)	(1.61)
coastal lowlands dummy	-0.58***	-0.14***	-0.01
	(4.99)	(3.48)	(0.10)
eastern lowlands dummy	-0.23***	-0.06***	-0.02
	(2.65)	(2.69)	(0.54)
western lowlands dummy	0.14	-0.04	-0.06*
	(1.44)	(1.60)	(1.94)
western transitional dummy	0.44***	-0.05**	-0.11**
	(4.81)	(2.09)	(2.22)
high potential maize zone dummy	0.12	-0.07***	-0.08***
	(1.63)	(3.81)	(3.53)
western highlands dummy	0.46***	-0.04	-0.10**
	(5.01)	(1.56)	(1.98)
marginal rain shadow dummy	-0.12	0.09**	0.10**
	(0.81)	(2.18)	(2.22)
year of survey (1=2004)	0.20***	-0.06***	-0.08***
	(3.61)	(3.83)	(3.10)
year of survey (1=2007)	0.04	0.01	-0.00
	(0.62)	(0.37)	(0.05)
Constant	0.64*	0.78***	0.91***
	(1.73)	(7.91)	(6.91)
Observations	3535	2290	3535

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Fruits

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.02	-0.02	-0.03
	(0.39)	(1.34)	(0.84)
household head age (years)	-0.02	-0.00	0.00
	(1.20)	(1.18)	(0.18)
household head age squared	0.00	0.00	-0.00
	(1.47)	(1.24)	(0.28)
education of household head (1=no education)	-0.09	-0.03	0.00
	(1.13)	(1.43)	(0.05)
education of household head (1=secondary education)	0.03	0.01	-0.00
	(0.39)	(0.47)	(0.01)
education of household head (1=post-secondary education)	-0.07	0.02	0.04
	(0.69)	(0.58)	(0.69)
dependency ratio	-0.00	-0.00	-0.00
	(0.06)	(0.48)	(0.19)
per capita land size (acres)	0.00	0.01**	0.01
	(0.12)	(2.55)	(1.19)
membership in farmer group (1=yes)	0.15**	0.01	-0.05
	(2.48)	(0.36)	(0.82)
ownership of transport equipment (1=yes)	-0.09*	-0.00	0.03
	(1.71)	(0.03)	(0.85)
ownership of communication equipment (1=yes)	0.12	0.06**	
	(1.56)	(2.55)	
distance to tarmac road (km)	-0.01***	-0.00*	0.00
	(2.62)	(1.80)	(0.40)
distance to extension service (km)	0.00	0.01***	0.00*
	(0.32)	(3.97)	(1.74)
crop price (ksh/kg)	-0.01	-0.01**	-0.00
	(0.68)	(2.14)	(0.61)
income quintile1 (quintile1_lag=1)	-0.05	-0.01	0.01
	(0.70)	(0.29)	(0.28)
income quintile2 (quintile 2_lag=1)	-0.07	-0.01	0.01
	(0.99)	(0.57)	(0.32)
income quintile4 (quintile 4_lag=1)	0.03	-0.03	-0.03
	(0.34)	(1.26)	(0.81)
income quintile5 (quintile 5_lag=1)	0.17**	0.05**	-0.01
	(2.21)	(2.39)	(0.16)
coastal lowlands dummy	-0.07	-0.09**	-0.04
	(0.64)	(2.37)	(0.63)
eastern lowlands dummy	0.44***	-0.00	-0.14
	(5.15)	(0.01)	(1.07)
western lowlands dummy	0.11	0.00	-0.03
	(1.16)	(0.11)	(0.60)
western transitional dummy	0.07	-0.04	-0.06
	(0.81)	(1.64)	(1.21)
high potential maize zone dummy	0.01	0.02	0.02
	(0.11)	(0.96)	(0.44)
western highlands dummy	0.26***	-0.01	-0.09
	(2.95)	(0.24)	(1.01)
marginal rain shadow dummy	-0.32*	0.01	0.13
	(1.79)	(0.24)	(0.92)
year of survey (1=2004)	0.12**	-0.01	-0.05
	(2.11)	(0.46)	(0.98)
year of survey (1=2007)	0.12**	0.07***	0.02
	(2.03)	(4.05)	(0.41)
Constant	0.17	0.54***	0.95**
	(0.43)	(5.13)	(2.56)
Observations	3076	1718	3076

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Roots and tubers

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.04	0.06***	0.06**
	(0.64)	(2.58)	(2.40)
household head age (years)	-0.04***	-0.01*	-0.01
	(3.46)	(1.72)	(1.18)
household head age squared	0.00***	0.00	0.00
	(2.95)	(1.36)	(1.12)
education of household head (1=no education)	-0.15*	-0.07***	-0.08*
	(1.85)	(2.60)	(1.87)
education of household head (1=secondary education)	0.02	-0.03*	-0.03
	(0.37)	(1.73)	(1.24)
education of household head (1=post-secondary education)	-0.06	-0.05*	-0.05
	(0.56)	(1.66)	(1.55)
dependency ratio	-0.02	-0.01	-0.01
	(0.70)	(0.51)	(0.72)
per capita land size (acres)	0.04**	0.02***	0.02**
	(2.49)	(3.96)	(2.16)
membership in farmer group (1=yes)	0.07	-0.00	0.01
	(1.10)	(0.19)	(0.31)
ownership of transport equipment (1=yes)	0.17***	0.01	0.03
	(3.06)	(0.40)	(0.78)
ownership of communication equipment (1=yes)	-0.03	0.01	
	(0.33)	(0.30)	
distance to tarmac road (km)	-0.00	0.00***	0.00*
	(0.91)	(2.83)	(1.72)
distance to extension service (km)	0.00	0.00	0.00
	(0.02)	(0.90)	(0.83)
crop price (ksh/kg)	0.01	-0.02***	-0.02**
	(0.60)	(3.40)	(2.42)
income quintile1 (quintile1_lag=1)	-0.29***	-0.04	-0.08
	(3.46)	(1.48)	(1.09)
income quintile2 (quintile 2_lag=1)	-0.07	-0.00	-0.01
	(0.93)	(0.04)	(0.43)
income quintile4 (quintile 4_lag=1)	0.09	-0.01	0.00
	(1.23)	(0.67)	(0.03)
income quintile5 (quintile 5_lag=1)	0.23***	0.05**	0.08
	(2.91)	(2.17)	(1.38)
coastal lowlands dummy	-0.20	-0.02	-0.05
	(1.61)	(0.49)	(0.79)
eastern lowlands dummy	-0.36***	-0.05	-0.10
	(3.72)	(1.59)	(1.11)
western lowlands dummy	-0.11	-0.07*	-0.07*
	(0.98)	(1.71)	(1.65)
western transitional dummy	0.46***	0.01	0.08
	(4.24)	(0.44)	(0.77)
high potential maize zone dummy	-0.30***	-0.03	-0.07
	(3.22)	(0.96)	(0.93)
western highlands dummy	-0.53***	-0.08*	-0.16
	(4.53)	(1.89)	(1.13)
marginal rain shadow dummy	-0.58***	-0.23***	-0.28*
	(3.71)	(3.71)	(1.83)
year of survey (1=2004)	0.10*	0.02	0.03
	(1.69)	(1.12)	(1.13)
year of survey (1=2007)	0.16**	0.09***	0.11***
	(2.47)	(4.87)	(2.62)
Constant	1.03**	0.71***	0.65***
	(2.44)	(5.50)	(4.64)
Observations	2920	1193	2920

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Tea, coffee and sugarcane

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.03	0.00	-0.00
	(0.25)	(0.11)	(0.18)
household head age (years)	-0.02	0.00	0.00
	(0.82)	(0.85)	(1.11)
household head age squared	0.00	-0.00	-0.00
	(0.64)	(1.15)	(1.30)
education of household head (1=no education)	0.05	-0.00	-0.00
	(0.35)	(0.05)	(0.01)
education of household head (1=secondary education)	-0.14	0.01	0.01
	(1.16)	(0.53)	(0.99)
education of household head (1=post-secondary education)	-0.40**	0.02	0.04*
	(2.31)	(1.16)	(1.96)
dependency ratio	0.06	0.00	-0.00
	(0.89)	(0.32)	(0.24)
per capita land size (acres)	0.05	0.00	0.00
	(1.03)	(0.40)	(0.02)
membership in farmer group (1=yes)	0.43***	0.01	-0.02
	(3.52)	(0.58)	(1.27)
ownership of transport equipment (1=yes)	-0.05	0.00	0.01
	(0.47)	(0.32)	(0.55)
ownership of communication equipment (1=yes)	-0.07	-0.02	
	(0.44)	(1.50)	
distance to tarmac road (km)	-0.00	0.00**	0.00*
	(0.54)	(2.18)	(1.73)
distance to extension service (km)	-0.03***	-0.00	-0.00
	(2.62)	(1.26)	(0.02)
crop price (ksh/kg)	0.09***	0.00***	0.00*
	(10.90)	(5.91)	(1.71)
income quintile1 (quintile1_lag=1)	-0.31**	-0.01	0.00
	(2.22)	(1.01)	(0.16)
income quintile2 (quintile 2_lag=1)	0.08	0.01	0.00
	(0.56)	(0.50)	(0.19)
income quintile4 (quintile 4_lag=1)	0.12	0.00	-0.01
	(0.90)	(0.14)	(0.57)
income quintile5 (quintile 5_lag=1)	0.23*	0.00	-0.01
	(1.65)	(0.33)	(0.76)
coastal lowlands dummy	-1.14***	-0.43***	-0.23***
	(3.71)	(5.93)	(3.38)
eastern lowlands dummy	-0.21	-0.22***	-0.16***
	(1.39)	(12.75)	(7.54)
western lowlands dummy	1.05***	0.05**	0.04
	(4.50)	(2.33)	(1.44)
western transitional dummy	1.93***	0.11***	0.06***
	(8.98)	(6.50)	(2.60)
high potential maize zone dummy	-0.12	-0.02	0.00
	(0.79)	(1.45)	(0.19)
western highlands dummy	0.80***	0.02*	-0.00
	(5.20)	(1.70)	(0.20)
marginal rain shadow dummy	-0.31	-0.38***	-0.29***
	(0.97)	(7.03)	(5.39)
year of survey (1=2004)	0.17	0.02*	0.02*
	(1.54)	(1.91)	(1.94)
year of survey (1=2007)	-0.21*	0.04***	0.05***
	(1.81)	(4.29)	(4.27)
Constant	0.18	0.83***	0.87***
	(0.25)	(11.50)	(11.03)
Observations	1783	1505	1783

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Napier and other feeds

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.27**	0.07	0.23
	(2.15)	(0.75)	(0.72)
household head age (years)	-0.03	-0.02	-0.03
	(1.43)	(1.16)	(0.86)
household head age squared	0.00	0.00	0.00
	(1.40)	(0.80)	(0.76)
education of household head (1=no education)	-0.02	0.16	0.12
	(0.10)	(1.35)	(0.75)
education of household head (1=secondary education)	0.16	0.16**	0.24
	(1.55)	(2.27)	(1.15)
education of household head (1=post-secondary education)	-0.06	-0.12	-0.13
	(0.34)	(0.88)	(0.72)
dependency ratio	-0.08	0.00	-0.06
	(1.35)	(0.05)	(0.49)
per capita land size (acres)	0.03	-0.00	0.02
	(1.00)	(0.11)	(0.34)
membership in farmer group (1=yes)	0.02	-0.03	-0.01
	(0.18)	(0.34)	(0.07)
ownership of transport equipment (1=yes)	-0.24**	-0.10	-0.24
	(2.46)	(1.36)	(0.81)
ownership of communication equipment (1=yes)	-0.11	0.07	
	(0.74)	(0.73)	
distance to tarmac road (km)	-0.01	0.01	-0.00
	(1.31)	(1.27)	(0.06)
distance to extension service (km)	0.01	-0.00	0.00
	(0.62)	(0.56)	(0.06)
crop price (ksh/kg)	-0.01	-0.09	-0.08
	(0.10)	(1.17)	(0.89)
income quintile1 (quintile1_lag=1)	-0.01	0.05	0.03
	(0.07)	(0.59)	(0.28)
income quintile2 (quintile 2_lag=1)	0.14	0.05	0.13
	(1.16)	(0.64)	(0.66)
income quintile4 (quintile 4_lag=1)	-0.15	0.00	-0.09
	(1.21)	(0.03)	(0.45)
income quintile5 (quintile 5_lag=1)	-0.34**	-0.04	-0.25
	(2.54)	(0.37)	(0.60)
eastern lowlands dummy	0.03	-0.13	-0.08
	(0.24)	(1.21)	(0.53)
western lowlands dummy	0.70**	0.38*	0.77
	(2.18)	(1.96)	(0.93)
western transitional dummy	-0.07	0.24*	0.16
	(0.37)	(1.80)	(0.78)
high potential maize zone dummy	-0.36**	0.08	-0.18
	(2.26)	(0.61)	(0.38)
western highlands dummy	0.38***	-0.03	0.22
	(3.11)	(0.33)	(0.50)
marginal rain shadow dummy	-0.02	0.04	0.03
	(0.06)	(0.19)	(0.13)
year of survey (1=2004)	0.16	0.04	0.14
	(1.47)	(0.58)	(0.68)
year of survey (1=2007)	0.16	0.20**	0.26
	(1.33)	(2.04)	(1.31)
coastal lowlands dummy	-4.91		
	(.)		
Constant	-0.45	1.01**	0.11
	(0.70)	(2.34)	(0.07)
Observations	1727	214	1727

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Other cash crops

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.24	0.01	0.01
	(1.32)	(0.47)	(0.55)
household head age (years)	-0.07**	0.00	0.00
	(2.12)	(0.71)	(0.64)
household head age squared	0.00**	-0.00	-0.00
	(2.13)	(0.84)	(0.77)
education of household head (1=no education)	0.08	-0.02	-0.02
	(0.41)	(0.69)	(0.84)
education of household head (1=secondary education)	0.50***	0.01	0.01
	(2.62)	(0.62)	(0.53)
education of household head (1=post-secondary education)	0.01	-0.03	-0.03
	(0.04)	(0.83)	(0.84)
dependency ratio	-0.16	0.02*	0.02
	(1.64)	(1.77)	(1.59)
per capita land size (acres)	-0.02	0.00	0.00
	(0.66)	(0.11)	(0.07)
membership in farmer group (1=yes)	0.03	0.02	0.02
	(0.17)	(1.12)	(1.18)
ownership of transport equipment (1=yes)	0.13	-0.01	-0.00
	(0.97)	(0.36)	(0.20)
ownership of communication equipment (1=yes)	-0.19	0.03	
	(0.94)	(1.16)	
distance to tarmac road (km)	-0.03**	0.00	0.00
	(2.53)	(1.47)	(1.13)
distance to extension service (km)	-0.01	0.00	0.00
	(0.60)	(1.29)	(1.31)
crop price (ksh/kg)	-0.00***	-0.00	-0.00
	(2.90)	(0.07)	(0.07)
income quintile1 (quintile1_lag=1)	-0.20	0.04	0.04
	(0.93)	(1.59)	(1.43)
income quintile2 (quintile 2_lag=1)	-0.18	0.04	0.03
	(0.89)	(1.54)	(1.34)
income quintile4 (quintile 4_lag=1)	0.12	0.04*	0.04
	(0.62)	(1.66)	(1.63)
income quintile5 (quintile 5_lag=1)	-0.11	0.01	0.01
	(0.59)	(0.63)	(0.56)
coastal lowlands dummy	0.28	-0.19***	-0.19***
	(1.32)	(6.60)	(6.09)
eastern lowlands dummy	-0.32	0.09*	0.09
	(1.19)	(1.74)	(1.55)
western lowlands dummy	0.79***	0.09**	0.08
	(2.85)	(2.51)	(1.60)
western transitional dummy	6.07	0.25*	0.24
	(.)	(1.84)	(1.54)
high potential maize zone dummy	1.19***	0.13***	0.13**
	(5.56)	(4.93)	(2.41)
western highlands dummy	-0.29	0.02	0.02
	(0.46)	(0.13)	(0.17)
marginal rain shadow dummy	0.55	-0.39***	-0.38***
	(0.85)	(4.71)	(4.49)
year of survey (1=2004)	0.15	0.06***	0.06***
	(0.97)	(3.10)	(3.15)
year of survey (1=2007)	0.44**	0.07***	0.07***
	(2.46)	(3.41)	(2.97)
Constant	2.63**	0.56***	0.59***
	(2.45)	(4.53)	(4.76)
Observations	722	596	722

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Milk

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	-0.14*	0.00	0.00
	(1.67)	(0.21)	(0.15)
household head age (years)	-0.02	-0.00	-0.00
	(1.28)	(0.07)	(0.06)
household head age squared	0.00	-0.00	-0.00
	(0.94)	(0.05)	(0.05)
education of household head (1=no education)	0.03	0.02	0.02
	(0.26)	(1.28)	(1.29)
education of household head (1=secondary education)	0.15*	0.00	0.00
	(1.84)	(0.44)	(0.34)
education of household head (1=post-secondary education)	0.35***	0.00	0.00
	(2.61)	(0.25)	(0.15)
dependency ratio	-0.04	-0.01*	-0.01*
	(0.94)	(1.83)	(1.79)
per capita land size (acres)	0.03**	0.01***	0.01***
	(2.04)	(4.47)	(4.17)
membership in farmer group (1=yes)	0.19***	0.01	0.01
	(2.61)	(0.62)	(0.46)
ownership of transport equipment (1=yes)	0.02	0.01	0.01
	(0.31)	(0.75)	(0.63)
ownership of communication equipment (1=yes)	0.36***	-0.02	
	(3.53)	(0.97)	
distance to tarmac road (km)	-0.03***	-0.00***	-0.00***
	(5.53)	(4.19)	(2.78)
distance to extension service (km)	0.02**	-0.00	-0.00
	(2.45)	(0.59)	(0.58)
milk price (ksh/kg)	0.05***	-0.00	-0.00
	(5.18)	(0.17)	(0.15)
income quintile1 (quintile1_lag=1)	-0.20**	-0.01	-0.01
	(2.02)	(0.91)	(0.66)
income quintile2 (quintile 2_lag=1)	-0.12	-0.01	-0.01
	(1.29)	(0.59)	(0.46)
income quintile4 (quintile 4_lag=1)	0.04	0.00	0.00
	(0.44)	(0.33)	(0.34)
income quintile5 (quintile 5_lag=1)	0.21**	0.02*	0.02*
	(2.18)	(1.90)	(1.75)
coastal lowlands dummy	-0.62*	0.09	0.09
	(1.88)	(1.56)	(1.51)
eastern lowlands dummy	-1.05***	-0.01	-0.01
	(7.32)	(0.44)	(0.18)
western lowlands dummy	-1.70***	-0.06**	-0.05
	(12.32)	(2.45)	(0.84)
western transitional dummy	-0.51***	-0.02	-0.02
	(4.08)	(1.38)	(0.99)
high potential maize zone dummy	-0.25***	-0.00	-0.00
	(2.58)	(0.35)	(0.28)
western highlands dummy	-0.90***	-0.03	-0.02
	(7.30)	(1.39)	(0.71)
marginal rain shadow dummy	0.53**	0.02	0.02
	(2.49)	(0.96)	(0.78)
year of survey (1=2004)	0.06	0.02*	0.02*
	(0.82)	(1.80)	(1.70)
year of survey (1=2007)	0.17**	0.03***	0.03**
	(2.26)	(2.81)	(2.35)
Constant	0.71	0.59***	0.57***
	(1.44)	(7.93)	(7.77)
Observations	2633	2013	2633

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Fertilizer

Variable	Probit	Truncated	Heckman
gender of household head (1=male)	0.19**	34.63	5.42
	(2.51)	(1.58)	(1.41)
household head age (years)	0.01	5.15	0.96
	(0.93)	(1.34)	(1.39)
household head age squared	-0.00	-0.05	-0.01
	(0.52)	(1.51)	(1.64)
education of household head (1=no education)	-0.07	34.53	6.10
	(0.78)	(1.44)	(1.30)
education of household head (1=secondary education)	0.47***	8.51	-0.46
	(5.57)	(0.50)	(0.12)
education of household head (1=post-secondary education)	0.58***	13.56	1.79
	(3.77)	(0.59)	(0.33)
dependency ratio	-0.01	-16.45	-2.83
	(0.26)	(1.48)	(1.54)
per capita land size (acres)	-0.05***	-10.37**	-1.88**
	(3.46)	(2.21)	(2.30)
membership in farmer group (1=yes)	0.37***	30.97	1.92
	(5.28)	(1.49)	(0.50)
ownership of transport equipment (1=yes)	0.06	18.28	4.52
	(0.87)	(1.23)	(1.50)
ownership of communication equipment (1=yes)	0.10	-8.05	
	(1.09)	(0.29)	
distance to tarmac road (km)	-0.03***	11.75***	2.69***
	(6.06)	(7.93)	(9.32)
distance to extension service (km)	0.01	-11.22***	-1.46***
	(0.83)	(4.99)	(4.64)
distance to fertilizer seller (km)	-0.02***	-5.03*	-0.65
	(2.75)	(1.71)	(1.41)
fertilizer price (ksh/kg)	-0.04***	3.56	0.72
	(2.82)	(0.69)	(0.81)
income quintile1 (quintile1_lag=1)	-0.45***	-82.88***	-9.14*
	(4.87)	(2.91)	(1.81)
income quintile2 (quintile 2_lag=1)	-0.35***	-40.83*	-6.62
	(3.85)	(1.72)	(1.49)
income quintile4 (quintile 4_lag=1)	0.02	15.49	4.01
	(0.24)	(0.79)	(1.02)
income quintile5 (quintile 5_lag=1)	0.17*	70.59***	19.52***
	(1.68)	(3.55)	(4.83)
coastal lowlands dummy	-3.12***	-4,464.78***	-79.93***
	(16.56)	(3.82)	(2.96)
eastern lowlands dummy	-1.79***	-1,357.67***	-98.39***
	(13.20)	(8.07)	(10.10)
western lowlands dummy	-2.66***	-823.61***	-69.44***
	(17.70)	(5.91)	(3.64)
western transitional dummy	-0.73***	-211.51***	-53.96***
	(4.99)	(6.59)	(9.85)
high potential maize zone dummy	-0.32**	-148.16***	-44.13***
	(2.28)	(6.30)	(10.49)
western highlands dummy	-0.24	-281.05***	-63.40***
	(1.50)	(7.41)	(12.31)
marginal rain shadow dummy	-2.22***	-618.68***	-96.40***
	(12.52)	(5.32)	(5.62)
year of survey (1=2004)	0.16**	-52.66***	-9.20**
	(2.10)	(2.81)	(2.57)
year of survey (1=2007)	0.55***	-57.79	-11.75
	(4.42)	(1.35)	(1.54)
Constant	1.98***	-274.86	67.74**
	(3.43)	(1.54)	(2.34)
Observations	3814	2739	3814

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Credit

Variable	Probit
Gender of household head (1=male)	-0.03
	(0.45)
Household head age (years)	-0.02
	(1.38)
Household head age squared	0.00
	(0.87)
Education of household head (1=no education)	-0.11
	(1.48)
Education of household head (1=secondary education)	0.08
	(1.27)
Education of household head (1=post-secondary education)	-0.06
	(0.65)
Dependency ratio	0.04
	(1.21)
Per capita land size (acres)	-0.04**
	(2.55)
Membership in farmer group (1=yes)	0.56***
	(9.61)
Ownership of communication equipment (1=yes)	-0.09
	(1.24)
Distance to tarmac road (km)	0.02***
	(5.76)
Distance to extension service (km)	-0.02***
	(4.12)
Income quintile1 (quintile1_lag=1)	-0.12
	(1.58)
Income quintile2 (quintile 2_lag=1)	-0.06
	(0.79)
Income quintile4 (quintile 4_lag=1)	0.15**
	(2.13)
Income quintile5 (quintile 5_lag=1)	0.32***
	(4.41)
Coastal lowlands dummy	-1.00***
	(8.49)
Eastern lowlands dummy	-1.12***
	(12.86)
Western lowlands dummy	-1.07***
	(11.99)
Western transitionsl dummy	-0.39***
	(4.67)
High potential maize zone dummy	-1.12***
	(15.42)
Western highlands dummy	-0.43***
	(4.92)
Marginal rain shadow dummy	-0.91***
	(6.66)
Year of survey (1=2004)	-0.47***
	(8.49)
Year of survey (1=2007)	0.11*
	(1.94)
Constant	0.87**
	(2.49)
Observations	3823

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%