THE MILLENNIUM DEVELOPMENT GOALS AND THE AFRICAN FOOD CRISIS: A MESO AND MICRO LEVEL ANALYSIS OF THE DRIVERS OF AGRICULTURAL INTENSIFICATION OF FOOD STAPLES IN KENYA.

A REPORT PREPARED
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1.0 INTRODUCTION

Agriculture is a vital development instrument for achieving the Millennium Development Goal that calls for halving by 2015 the share of people suffering from extreme poverty and hunger. In sub-Saharan Africa, agriculture is seen as a strong option for spurring economic growth, overcoming poverty and enhancing food security. Growth in Agricultural productivity is vital for stimulating growth in other sectors of the economy. However, accelerated growth requires agricultural intensification and a sharp productivity increase in smallholder farming combined with more effective support to the many Africans surviving as subsistence farmers in the rural remote areas.

In the 21st century, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction.. Agriculture alone cannot achieve the magic of massively reducing poverty, but it has proven to be powerful for that task. In the agriculture-based countries, which include most of Sub-Saharan Africa, agriculture and its associated industries are essential to growth and to reducing mass poverty and food insecurity. Using agriculture as the basis for economic growth in the agro-based countries requires a productivity revolution in smallholder farming. However, given Sub-Saharan Africa's unique agriculture and institutions, this revolution will have to be different from the Asian green revolution.

Whilst the worlds of agriculture are vast, varied and rapidly changing, with the right policies and supportive instruments at local, national and global levels, today's agriculture offers new opportunities to hundreds of millions of rural poor to move out of the poverty traps. Pathways out of poverty traps offered by agriculture include small holder faming, animal husbandry, employment in the "new agriculture" of high value products, and entrepreneurship and jobs in the emerging rural, nonfarm economy.

Agriculture thus offers great promise for growth, and poverty reduction. However, realizing this promise requires the visible hand of the state-providing core public goods, improving the investment climate, regulating natural resource management and securing desirable social outcomes.

Considering the fact that agriculture dominates the economies of SSA and that between 50% and 90% of the total production comes from small scale farmers, the role of small holder producers in the achievement of the MDGs is crucial. An understanding of the performance of small holder farmers is thus an important prerequisite for policy formulations aimed at improving productivity levels which will ultimately lead to the achievement of MDG1.

Kenya, like other SSA countries, displays the hallmarks of a developing economy. Agriculture dominates the national economy, employing directly or indirectly over 80% of the active population and indirectly over 80% of the active population and accounts for over 60% of the GDP (Odhiambo, 1998). About 80% of the total agricultural output in Kenya comes from small-scale producers.

The agricultural sector in Kenya performed exceptionally well in the 1960s and the early 1970s growing at an average rate well above 7% per annum. From the early 1980s to date, growth of the sector has slowed down considerably. This deterioration has been attributed, partly to an increasing shortage of land suitable for agriculture. Earlier growth had been achieved through expansion of land. However, this has not been possible in the recent past due to increased population. Cultivation of marginal areas due to lack of suitable agricultural land has resulted in declining yields. Expansion of farm labour has not been helpful either. To increase production, farmers must add new, more productive inputs in order to shift their productive capacities upwards and increase returns to labour and land.

Although the need for agricultural intensification for further growth in the sector is fully recognized, recent trends have been worrying. The problem is that the actual yields of major crops in Kenya fall

below the potential yields. Low productivity in agriculture in general presents a problem to individuals in terms of the levels of yields per acre and for the country in terms of efficient utilization of scarce agricultural resources. The low crop productivity in many parts of Kenya has been attributed to several factors, among them being poor policy structures, harsh environmental factors, poor infrastructure, insufficient and/or lack of use of modern inputs and poor crop and animal husbandry (Nyiira 1987, Kenya, 1997).

In the light of the deteriorating agricultural and food productivity in Kenya and taking cognizance of the role of agriculture in the achievement of the MDG1, this study aimed at examining the relationship between agricultural development in Kenya, on the one hand, and food security and poverty alleviation, on the other. This dynamic relationship was captured using production and socio-economic data of both qualitative and quantitative nature collected at the farm (Household), village and regional levels. The study takes cognizance of the urgent need to improve our understanding of the drivers behind recent changes in staple food production in the small farm sector (accounting for 70 – 90% of farms in many African countries) and the welfare impact of these changes on small farm households.

2.0 RESEARCH OBJECTIVES

The overall general objective of this study was to investigate the relationship between policy, technology adoption, agricultural commercialization and household welfare through use of production and socio-economic data collected at the household, village and regional levels. This broad, objective was achieved by pursuing the following specific objectives.

a) Analyzing the drivers behind recent changes in staple crop production in the small farm sector and the welfare impact of these changes on the small farm households.
b) Assessing the extent to which differences and trends in production, technology adoption and crop marketing can be explained by the role of the local government and other specific village and household characteristics.
c) Capturing the changes in productivity, technology adoption, crop marketing and welfare indicators that have occurred in the period 2002 to 2007.

The ultimate objective of this study was to make policy recommendations that will lessen food insecurity, reduce extreme poverty and hunger and help Kenya make progress towards achieving the MDGs.

3. 0 METHODOLOGY

3.1 Study Area, Sampling and Data Collection

Administratively, Kenya is divided into eight provinces and over two hundred and six districts. However, the process of redefining district boundaries is still ongoing and the number of districts is expected to increase. Each district is further sub-divided into division, locations, sub-locations and villages. Villages consist of a number of households. Agricultural data is available on the basis of the above administrative set up. Maize and its derivatives is the most important staple food crop and is grown in almost all the households. Multistage purposive sampling as was done during the Afrint1 in 2002 was used from the province down to the household. In selecting the provinces, districts, divisions sub locations and the villages; this study just like Afrint1 was guided by the following factors:

- The area having considerable variability in agro-ecological potential (from high to low)
- The area having different levels of market access
- Population density and farm size.

Consequently, at the national level two districts selected during Afrint1 were again selected for this study. The larger Kakamega district in western province was selected as an area with a very high population density. The larger Nyeri District in Central province was chosen for its considerable variability in agro-ecological potential and market access. The same five villages as identified in Afrint1 were selected from each district primarily on the basis of differences in agro ecological potential and market access.

3.1.1 Agro-ecological Potential and Market Access in the Larger Nyeri District

The larger Nyeri District partly lies on the South Western part of the moist windward side of Mount Kenya (a giant volcano) and also on the driver Western leeward side of this mountain. It also borders the semi-arid Laikipia plateau and the moist windward Eastern slopes of the Aberdare ranges. Consequently, the contrast in natural potential is therefore enormous.

The larger Nyeri District is divided into seven administrative divisions namely:- Mathira, Municipality, Mukurwe-ini, Tetu, Othaya, Kieni East and Kieni West. There are considerable variations in the agro-ecological potential found on the slopes of Mt. Kenya and the Aberdare. Kabaru area in Mathira Division is a good example of an area with the highest potential and is a major producer of food and cash crops. However, the potential for some of these areas can be enhanced if the road network is improved, to allow the crops produced to reach the market particularly during the rainy seasons.

Except for Kieni East, Kieni West, and some parts of Mukweri-ini, the larger Nyeri District can generally be classified as an area of high agro ecological potential. However, there are intra-divisional variations in some high potential areas of the district. There are less intensive farming patterns in Ngorano and Ruguru Locations in Mathira, Rutune in Mukurwe-ini, Gachika and Nyaribo in Municipality division. These have been identified as pockets whose potential can be exploited through provision of water for irrigation.

The lower parts of Mukurwe-ini and also parts of Kieni Plateau experience aridity and this has hindered the full exploitation of the existing agricultural potential. Provision of water for irrigation would enhance exploitation of the horticultural potential in these areas especially in Kieni East and West divisions. The soils in Rutune area of Mukurwe-Division are somewhat excessively drained and cannot sustain agricultural activity.

In Kieni East and West divisions, only about 50% of the total agricultural land has been put into productive use. Maize, beans and Irish potatoes are mainly grown for subsistence. Horticultural products are the leading cash crops in these divisions, although some pyrethrum is also growth on the eastern slopes of the Aberdares. The two divisions have substantial potential in horticultural production which can be better exploited through provision of water for irrigation.

The district’s potential in the production of horticultural products is yet to be fully exploited. Potential exists not only in Kieni East and West, but also in Mathira and the upper parts of Tetu division. However, the problem of poor access roads has hindered its full exploitation. Some of the agricultural produce fails to reach the market particularly during the rainy seasons.

Coffee is a major cash crop grown in all the division except in Kieni East and West divisions. Tea is also a major cash crop grown in Mathira, Othaya and Tetu division, i.e. on the well drained slopes of the Aberdare ranges and Mount Kenya. The poor state of roads in the tea growing areas causes a lot of waste resulting in reduced earnings. Macadamia nuts are also grown in the coffee growing areas. Mulberry farming is on as a pilot project in Kieni East. Wheat is grown in the large farm sector particularly in Kieni East. In addition to zero grazing, commercial livestock farming/ranching is a major economic activity in Kieni West. Solio ranch is famous for beef cattle production.

Municipality division has the highest density of roads and markets in this division are quite accessible. Mathira division has the widest coverage of roads, although the greatest length is of the minor access roads. This is followed by Tetu, Othaya and Mukurwe-ini. The least coverage is in Kieni East and West, which are relatively newly settled areas. Some of the roads in areas such as the lower parts of Mukurwe-ini, upper parts of Tetu, Magutu, Mount Kenya and Ngorano in Mathira division become inaccessible during the rainy seasons.

As noted earlier, Kieni East and West divisions produce a lot of horticultural products. However, a substantial amount of this produce does not reach the market because of lack of motorable roads in these areas. These areas therefore need to be opened up through provision of all weather roads if the horticultural sector is to play a greater role in the economy of district.

Although the district has a fair share of classified roads, most of them are poorly maintained. Most of the gravel works have been eroded. The feeder roads which are supposed to be maintained through coffee and tea cess by the Nyeri county council remain impassable during the rainy season due to poor maintenance. The most affected areas are the lower parts of Mukurwe-ini, upper parts of Tetu, Ngorano, Konyu and Magutu areas of Mathira division. In these areas a substantial amount of coffee and tea gets wasted or lose quality by the time it reaches the factories.

Kieni East, Kieni West and some other areas particularly on the slopes of Mount Kenya and Aberdares being newly settled areas, have not been fully opened up and consequently they become inaccessible to the market especially during the rainy season. In these areas, a substantial amount of horticultural produce therefore goes to waste due to lack of feeder roads. The poor condition of roads in some parts of the district is therefore, one of the major constraints which ash to be addressed if the full productive potential is to be realized.

The larger Nyeri district is also highly endowed in tourism potential, but his has not been fully exploited due to inaccessibility of roads leading to the national parks. This situation is worse during the rainy season.

Some parts of the larger Nyeri district (in particular the Northern part of Kieni division) suffer prolonged periods of drought (Kenya, 1984) and since the district has no famine relief programme, agricultural produce is distributed from the areas of surplus production to the areas of deficit through the system of market places. Kieni East and West divisions provide examples of places with a poor spatio-temporal integration of periodic markets (Wambugu, 1994).

3.1.2 Contrasts in Agro-ecological Potential and Market Access in the Larger Kakamega District

The larger Kakamega district today comprises of the districts of Vihiga, Butere-Mumias, Kakamega and Lugari. The rich and varied ecological base (high temperatures, reliable rainfall, fairly fertile soils and various rocks and forests) has been a significant factor in determining human activities such as settlement and farming. The larger Kakamega district is one of the districts with a very high population density in Kenya. The high population density and the high population growth rate are some of the obstacles to the development efforts in the district for they overburden the resource base. Every part of the district is virtually inhabited except the rocky hills in the southern and central parts and the Kakamega forest. The density of population tends to increase from north to south. The southern part of Kakamega district has well drained soils and a fairly flat area and swampy soils lead to regular flooding and water logging, making construction of roads difficult.

Kakamega has annual rainfall of between 1200 – 2100 mm suggesting a high potential area. In the centre of the district, rainfall is too high and this leads to leaching of the soils and crop spoilage. The district borders the Nandi escarpment to the east. However, although the escarpment has fertile soils, difficulties experienced in communication leaves the area suitable for livestock keeping and forestry only.

The southern parts of the district receive more rainfall than the northern parts of Lurambi and Lugari divisions. The land use patterns are as follows: the northern parts namely Lugari and Likuyani division are the major producers of maize and beans which are sold to the other divines, the western parts (Butere and Mumias) are under sugarcane. Tea is grown on small scale in Shinyalu and Ikolomani divisions. Coffee is grown all over the district, sunflower is also an important cash crop and livestock keeping is also an important land use type. Over exploitation of the land potential has led to environmental degradation.

Since Kakamega district receives a lot of rain, all weather roads are necessary. Divisions such as Shinyalu, Ikolomani, Kabras, Lugari and Likuyani with great agricultural potential require improvement in the road coverage. Mumias division and parts of Butere and Lurambi divisions in the sugar belt have good graveled roads which are maintained by Mumias Sugar Company.

Development in the district is hindered by inadequate infrastructural facilities (such as roads) and poor marketing systems among others. Most of the roads in the district are earth roads and only a small proportion is all weather. Due to the heavy rains, roads are impassable during the rainy season. As a result of this accessibility of farm produce and other raw materials to markets becomes difficult. The high potential areas such as Lugari, Navakholo and Kabras divisions have poor roads. In the tea producing divisions of Shinyalu and Ikolomani most roads leading to tea buying centres are impassable during the wet season when green leaf production is highest, leading to substantial amounts of green leaf being uncollected and hence wasted. In these areas other perishable farm produce such as milk and vegetables cannot reach the market on time.

As a whole, Kakamega district has uneven distribution of the road network with a concentration in the southern and central parts but dispersion in the northern parts. The district has notable variations in the distribution of indices of the road network namely density, accessible distance, beta, theta and gamma indices. Nodes (market centres) on the road network have varying levels of accessibility broadly classified as high, medium and low. The small urban and market centres act as relays of movement as well as providing essential services to their hinterlands.

In a nutshell and considering the two districts, Nyeri has better market access in the regional towns of Nyeri, Karatina, Nanyuki and Nairobi (the capital of Kenya). The district also has a higher road density. Consequently, its agriculture is relative more developed. In contrast, although Kakamega is better endowed agro-ecologically than Nyeri, the high population density, inadequate infrastructure and poor market access have prevented the district from realizing its full agro-ecological potential.

3.1.3 Village Characteristics and Crops Grown

Two administrative divisions in Nyeri district and five in the larger Kakamega district were again selected just like in Afrint1. The same five villages as identified in Afrint1 were again selected from each district. The ten villages selected and their geographical locations are shown in Table 1.

Table 1: Sampled Districts Villages and their Geographical Location

Village	Region/ District	Village GPS coordinates		Nearest town	Nearest town GPS coordinates	
		Latitude	Longitude		Latitude	Longitude
Shikomoli	Larger Kakamega	$N0^0$ 3`	$E34^0$ 47`	Jepsis	$N0^0$ 3`	$E34^0$ 46`
Ekero	Larger Kakamega	$N0^0$ 19`	$E34^0$ 30`	Ekero	$N0^0$ 19`	$E34^0$ 30`
Chegulo	Larger Kakamega	$N0^0$ 29`	$E34^0$ 47`	Malava	$N0^0$ 22`	$E34^0$ 40`
Munyuki	Larger Kakamega	$N0^0$ 41`	$E34^0$ 52`	Lumakanda	$N0^0$ 38`	$E34^0$ 58`
Mukuyu	Larger Kakamega	$N0^0$ 41`	$E34^0$ 52`	Makutano	$N0^0$ 43`	$E34^0$ 56`
Gatondo/thegenge	Nyeri	$S0^0$ 26`	$E37^0$ 10`	Gatondo	$S0^0$ 26`	$E37^0$ 10`
Ichuga/Gathumbi	Nyeri	$S0^0$ 26`	$E37^0$ 99`	Icuga	$S0^0$ 26`	$E37^0$ 6`
Kiambii	Nyeri	$S0^0$ 22`	$E37^0$ 5`	Kiamariga	$S0^0$ 23`	$E37^0$ 5`
Gatagati	Nyeri	$S0^0$ 18`	$E37^0$ 7`	Kimahuri	$S0^0$ 18`	$E37^0$ 7`
Irigithathi	Nyeri	$S0^0$ 11`	$E37^0$ 4`	Irigithathi	$S0^0$ 11`	$E37^0$ 4`

Source: Field Survey, 2008

The villages in Mathira and Kieni East divisions provided a good transect for studying the agricultural intensification among smallholder farmers. The transect running from Thegenge through Ichuga, Kiambii, Gatagati and Irigithathi villages was chosen as it exhibits the following characteristics:

- Most, if not all, of the crops grown in the district are found in these villages
- It shows a gradation in the levels of agricultural intensification and
- The villages have marked differences in market access

The villages in Mathira division are agro-ecologically better endowed than the villages in Kieni East and they also have better market access. The higher road density and the proximity to a major market (Karatina) which is well linked to other important urban markets make the villages to have better market access.

Thegenge/Gatondo village was chosen to represent an area of high agro-ecologically potential and good market access. Ichuga/Gathumbi village was chosen to represent an area of medium potential and good market access. Kiambii village has poor agro-ecological potential and average market access. Gatagati village was chosen to represent areas with poor market access, good agro-ecological potential coupled with some irrigation. Irigithathi village was chosen to represent an area with relatively large farm sizes, poor agro-ecological potential and average market access.

Similarly, the villages in Kakamega district were selected on the basis of having different agro-ecological potential, market access and population density.

Shikomoli village was chosen to represent an area with very high population density (hence small farm sizes), relatively poor agro-ecological potential (the village is rocky and hilly with poorly developed soils) and average market access. Ekero village was chosen to represent a village with relatively good

market access. The village has good graveled roads maintained by Mumias Sugar Company. The village is also served by the Mumias – Kakamega tarmac road. Ekero village provides an example of an Outgrower scheme in sugar where farmers grow maize for subsistence. Chegulo village was chosen to represent an interior, hard to access village, but with medium potential and some small-scale irrigation.

Munyuki and Mukuyu villages in the newly created Lugari District were selected to represent areas of maize monoculture with high agro-ecological potential. Munyuki has a fairly good market access in the markets of Lumakhanda and Kipkarren River while Mukuyu has very poor market access. The two villages have relatively low population densities. The characteristics of these villages are summarized in table 2.

Table 2: Characteristics of the Sampled Villages

Village	Farm size	Population density	General soil fertility	Average annual rainfall	AEZ	AEP	Market access	Major crops grown
Shikomoli	Small	848	Low	2000	UM1	medium	medium	Coffee, tea, maize
Ekero	Medium	617	Good	1800	LM1	Good	Good	Sugarcane, maize
Chegulo	V large	287	Medium	1600	LM2	Poor	Poor	Sugarcane, sweet potatoes
Munyuki	V large	436	Good	1400	UM4	Good	Good	Maize, beans, sweet potatoes
Mukuyu	Small	373	Good	1200	UM4	Good	poor	Maize, beans, sweet potatoes
Thegenge/Gatondo	Small	494	Good	1400	LH1	Good	Good	Tea & horticultural products
Ichuga/Gathambi	Small	512	Medium	1000	UM3	Medium	Good	Coffee, maize
Kiambii	Small	510	Medium	900	UM4	medium	medium	Maize
Gatagati	Medium	128	Good	1000	LH3	Medium	Poor	Horticultural products
Irigithathi	Large	126	Poor (low)	800	LH4	poor	medium	maize

Source: Kenya, (2000), Jaetzold and Schmidt, (1983), Karugia, (2003).

3.1.4 Data Collection

The main micro-study data collection instruments were a household survey questionnaire directed at three hundred sampled households sampled during Afrint1. Treating the 2002 Afrint1 survey as a baseline the 300 households were resurveyed. A combination of both quantitative and qualitative household data offered an opportunity to investigate the important dynamic relationship between technology adoption, agricultural commercialization and household welfare. More specifically the household survey questionnaire enabled the researchers to identify the key drivers of agricultural development in terms of temporal changes in production and yields of food staples, i.e area expansion or intensification based on available technologies or the adoption of new ones. The questionnaire also collected data that enabled the researchers to examine the relationship between, on the one hand, temporal changes in yields and technology adoption and temporal changes in the household welfare using a selection of proxy indicators for welfare available at the household level. The main respondents to the household survey were the household heads or the farm managers.

At the meso-level a village diagnostics questionnaire containing both pre-coded questions and issues that required careful probing interviews with key informants and farmer groups was used to collect information. The village diagnostic questionnaire administered in the ten villages, the ones selected in Afrint1, was used to collect information on the general village situation with respect to agricultural intensification, including among others kinds of state interventions, market access, farmer organizations, agricultural techniques and gender aspects. The questionnaire also contained a number of open-ended questions of a qualitative nature touching on the role of the local government in impending and/or facilitating agricultural intensification and in commercialization of small holder agriculture that were reported in a text format by the researchers.

An important aspect of the village diagnostics and household survey questionnaires was their ambition to capture the agricultural dynamism that has occurred over time. This was captured by asking farmers and key informants to recollect how the situation was like in 2002 when Afrint1 study was done (as reflected in the indicators of intensification) in both questionnaires. The questionnaires had questions linking various kinds of farm management, resource access, crop strategies and productivity to various demographic and socio-economic characteristics of the household.

This study used the sampling frame as was used in Afrint1 2002 study. In the 2002 Afrint1 study, the process of sampling the households started with the selection of villages where informal discussions on the objectives of the study were held with agricultural officers, village elders and farmers. Once villages were purposefully selected, enumerators with the help of location chiefs, sub location assistant chiefs and village elders compiled sample frames consisting of households in each village. From each sample frame, which consisted of between 150 and 200 households 30 households were randomly selected. Most categories of households were represented in the final sample which consisted of 30 households form ten villages. Attrition is a problem in all panel studies like this one, since a portion of the original units might disappear from the population, either by passing away or by emigrating from the area. In this study the problem of attrition was dealt with in a number of ways. In cases where we had more than one descendant household, we randomly selected one descendant household to replace the original one. We also tried to trace households which had migrated from the villages by making enquiries with neighbors. This study tried to make the 2007 sample representative of the current village agrarian population by making lists of households who have settled in the village since 2002 and drew a random sample of these. Consequently the new 2007 had the following categories of households: unpartitioned households with the same head as in 2002 (which were the majority), unpartitioned households with new head, newly sampled offspring households, in-migrated households (sampled from list of in-migrants) and out-migrated households. No serious problems were reported in relation to the administration of the household and the village diagnostics questionnaires. They had relatively few questions that were considered problematic or unduly time consuming. However, some cultural factors such as disclosing the actual number of children caused some minor problems which were addressed by the researchers. Thus, the overall the quality of data collected was judged to be quite good and met the objectives of the study.

3.1.5 Data analysis

Data from the pre-coded questionnaires were entered in the statistical package for social scientists (SPSS) version 12.0. The data were then cleaned and analyzed. SPSS enables easy manipulation of the data to obtain descriptive statistics and cross tabulations which provided a general description of the characteristics and performance of smallholder agriculture in Kenya. Tables, graphs and pie-charts were used to present the data. In addition correlation analysis was used to establish the relationship between various measures of intensification and variables that were *a priori* hypothesized to be associated with it. Probit and Tobit models were used to analyze the determinants of agricultural intensification and adoption

of a number of agricultural technologies. The LIMDEP Econometric Software (Green, 2000) was used to carry out the Probit and Tobit model analysis.

4. 0 RESULTS AND DISCUSSION

4.1 Village Diagnostics (Meso-level) Survey Results and Discussion.

4.1.1 General Village Characteristics

The general village characteristics are discussed under the headings population size and land use, road infrastructure, land availability and land tenure.

4.1.1.1 Population Size and Land use

The approximate number of households (approximate population of the villages) varied from village to village. Gatondo village had the highest number of households followed by Ichuga. Most households (73.7%) were male headed, 21.6% were female headed and the rest were headed by children (4.7%). This information on number of households in the villages and household headship is depicted in Table 3.

Table 3: Number of Households per Village and Household Headship

Village	Approximate No. of HHs.	Male Headed HHs	Female HHs	Child HHs
Shikomoli	240	180	50	10
Ekero	360	270	60	30
Chegulo	120	85	25	10
Munyuki	120	80	20	20
Mukuyu	400	320	60	20
Thegenge/Gatondo	400	600	180	20
Ichuga/Gathumbi	700	500	165	35
Kiambii	106	50	50	6
Gatagati	400	300	85	15
Irigithathi	275	210	65	0
Total	3521(100%)	2595 (73.7%)	760 (21.6%)	166 (4.7%)

Source: Field Survey, 2008

The survey results show that the villages are composed of a number of ethnic groups (multi-ethnic) with Mukuyu village displaying the greatest multi-ethnic composition. The major ethnic groups in Kenya (Kikuyu, Luhya, Kalenjins, Luo, Kamba and, Kisii) are found in most of the sampled villages. The high multi-ethnicity in Mukuyu village can be explained by large immigration into Lugari District where the Government directed the degazettement of parts of former government forestland. Though Lugari District was previously dominated by the Luhya sub-ethnic groups its ethnic and demographic patterns have been changing rapidly since the mid 1970s. This has been caused by the large immigration of new ethnic groups such as the Kikuyu from Central and Rift Valley Provinces, Kalenjins from the Rift Valley, Gusii from Kisii and Luo from Nyanza. There has also been a large immigration of the Maragoli Luhya sub-ethnic group from Vihiga District into the district. Through the formation of temporary land buying companies, these new immigrant groups have bought parcels of land in the district and subdivided it among the members. These groups also assist members to pay for land leasing charges. This immigration seems to have initiated the recent rapid expansion in the movement of staple foodstuffs from

Lugari/Transnzoia and the Western parts of Uasin Gishu District to Luo Nyanza, Kisii and Maragoli. This multi-ethnic social structure provides a rich study unit because it mirrors what one can expect to find in other rural areas of the country as regards, for example, local initiatives and attitudes and receptiveness of new poverty reduction strategies.

Given the above scenario especially subdivision of parcels of land, the available land is quickly dwindling and future growth in food production will have to come from further intensification of agriculture.

According to the 2002 data (Karugia, 2003), the land under cultivation varied from village to village. It was lowest in Shikomoli, Munyuki and Mukuyu villages. Cultivated land area was highest in Ichuga/Gathumbi village. The land use pattern in the various villages as per the 2002 data is depicted in table 4.

Table 4: Land Use Patterns in the Sampled Villages in 2002

Types of land use (%)	Shikomoli	Ekero	Chegulo	Munyuki	Mukuyu	Thegenge/ Gatondo	Ichuga/ Gathumbi	Kiambii	Gatagati	Irigithathi
Cultivation	50	70	60	50	50	70	80	70	70	58
Fallow and Pasture	10	5	20	15	20	0	10	10	30	28
Forest/virgin land	5	0	2	1	10	0	0	0	0	0
Marginal land	15	2	1	20	5	5	0	0	0	10
Water bodies	10	10	5	1	5	0	1	0	0	0
Other uses	10	13	12	13	10	25	9	20	0	4

Source: Karugia, 2003

However, the re-surveyed villages estimated that currently a big percentage of the village population composed of farming households, with the percentages ranging from 60% (in Ekero village) to 99% (in Ichuga/Gathumbi and Kiambii villages). The most important source of income in the surveyed villages was identified as crop sales, animal sales and fishing.

With the exception of Irigithathi village, the survey established that land frontiers in villages are completely exhausted and that the fields are permanently cultivated. In Irigithathi village, land frontier is still open, but can be foreseen to close within the next few years. Apart from Ekero village where newly formed households mainly obtain land through purchasing the other villages said that these households acquire land through inheritance of land already under cultivation. The major means of increasing farm size for already established households was through buying land or through renting/borrowing land. All the villages reported that they are patrilineal.

Female headed households obtain land through a variety of ways. In Shikomoli, Munyuki, Mukuyu, Thegenge/Gatondo, and Kiambii villages, they inherit land already under cultivation. In Ekero village they purchase land, while in Ichuga/Gathumbi village they are allocated family land. In Irigithathi they borrow/rent land. However, in Chegulo village female headed households do not have access to land. Apart from Chegulo village widowed women inherit land from their late husbands. In all the surveyed villages save for Ekero, women do not retain land upon divorce. Also apart from Chegulo, parents inherit land from their late sons and so do widowed women.

Taking into account the fact that a large percentage of the village population are farming households and that land frontiers are completely exhausted, soil mining and other negative environmental consequences are inevitable. There is an urgent need, therefore, to come up with viable options (appropriate intensification strategies) that avoid negative environmental consequences. A closed land frontier increases the demand for land augmenting techniques such as irrigation and drainage and biotechnical inputs.

4.1.1.2 Road infrastructure

All the ten villages had regular public transport with all of them being serviced more than once a day. Information on the distances from the village centre to the nearest all weather road, nearest place serviced by public transport and how often the place is serviced by public transport is summarized in Table 5.

Table 5: Distances from the Village Centers to Various Service Centers.

Village	All weather road	Nearest public transport	Frequency of public transport service
Shikomoli	4	4	>1 per day
Ekero	1	1	>1 per day
Chegulo	7	3	>1 per day
Munyuki	1	7	>1 per day
Mukuyu	14	1	>1 per day
Thegenge/Gatondo	1	1	>1 per day
Ichuga/Gathumbi	1	1	>1 per day
Kiambii	1	1	>1 per day
Gatagati	1	1	>1 per day
Irigithathi	6	1	>1 per day
Mean	3.7	2.1	-

Source: Field Survey, 2008

Although the results presented in Table 3 show that the villages are fairly well served by road infrastructure, provision of transport infrastructure is a costly undertaking. Nevertheless, provision of adequate road infrastructure is essential for integration and agricultural development. According to Oluoch-Kosura (2003) the state of infrastructure in Kenya has deteriorated to the extent that it has become a hindrance to growth. Poor and inadequate road infrastructure increases costs of transport. In Kenya, transport costs are high and act as disincentives for small scale farmers to commercialize and to intensify their agricultural practices.

4.1.1.3 Land Availability and Land Tenure

With the exception of Kiambii village, the other nine villages reported that, since 2002, migrants had come to the villages seeking land. The number of migrants varied from village to village with Gataagati and Irigithathi village reporting the highest number. Most of these migrants seeking land came from other rural areas, and were of the same ethnicity as majority of the residents in the villages, it was reported that the recent migrants had other sources of income as compared to the majority of the resident population. The survey established that recent migrants would mainly attain land through purchasing though a few would be allowed to rent land. It was further established that apart from Shikomoli village, migrants attain land of the same quality as residents, and that migrants and rights are not circumscribed in any way.

Apart from Ichuga/Gathumbi village, the other villages reported that persons not resident in the village own land. Such land is used in a variety of ways. In Ekero village the land is open to use by the community on condition that the owner has primary user rights to it. In Shikomoli, Thegenge/Gatondo, Kiambii, Gatagati, and Irigithathi the land is used by relatives of the owner. In Chegulo and Irigithathi the land is rented to other farmers. Some non-resident land owners in Chegulo just let the land lie fallow. It was established that majority of the non-resident landowners reside in the major, urban areas and in the capital city of Nairobi.

The study found out that it is only in the village of Irigithathi where farmers regularly put part of their land in fallow, with 50% of the farmers letting part of their land lie fallow. The farmers reported that during the last ten years the fallow periods have become shorter. However, this was not the case in Shikomoli village where no change in the fallow period was reported. The above scenario shows that apart from Irigithathi village availability of land reserves and land frontier is exhausted and the fields are permanently cultivated throughout the cropping season. In Irigithathi village the main reason cited for letting the land lie fallow was short term fallowing for soil fertility rehabilitation.

Occurrence of landless households was reported in all the villages save for Shikomoli and Chegulo villages. The number of landless households ranged from a high of 150 households in Thegenge/Gatondo village to a low of 3 households in Ichuga/Gathumbi and Kiambii villages. Of the landless households a big proportion are female headed and eke a living through providing agricultural labour to the other households.

In the villages of Munyuki, Ichuga/Gathumbi, Kiambi, Gatondo/Thegenge and Gatagati the main reason for landlessness was cited as land scarcity. In Irigithathi village the reason advanced for landlessness was migration which has led to forfeiting of usufructal land rights. In Gatagati village, lack of income preventing cultivation of land leading to forfeiting of usufructal land rights was also cited as another reason for landlessness. In Gatagati village, lack of income preventing cultivation of land leading to forfeiting of usufructal land rights was also cited as another reason for landlessness. In Ekero, Munyuki, Mukuyu, Thengenge/Gatondo, Ichuga/Gathumbi and Gatagati villages, it was found out that women loose their land upon divorce and this was cited as a major factor in he phenomenon of landlessness particularly among the female headed households. Karugia (2003) found out that in the villages of Shikomoli, Ekero, Chegulo and in the Abaluhya households in Munyuki and Mukuyu, the land tenure system discriminates against women in the acquisition and ownership of land. According to the Abaluhya customs land belongs to men. In these villages women experience tenure insecurity and this impacts negatively on agricultural production and intensification. In the villages in Nyeri, women enjoy equal rights (apart from the divorcees). The extent of landlessness and the reasons thereof are summarized in Table 6.

Table 6: Landless Households and Reasons for Landlessness

Village	**Estimated landless households**	**Female Headed Landless Households%**	**Landless who provide agricultural labour of**	**Reasons**
Ekero	36	99%	39%	Women loose their land upon divorce/widowhood
Munyuki	20	40%	60%	Land scarcity
Mukuyu	10	90%	10%	Women loose their land upon divorce/widowhood
Thegenge/Gatondo	150	87%	60%	Land scarcity, Women loose their land upon divorce/widowhood

Ichuga/Gathumbi	3	40%	80%	Land scarcity
Kiambii	3	0%	33%	Land scarcity
Gatagati	60	66%	95%	Lack of income prevents cultivation of land, leading to forfeiting of usufruct land rights. Women loose their land upon divorce/widowhood
Irigithathi	100	70%	80%	Migration has led to forfeiting of usufruct land, leading for forfeiting of usufruct land rights.

Source: Field Survey, 2008

It is implicitly assumed that individual land tenure system imply a strong incentive to improve land productivity. As a result of secure land tenure, it is believed that social stability will follow, capital accumulation in agriculture will take place, a rural credit and land market will develop and long-term investments in agriculture will become attractive.

5.0 Agricultural Dynamism: Agro-ecology and Environmental Problems

This section considers the agro-ecological and environmental problems that have implications on agricultural intensification. The section zeroes in on irrigation, water harvesting, rainfall conditions and environmental problems.

5.1 Irrigation

Irrigation is important for agricultural intensification especially in areas of inadequate rainfall. Out of the ten sampled villages four of them (namely Shikomoli, Ekero, Mukuyu and Kiambii) practiced no irrigation, however rudimentary. The percentage of cultivated land under irrigation was highest in Gatagati village where 70% of the land under cultivation was reported to be under irrigation. The percentage of cultivated land under irrigation is shown in Table 7.
Cultivated

Table 7: Land under Irrigation in the Sampled Villages

Village	Mean land (%) under irrigation, 2002	Cultivated land (%) under irrigation, 2008
Shikomoli	0.00	0
Ekero	9.87	0
Chegulo	0.26	1
Munyuki	0.16	1
Mukuyu	0.61	0
Thegenge/Gatondo	19.22	3
Ichuga/Gathumbi	6.11	10
Kiambii	0.69	0
Gatagati	67.52	70
Irigithathi	60.22	10

Source: Karugia, 2003 and Field Survey, 2008

As depicted in Table 7, since 2002 the land under irrigation has decreased in the villages of Ekero, Mukuyu, Thegenge/Gatondo, Kiambii and Irigithathi while it has slightly increased in the villages of Chegulo, Munyuki, Ichuga/Gathumbi and Gatagati. In the villages of Chegulo and Munyuki, the highest level of management regulating irrigation was small scale, farmer constructed, water control devices managed by individual households. In the villages of Ichuga/Gathambi, Thegenge/Gatondo, Gatagati and Irigithathi irrigation management was small scale, farmer constructed, water control devices managed by associations of households at local level. The slight increase in irrigated land was attributed to associations of small-scale farmers constructing water control devices and judiciously managing them.

Results presented in Table 7 show that most of the small holder farmers in the sampled villages have not invested in irrigation. Irrigation investments are a basic component of agricultural intensification. Investments in irrigation were a basic component of the Asian Green Revolution. There is potential for irrigation expansion in the surveyed villages which is far from utilized. It is this under-utilized potential that holds some promise for the future in Kenya, given its possibly greater need for irrigation due to serious problems of erratic and inadequate rainfall, high evapotranspiration and climate change.

5.2 Rain Water Harvesting and Rainfall Conditions

Rainwater harvesting, an important aspect of harnessing water was not reported in any of the ten sampled villages. In most of the surveyed villages, rainfall amounts were reported to be average for the three consecutive seasons (2005 to 2008) as shown in Table 8.

Table 8: Rainfall Conditions in the Sampled Villages

Village	Season before the most recent one	Two seasons before the most recent one
Shikomoli	Above average	Above average
Ekero	Above average	average
Chegulo	Above average	average
Munyuki	average	average
Mukuyu	Above average	Above average
Thegenge/Gatondo	Below average	average
Ichuga/Gathumbi	Average	average
Kiambii	Below average	Below average
Gatagati	Average	Average
Irigithathi	Below average	Average

Source: Field Survey, 2008

Historically, inadequate rainfall has been one of the main limiting factors in African agriculture. Rainfed agriculture cannot be sustained in areas where rainfall conditions are average or below average given the changing weather patterns associated with climate change. Given the above scenario where some villages reported below average rainfall conditions, there is need to devise alternative means of enhancing water availability such as irrigation and water harvesting. As noted earlier irrigation and water harvesting hold some promise for enhancing agricultural productivity and intensification in Africa.

5.3 Environmental Conditions

Apart from Irigithathi village all the other nine villages reported that soil mining was a rampant problem. The problem of soil erosion was reported in the five villages in Kakamega and in Gatagati village in Nyeri. The other four villages in Nyeri have put in place soil conservation measures and hence, the problem of soil erosion was not seen as a serous one. Deforestation as an environmental problem was reported in the villages of Ekero, Chegulo, Munyuki, Mukuyu and Gatagati. Mukuyu and Munyuki villages are in areas where the government ordered the de-gazettement of parts of the former government forest land in Lumakanda location of Lugari District. Gatagati village is on the fringes of Mount Kenya forest and deforestation is bound to be a serious problem through encroachment in a bid to get more land for agriculture.

Other environmental problems reported in the villages include planting of eucalyptus trees making the rivers dry up, problem of waste disposal, water pollution from the jaggeries, air pollution from Webuye Pan Paper mills, destruction of crops by wild animals, water and air pollution from the coffee factories, rivers generally drying up and water levels lowering. These environmental problems are summarized in Table 9.

Table 9: Environmental Problems in the Sampled Villages

Village	Environmental problems
Shikomoli	Soil mining, soil erosion, eucalyptus trees making rivers dry up
Ekero	Soil mining, soil erosion, deforestation, urban waste disposal
Chegulo	Soil mining, soil erosion, deforestation, water pollution from jaggeries
Munyuki	Soil mining, soil erosion, deforestation, air pollution from paper mill
Mukuyu	Soil mining, soil erosion, deforestation,
Thegenge/Gatondo	Soil mining, destruction of crops from wild animals
Ichuga/Gathambi	Soil mining, water pollution from coffee factories
Kiambii	Soil mining, rivers drying up
Gatagati	Soil mining, deforestation, water pollution
Irigithathi	Water levels in rivers lowering

Source: Field Survey, 2008\

The problems reported in Table 9 are as a result of a number of factors. Soil mining which refers to continuous cropping without fertilizing (nutrient exhaustion) is being experienced in virtually all the villages due to small land parcels resulting from high population pressure and lack of resources to buy soil fertility replenishing inputs. Poor farming practices are responsible for soil erosion. In some villages farmers might even not be aware of the importance of soil conservation. Deforestation is as a result of encroachment into forestland in a bid to get more land for agriculture. The above reported environmental problems have very serious implications on agricultural productivity and intensification. Environmental degradation has been a main limiting factor in sub-Saharan agriculture.

5.4 Cattle Grazing

In all the surveyed villages it was observed that zero grazing was the most important made of grazing cattle. They are either tethered, put in pens or stall fed. Grazing on common pasture (road side grazing) was reported in Thegenge/Gatondo and Kiambii villages. Grazing of cattle on individual fields was reported in Chegulo and Munyuki villages. Similarly, the small stock are also tethered, penned or stall fed, in all the villages surveyed. However, in Kiambii village the small stock is also grazed on common

pasture (usually on the road side and forest areas). Grazing on individual fields for the small stock was reported in Chegulo village. Grazing of cattle and small stock on land which is subjected to short fallow was only reported in Irigithathi village.

In half of the villages surveyed, the cattle and small stock are kept for household uses (consumption, provision of manure etc), while in four villages, they are kept f or commercial purposes (milk for sale or sale of live animals). However, in Mukuyu village cattle and small stock are kept for saving purposes. None of the villages reported the use of animals for draught purposes. The issues of open access (common grazing land being open to outsiders) and pastoralists having the possibility of grazing their stock on harvested fields in exchange for dung were not reported in any of the ten villages surveyed.

Cattle provide manure which can be used for fertilizing the soil and consequently enhance agricultural productivity. Cattle keeping should be encouraged especially for poor households which cannot afford chemical fertilizers.

6.0 Other Significant Factors Affecting Agricultural Intensification

6.1 Credit Availability

In all the surveyed villages farmers reported that there are opportunities for them to obtain credit. A number of institutions extend credit to the farmers as shown in Table10.

Table 10: Credit Providers in the Surveyed Villages

Village	Credit provider
Shikomoli	Government agencies (incl. SACCOS), Micro-credit institutions, rotation saving clubs/self-help groups (RoSCA) Private money lenders, family/friends)
Ekero	formal banking system, Government agencies (incl. SACCOS), NGOs/donors (incl. SACCOS), Co-operatives. Micro-credit institutions, Rotation saving clubs/self-help groups (RoSCA) Private money lenders, Family/friends)
Chegulo	Formal banking system, Government agencies (incl. SACCOS) Micro-credit institutions, family/friends, Village GPS coordinates
Munyuki	Formal banking system, government agencies (incl. SACCOS), Micro-credit institutions
Mukuyu	Micro-credit institutions, rotation saving clubs/self-help groups, others
Thegenge/Gatondo	Formal banking system, Government agencies (incl. SACCOS), NGOs/donors (incl. SACCOS), Co-operatives. Micro-credit institutions, Rotation saving clubs/self-help groups (RoSCA) Private money lenders, Family/friends
Ichuga/Gathambi	Micro-credit institutions, Family/friends, Village GPS coordinates
Kiambii	Co-operatives. Micro-credit institutions, Rotation saving clubs/self-help groups (RoSCA) Family/friends.
Gatagati	Government agencies (incl. SACCOS), Co-operatives. Micro-credit institutions Rotation saving clubs/self-help groups (RoSCA) Family/friends.
Irigithathi	Government agencies (incl. SACCOS), Micro-credit institutions, Rotation saving clubs/self-help groups (RoSCA), Family/friends

Source: Field Survey, 2008

Credit is an important aspect in agricultural productivity and intensification. Credit has been found to be one of the institutional factors that affect agricultural intensification.

Apart from the villages of Thegenge/Gatondo, Ichuga/Gathambi, Kiambii and Gatagati, the other six villages reported that credit is available for staple food production for the farmers. Land title deeds, cattle, and household assets were reported to be the most important collateral required to obtain credit for staple food production (Table11).

Table 11: Collateral Required to Obtain Credit for Staple Food Production

Village	Collateral required
Shikomoli	Land title deed, Other assets
Ekero	Land, cattle, Deposits, Other assets
Chegulo	Harvest, Land other assets
Munyuki	Land
Mukuyu	Cattle, Other assets
Irigithathi	Land, Cattle, Other assets

Source: Field Survey, 2008

6.2 HIV/AIDS Prevalence

HIV/AIDS has been known to affect agricultural productivity through labour loss and diversion of agricultural resources to care for the infected. In all the ten surveyed villages the severity of the problem of HIV/AIDS was reported to be modest though the percentages given show that the problem could be serious. The percentage of households in the villages (or the wider area) affected by HIV/AIDS is summarized in Table 12.

Table 12: HIV/AIDS Prevalence in the Surveyed Villages

Village	HIV/AIDS Prevalence (%)
Shikomoli	20
Ekero	20
Chegulo	25
Munyuki	36
Mukuyu	05
Thegenge/Gatondo	08
Ichuga/Gathambi	10
Kiambii	10
Gatagati	5
Irigithathi	3

Source: Field Survey, 2008

In all the villages surveyed, HIV/AIDS prevention programmes were reported to be there. VCT centres and NGOs dealing with HIV/AIDS were reported to be very active in all the ten villages.

The relatively high HIV/AIDS prevalence in some of the surveyed villages has implications on labour availability for agricultural production. Apart from environmental constraints labour has been seen as one of the main limiting factor in Sub-Saharan Africa agriculture.

6.3 Contract Farming

In the villages of Ekero, Chegulo, Thegenge/Gatondo, Ichuga/Gathambi, Gatagati and Irigithathi contract farming and presence of out-grower schemes were reported. The number of contract farming companies and out-grower schemes ranged from one (in the villages of Ekero, Chegulo and Irigithathi) through three (in the villages of Thegenge/Gatondo and Ichuga/Gathambi) to a maximum of five (in Gatagati village). It was observed that the contract farming and the out-grower schemes do not target staple food production. They target non-food cash crops and other food crops. In the Kakamega villages the contract farming and out-grower schemes target the growing of sugarcane while in the villages of Nyeri they target the growing of horticultural crops (flowers, snow peas, French beans etc) and the growing of tea and coffee. The proportion of farmers engaged in contract farming ranged from a paltry 3% in Ekero village to 98% in Thegenge/Gatondo village. The proportion of female farmers engaged in contract farming ranged from 0% in Ekero village to 80% in Thegenge/Gatondo and Irigithathi villages. The number of contract farming companies and out-grower schemes, proportion of farmers engaged in contract farming and the proportion of female farmers engaged are depicted in Table 13.

Table 13: Number of Out-grower Schemes and Proportion of Farmers and Females Involved in Contract Farming

Village	No. of out-grower schemes	Proportion of farmers	Proportion of female farmers
Ekero	1	3	0
Chegulo	1	80	10
Thegenge/Gatondo	3	98	80
Ichuga/Gathambi	3	15	5
Gatagati	5	60	67
Irigithathi	1	15	80

Source: Field Survey, 2008

It was observed that the out-grower companies provide a number of services and inputs to the contract farmers, which include provision of seeds, fertilizers, pesticides, quality control and confirmation of standards, land fumigation and preparation, irrigation, extensions, credit and other services and inputs. It was established that the produce from the contact farming was destined for markets in the capital city of Nairobi, other major urban markets and export markets.

The villages of Shikomoli, Ekero, Thegenge/Gatondo, Ichuga/Gathambi, and Gatagati reported that contract farmers were still in the villages even in 2002. the number present today and who were still there in 2002 ranged from one to two. This information on contract farming is summarized in Table 14.

Table 14: Services/inputs Provided by Out-grower Schemes, Destination of Produce and Out-grower Schemes Present in 2002 and Still Present to Date

Village	Services provided	Destination of produce	No. of out-grower schemes present in 2002 and today
Ekero	Seeds, Fertilizer	Sugar factories	1
Chegulo	Fertilizer, Quality control, Credit	Sugar factories & jaggeries	1
Thegenge/Gatondo	Seeds, Fertilizer, Pesticides, Quality control and confirmation of standards, Land fumigation/preparation, irrigation, credit.	Capital city, export market	1
Ichuga/Gathambi	Seeds, fertilizer, pesticides, quality control and confirmation of standards, land fumigation/preparation, irrigation.	Export market	1
Gatagati	Seeds, Quality control and confirmation of standards, extension	Capital city, export market	2
Irigithathi	Seeds, fertilizer, Pesticides, quality control and confirmation of standards, land fumigation/preparation, extension.	Capital city, other major urban markets, export	0

Source: Field survey, 2008

Table 14 shows that Outgrower schemes provide quite a number of services which target cash and not staple food crops. This scenario does, not provide incentives for farmers to intensify production of food staples.

7.0 Staple Crops: Availability and Access to Varieties

7.1 Availability of Maize Seed Varieties

All the ten surveyed villages reported that farmers use hybrid maize varieties, and that farmers were presently acquiring new hybrid maize varieties. New hybrid maize varieties were reportedly being acquired from government agencies, local government, out-grower schemes and private traders. Private traders were the main suppliers of hybrid maize varieties as they did this in all the surveyed villages. This information is summarized in Table 15.

Table 15: Suppliers of Hybrid Maize Varieties in the Surveyed Villages

Village	Supplier of hybrid maize	Main supplier
Shikomoli	Private traders	Private traders
Ekero	Government agencies (MOA), local government & private traders	Private traders
Chegulo	Private traders	Private traders
Munyuki	Private traders	Private traders
Mukuyu	Private traders	Private traders
Thegenge/Gatondo	Private traders	Private traders
Ichuga/Gathambi	Private traders	Private traders

Kiambii	Government agencies (MOA), private traders	Private traders
Gatagati	Private traders	Private traders
Irigithathi	Private traders	Private traders

Source: Field Survey, 2008

In all the villages, save for Shikomoli and Ekero, it was reported that farmers recycle old hybrid maize (i.e. use harvested maize as seed the following season). The farmers reported that even in 2002 they were acquiring new hybrid seed. It was further established that even in 2002 the main supplier of new hybrid maize seed was the private trader. However, in Ekero village, the main supplier then was an out-grower company called Mumias Outgrower Company (MOCO). Apart from Irigithathi which reported a decline in the use of hybrid maize varieties since 2002, all the other villages reported an increase. The use of OPV maize varieties was reorted only in Irigithathi village and it was the only village which was reported to be acquiring new improved OPV maize seed. The farmers acquired new improved OPV maize seed from private traders, who also happened to be the main suppliers. Shikomoli and Irigithathi villages reported that in 2002 the farmers were using improved OPV maize varieties. However, the use of OPV maize varieties in Shikomoli has been abandoned. It is evident that OPV maize varieties are not popular with the farmers. In the year 202, the main supplier of new improved OPV maize seed was reported to be the private trader.

Shikomoli, Kiambii and Irigithathi villages reported a decrease in the use of OPV maize varieties since 2002, while the rest of the villages reported no change since they had not embraced the use of OPV maize varieties.

All the surveyed villages reported that improved maize seed was readily available when needed. However, the villages of Chegulo, Kiambii, Ichuga/Gathumbi and Irigithathi the farmers reported that improved maize seed is not available at the promised quality. All the villages reported that the required amounts of improved maize seed was always available. The distances to the nearest outlet for improved maize seed varied from village to village with the longest distance being 5 kilometres.

The most common units for retail of maize seed were 2 kg packets and 10 kg bags. In Munyuki and Mukuyu villages (villages of virtually maize monoculture) the 10 kg bags dominted while in the rest of the villages the 2 kg packets were the most dominant. The minimum price of a 2 kg packet of hybrid maize seed ranged from ksh. 210 in Irigithathi village to ksh. 350 in kambii village. The maximum price ranged from ksh. 280 in Irigithathi and Shikomoli villages to ksh 420 in Kiambii village. The minimum and the maximum prices of hybrid maize seed are shown in Table 16.

Table 16: Minimum and Maximum Prices of Hybrid Maize Seed

Village	Unit for retail sale	Minimum price (ksh)	Maximum price (ksh)
Shikomoli	2 kg	280	280
Ekero	2 kg	280	350
Chegulo	2 kg	280	350
Munyuki	10 kg bag	1330	1400
Mukuyu	10 kg bag	1260	1400
Thegenge/Gatondo	2 kg	280	350
Ichuga/Gathambi	2 kg	280	350
Kiambii	2 kg	350	420
Gatagati	2 kg	280	350
Irigithathi	2 kg	210	280

Source: Field survey, 2008

In Irigithathi village where improved OPV maize seed was in use, the minimum price of a 2 kg packet was ksh. 350, while the maximum was ksh. 420. in all the villages surveyed, the respondents reported that maize seed was not subsidized. Respondents in Shikomoli, Ekero, Chegulo and Gatagati said that the price of improved maize seed had not changed since 2002. those in Munyuki and Mukuyu said that improved maize seed is cheaper today compared to year 2002, while those in Thegenge/Gatondo, Ichuga/Gathumbi, Kiambii and Irigithathi villages said seed is more expensive today. These responses on seed costs as compared to 2002 are shown in Table 17.

Table 17: Price Changes of Improved Maize Seed Since 2002

Village	Price changes since 2002
Shikomoli	No change
Ekero	No change
Chegulo	No change
Munyuki	Cheaper today
Mukuyu	Cheaper today
Thegenge/Gatondo	More expensive
Ichuga/Gathambi	More expensive
Kiambii	More expensive
Gatagati	No change
Irigithathi	More expensive

Source: Field Survey, 2008

The results presented in Tables 15 through 17 point to availability and access to improved maize varieties in the surveyed villages. However, it is important to bear in mind other agronomic and economic constraints that farmers face in their efforts to increase productivity and to intensify their agricultural practices.

7.2 Marketing of Maize

Marketing of maize was reported in the villages of Chegulo, Munyuki and Mukuyu. The marketing channels varied from village to village. In Chegulo the farmers sold their maize at the village market and in markets outside the village. In Munyuki the main marketing channels were selling at the farm gate and through the state marketing board (the NCPB). In Mukuyu, farmers reportedly marketed their maize at the farm gate. Brokers and middlemen were also reported as other channels through which farmers sell their maize.

The maximum price of 100 Kg of maize in the closest market outside the village ranged from 33 USD through 37 USD to 40 USD. These price ranges show a very high variability. The maximum and minimum prices in USD/100 kg of maize in the surveyed villages are shown in Table 18.

Table 18: Minimum and Maximum Maize Prices in the Surveyed Villages.

Village	Minimum price in USD/100 Kg	Maximum price in USD/100kg
Shikomoli	20	33
Ekero	17	37
Chegulo	13	33
Munyuki	13	33
Mukuyu	13	33
Thegenge/Gatondo	13	40
Ichuga/Gathumbi	22	40
Kiambii	20	40
Gatagati	20	40
Irigithathi	15	40

Source: Field survey, 2008.

The distances to the closest market outside the village where farmers sold or bought maize ranged from 1 Km to 20 Km, and the costs of transporting 100 Kg of maize to the markets were 1 USD and 2 USD in all the surveyed villages. This information on distance to the closet market and transport costs are shown in Table 19.

Table 19: Distance to the Closest Market and Cost of Transport.

Village	Distance to the closest market (Km)	Cost of transporting 100 Kg of maize (USD)
Shikomoli	3	2
Ekero	1	1
Chegulo	7	2
Munyuki	3	1
Mukuyu	1	1
Thegenge/Gatondo	6	2
Ichuga/Gathumbi	5	2
Kiambii	1	1
Gatagati	20	2
Irigithathi	6	2
Mean	5.3	1.6

Source: Field Survey, 2008

In the villages of Chegulo and Munyuki it was reported that selling through brokers and middlemen was the most dominant mode of disposing maize, while in Mukuyu selling at the farm gate was the most dominant channel. Villagers in Chegulo, Munyuki and Mukuyu reported having been in the maize trade even in 2002. Compared to 2002 the farmers said that the average price of maize has increased.

The marketing of maize at the farm gate, and through brokers and middlemen implies that there are some constraints (infrastructural, institutional and policy) that hinder proper marketing. Selling at the farm gate and through brokers and middlemen also point to the existence of undeveloped markets and unless markets are properly developed, farmers will have no incentives to raise their agricultural productivity and to intensify their agricultural practices.

7.3. Availability of Cassava Varieties.

The use of improved, CMV-resistant, early bulking cassava varieties was reported in only three villages (Ekero, Munyuki and Mukuyu). Farmers in these villages reported that they acquired improved cassava cuttings principally from Government Agencies (MOA). The MoA through its extension arm was reported to be the main supplier of improved cassava cuttings. Four villages (Ekero, Chegulo, Munyuki and Mukuyu) reported use of improved cassava varieties in 2002. However, Chegulo village seems to have abandoned cassava growing. Improved cassava cuttings in 2002 were being supplied by the Government Agencies (MoA). The villages of Shikomoi and all the five in Nyeri reported no change in the use of improved cassava varieties since 2002. The farmers said that they have never embraced cassava growing practice. However, in Ekero and Munyuki villages the use of improved cassava varieties has decreased since 2002.

The major multiplication points of cassava varieties were found to be own farm (in the villages of Ekero and Mukuyu), in fellow farmers farms (Chegulo village) and non-village sources (KARI stations) in Munyuki village. The CMV was reported in the villages that grew cassava in 2002. The CMV prevalence rate was estimated as follows: Ekero (20%), Chegulo (95%), Munyuki (50%) and Mukuyu (60%). In the villages of Chegulo and Ekero, the farmers said that fresh improved cassava cuttings were available when needed, but this was not the case in Munyuki and Mukuyu. Farmers in Ekero and Mukuyu villages reported that improved cassava cuttings are available at the promised quality, while those in Chegulo and Munyuki reported the contrary. Apart from Mukuyu village the other three villages (Ekero, Chegulo and Munyuki) reported that the required amounts of improved cassava cuttings are available. The distances to the nearest retail outlet for cassava cuttings varied from village to village, for Ekero it was 1 Km, Chegulo (7 kms), Munyuki (3 kms) and Mukuyu (80 kms). In all the villages that grew cassava, improved cassava cuttings were said to be subsidized.

The above scenario, does not augur well for food security since Cassava is a famine crop. Inorder to enhance food security famine crops such as cassava, sweet potatoes yams etc should be popularized.

7.4 Marketing of Cassava

In the villages of Ekero and Mukuyu farmers reported that they sell their cassava. The produce is sold at the farm gate and also in markets outside the village. In the surveyed villages the minimum price of 100 Kg of cassava was USD 12 in the closest market outside Chegulo village. The maximum price of USD 53 of Cassava was reported in the closet market outside Shikomoli village. The distance to the closest market outside the villages, the minimum and maximum prices of 100 kg cassava are summarized in Table 20.

Table 20: Minimum and Maximum Cassava Prices and Distance to the Closest Market Outside the Village.

Village	Minimum price USD/100 KG	Maximum price USD/100 KG	Distance to closest market (km)
Shikomoli	43	53	3
Ekero	30	45	1

Chegulo	12	30	7
Munyuki	33	42	2
Mukuyu	30	33	1
Thegenye/Gatundo	33	43	5
Ichuya/Gathumbi	30	37	3
Kiambii	25	33	5
Gatagati	25	40	2
Irigithathi	30	40	6

Source: Field Survey, 2008.

In Ekero and Mukuyu villages it was reported that the cost of transporting 100 kg of cassava to the nearest market outside the villages was 1 USD. However, the farmers said that selling at the farm gate was the dominant channel of marketing cassava. It was only in these two villages (Ekero and Mukuyu) where selling of cassava was reported to have been taking place even in the year 2002. On how the average price of cassava has changed since 2002, the surveyed villages reported no change.

The selling of cassava at the farm gate and the static prices of cassava point to undeveloped markets. These undeveloped markets do not act as incentives for farmers to increase cassava production.

7.5 Availability and Marketing of Rice.

In all the surveyed villages the farmers reported that rice is not grown and consequently they were not acquiring improved rice seed. The farmers further said that even in the year 2002 they were not growing rice and consequently there was no change in the use of improved rice varieties in the villages. The farmers however, buy rice in the closest markets outside the villages. The maximum and the minimum buying price in USD/100 kg of rice are show in the Table 21.

Table 21: Maximum and Minimum Buying Price of Rice in the Surveyed Villages

Village	Minimum price USD/100 Kg	Maximum price USD/100 kg
Shikomoli	105	190
Ekero	105	190
Chegulo	105	190
Mukuyu	105	190
Thegenge/Gatondo	105	190
Ichuga/Gathumbi	100	185
Kiambii	100	185
Gatagati	100	185
Irigithathi	100	185
Mean	102.5	187.5

Source, Field Survey, 2008.

The surveyed villages neither grew nor sold rice in the year 2002 and the farmer said that the average price has remained unchanged since 2002.

7.6 Availability and Marketing of Sorghum.

In the villages of Ekero, Chegulo, Munyuki and Mukuyu farmers reported that they use improved sorghum varieties. They acquired the improved sorghum varieties from Government agencies (MoA). However, in Chegulo village private traders also supplied the improved sorghum varieties. Apart from Ekero village where the main supplier of improved sorghum varieties was the private trader, the other three villages reported that Government agencies (MoA) were the main suppliers. All the surveyed villages reported that farmers did not use improved sorghum varieties in the year 2002. the villages of Ekero, Chegulo, Munyuki and Mukuyu reported an increase in the use of improved sorghum varieties since 2002 while the rest reported no change. Improved sorghum varieties were reportedly available when needed in the villages of Ekero, Chegulo and Munyuki, however, the farmers in Mukuyu village said that they are not available when needed.

The four villages that grew sorghum reported that improved sorghum seed is available at the promised quality. Save for Mukuyu, the other three villages reportedly said that the required amounts of improved sorghum seed are available. Table 22 gives a summary on distance to the nearest retail outlet for improved sorghum seed, most common unit for retail sale of sorghum seed, price of improved sorghum seeds, subsidy and changes in price since 2002.

Table 22: Summary Table on Various Aspects of Improved Sorghum Seed in the Surveyed Villages

Village	Distance to nearest retail outlet (Km)	Most common unit (packet)	Price (USD) min		Subsidy	Price changes since 2002
Ekero	1	2 kg	1	2	No subsidy	More expensive
Chegulo	10	2 kg	4	5	Subsided	No change
Munyuki	3	2 kg	4	5	No subsidy	No change
Mukuyu	14	2 kg	4	5	No subsidy	More expensive

Source: Field survey, 2008.

Apart from Ekero village, the farmers in the surveyed villages did not sell their sorghum. In this village sorghum is sold in markets outside the village. The prices, distance to the closest market, cost of transport and changes in changes in the average price of sorghum since 2002 are summarized in Table 23.

Table 23: Price, Distance and Cost of Transporting Sorghum in the Surveyed Villages

Village	Price (USD) minimum		Distance to nearest market (Km)	Transport cost/100kg (USD)	Price changes since 2002
Shikomoli	50	60	3	-	Increased
Ekero	45	60	1	1	Increased
Chegulo	42	50	7	2	Increased
Munyuki	50	58	3	-	Increased
Mukuyu	50	58	1	-	Increased
Thegenge/Gatondo	50	58	6	-	Increased
Ichuga/Gathumbi	50	58	5	-	Increased
Kiambii	50	58	1	-	Increased

Gatagati	50	58	2	-	Increased
Irigithathi	50	58	6	-	Increased

Source: Field survey, 2008

The high costs of improved sorghum seed varieties and lack of subsidized seeds coupled with the long distance to the sorghum markets may have acted as disincentives for farmers to adopt improved sorghum growing.

7.7 Marketing of other Main Food Crops and Vegetables.

The surveyed villages reported that they grew other main food crops and vegetables apart from maize. These include beans (which are grown in the villages of Shikomoli, Ekero, Munyuki, Mukuyu, Gatondo/Thegege and Ichuga/Gathumbi) sweet potatoes (Chegulo village), Irish potatoes (Kiambii village) and vegetables (grown in Gatagati and Irigithathi villages). Some of the farmers market these food crops through various channels. Table 24 gives a summary of the main food crops and vegetables grown, marketing channels, cost of transporting one unit o the food crop and the market channel that dominate the market for these food crops.

Table 24: Crops Grown, Marketing Channels and Costs of Transport of other Food Crops in the Surveyed Villages

Village	Other main food crop	Marketing channels	Cost of transport/100 kg (USD)	Dominant market channel
Shikomoli	Beans	Not marketed	-	-
Ekero	Beans	Not marketed	-	-
Chegulo	Sweet potatoes	Brokers and middlemen	2	Farmers sell their produce in markets outside the village
Munyuki	Beans	Farmers sell the produce at the farm gate, Farmers sell the produce in the village market, Farmers sell their produce in markets outside the village	1	Brokers and middlemen
Mukuyu	Beans	Farmers sell the produce at the farm gate, Farmers sell the produce in the village market, Farmers sell their produce in markets outside the village	2	Brokers and middlemen
Thegengi/Gatondo	Beans	Not marketed	-	-
Ichuga/Gathumbi	Beans	Not marketed	-	-
Kiambii	Irish potatoes	Farmers sell the produce at the farm gate, Farmers sell their produce in markets outside the village	2	Farmers sell the produce at the farm gate

Gatagati	Vegetables	Farmers sell the produce at the farm gate, Farmers sell the produce in the village market, Farmers sell their produce in markets outside the village	2	Farmers sell the produce at the farm gate
irigithathi	Vegetables	Farmers sell the produce at the farm gate	2	Farmers sell the produce at the farm gate

Source: Field survey, 2008

The survey further established that the farmers in these villages were still selling these food corps and vegetables in 2002. In Shikomoli village the price of beans were reported said to have remained unchanged since 2002. The price of vegetables in Gatagati and Irigithati villages were reported to have decreased since 2002. However, the prices of beans (in the other villages) and sweet potatoes (in Chegulo) were said to have increased since 2002.

7.8 Marketing of Non-food Cash Crops

The farmers in the surveyed villages also grew non-food cash crops which they sold through a number of channels as shown in Table 25. However, Munyuki village did not grow non-food cash crops.

Information on marketing channels, costs of transport and how the price of these non-food cash crops has changed since 2003 is summarized in Table 25.

Table 25: Non-food Cash Crops Grown, Marketing Channels, Transport Costs and Price Changes Since 2002 in the Surveyed Villages

Village	Non-food cash crop grown	Marketing channels	Transport costs USD/100Kg	Dominant market channel	Price change since 2002
Shikomoli	Tea	Through state marketing boards, Farmer's groups/organizations	20	Farmers groups/organizations	Decreased
Ekero	Sugarcane	Through Outgrower schemes, other specify.	8	NGO/Donor projects	Increased
Chegulo	Sugarcane	Through Outgrower schemes, other specify.	8	Through Outgrower schemes	Decreased
Munyuki	-	-	-	-	-
Mukuyu	Coffee	Farmer's groups/organizations	2	Farmers groups/organizations	Decreased
Thegengi/Gatondo	Tea	Through Outgrower schemes Farmer's groups/organizations	25	Through Outgrower schemes	Unchanged
Ichuga/Gathumbi	Coffee	Farmer's groups/organizations	17	Farmers groups/organizations	Increased
Kiambii	Coffee	Farmer's groups/organizations	18	Farmers groups/organizations	Increased

Gatagati	Vegetables and fruits for export	Through Outgrower schemes,	4	Through Outgrower schemes	Increased
Irigithathi	Vegetables and fruits for export	Farmers sell the produce at the farm gate, export companies	9	Farmers sell the produce at the farm gate	Decreased

Source: Field survey, 2008

8.0 Fertilizer Access

All the surveyed villages reported that the farmers use chemical fertilizers in their farming. Chemical fertilizer was said to be available when needed in the correct and affordable amounts. However, farmers in two villages (Ekero and Mukuyu) reportedly said that chemical fertilizer is not available in the correct and affordable amounts. Chemical fertilizer is provided by Government agencies (MoA), farmer organizations or cooperatives, private traders and Outgrower schemes. In all the surveyed villages the main provider/ supplier of chemical fertilizer was reported to be the private trader. The distances to nearest outlets for chemical fertilizers ranged from a minimum of 1 Km to a maximum of 10 Km. Chemical fertilizer is mainly sold using 50Kg bags. The minimum and maximum prices of 1 Kg of various types of chemical fertilizers in USD are summarized in Table 26.

Table 26: Prices of Various Types of Chemical Fertilizers in the Surveyed Villages.

Village	**UREA**		**DAP**		**NPK**		**CAN**	
Shikomoli	1	1	1	1	-	-	1	1
Ekero	1	1	1	1	-	-	1	1
Chegulo	1	1	1	2	-	-	1	2
Munyuki	1	2	1	2	1	2	1	2
Mukuyu	1	2	1	2	1	2	1	2
Thegenge/Gatondo	1	2	1	2	1	2	1	2
Ichuga/Gathumbi	1	2	1	2	1	2	1	2
Kiambii	1	2	1	2	1	2	1	2
Gatagati	1	2	1	2	1	2	1	2
Irigithathi	1	2	1	2	1	2	1	2

Source: Field Survey, 2008

Unavailability of chemical fertilizers in some villages, supply of the same by the private trader (who is out to maximize profits), long distances to marketing outlets, lack of subsidized fertilizers and high costs as compared to 2002 are important constraints to increased staple food production. Lack of access to and affordability of chemical fertilizers are among the most important constraints to agricultural intensification among small holder farmers in Kenya. Some types of chemical fertilizers are not available in certain villages. NPK was not available in the villages of Shikomoli, Ekero and Chegulo. TSP was reportedly not available in all the surveyed villages. The surveyed villages overwhelmingly reported that chemical fertilizer is not subsidized. The farmers reported that they were using chemical fertilizer in 2002, with the private traders being the main supplier even then. All the farmers in the surveyed villages said that chemical fertilizer is more expensive now as compared to 2002.

9.0 Agricultural Techniques

Farmers in the surveyed villages practiced a wide range of agricultural techniques. Crop rotation was practiced in the villages of Ekero, Chegulo, Thegenge/Gatondo, Gatagati and Irigithathi intercropping was being practiced in all the villages and so was intercropping with nitrogen fixing crops (beans, legumes, etc). Fallowing as an agricultural technique was reported only in Irigithathi village. No village practiced improved fallowing. Other agricultural techniques widely practiced by almost all the farmers in the surveyed villages include use of animal manure, soil and water conservation; improve planting practices, agro forestry and use of pesticides and herbicides. The agricultural techniques employed by the farmers in the surveyed villages are summarized in Table 27.

Table 27: Agricultural Techniques Practiced in the Surveyed Villages.

Village	Agricultural techniques practiced
Shikomoli	Intercropping, Intercropping with nitrogen fixing crops(beans, legumes etc), animal manure, Zero or minimum tillage, Soil and water conservation (level bunds, grass strips, terracing etc, Agro forestry, pesticides/herbicides
Ekero	Crop rotation, intercropping, intercropping with nitrogen fixing crops (beans, legumes etc) Animal manure, Breaking the hard pan, Soil and water conservation (level bunds, grass strips, terracing etc), improved planting practices, integrated (soil) nutrient Management (INM), Agro forestry, Pesticides/herbicides.
Chegulo	Crop rotation, intercropping, intercropping with nitrogen fixing crops (beans, legumes etc), Animal manure, Green manure/compost/residue incorporation, Soil and water conservation (level bunds, grass, strips, terracing etc), improved planting practices, Agro forestry, Pesticides/herbicides
Munyuki	Intercropping, intercropping with nitrogen fixing crops (beans, legumes etc).Animal manure, Green manure/compost/residue incorporation, soil and water conservation (level bunds, grass strips, terracing etc), improved planting practices, agro forestry, pesticides/herbicides
Mukuyu	Intercropping, intercropping with nitrogen fixing crops (beans, legumes etc), animal manure, Breaking the hard pan, Green manure/compost/residue incorporation, Soil and water conservation (level bunds, grass strips, terracing etc) improved planting practices, Integrated (soil) nutrient management (INM), Agroforestry, Pesticides/herbicides
Thegenge/Gatondo	Crop rotation, intercropping, intercropping with nitrogen fixing crops (beans, legumes etc), animal manure, soil and water conservation (level bunds, grass strips, terracing etc) improved planting practices, soil and water conservation (level bunds, grass strips, terracing etc), improved planting practices, agroforestry, pesticides/herbicides
Ichuga/Gathumbi	Intercropping, intercropping with nitrogen fixing crops (beans, legumes etc), animal manure, soil and water conservation (level bunds, grass strips, terracing etc),Agroforesty, pesticides/herbicides
Kiambii	Intercropping, intercropping with nitrogen fixing crops (beans, legumes etc), animal manure, Soil and water conservation (level bunds, grass strips, terracing etc), Agroforestry, pesticides/herbicides

Gatagati	Crop rotation, intercropping, intercropping with nitrogen fixing crops (beans, legumes etc), animal manure, Breaking the hard pan, improved planting practices, agroforestry, pesticicdes/herbicides
Irigithathi	Crop rotation, intercropping, intercropping with nitrogen fixing crops (beans, legumes etc),fallowing, animal manure, zero or minimum tillage, soil and water conservation (level bunds, grass strips, terracing etc) improved planting practices, Integrated (soil) Nutrient Management (INM), Integrated Pest Management (IPM), Agroforestry, Pesticides/herbicides.

Source: Field survey, 2008

In the villages of Ekero, Chegulo, Munyuki, Mukuyu and Irigithathi, farmers reported that tractors are available for hire. Drying floors and modern grain stores were reportedly not available in all the surveyed villages. Processing equipment such as rice, mills, cassava greater and cassava peeler/chipper were said to be unavailable in all the surveyed villages. However, maize mills were said to be available in all the villages except Chegulo, Thegenge/Gatondo and Kiambii.

It is important to note that with high population growth and land degradation there is a growing shortage of land in the surveyed villages. As a result, farmers gradually are turning to various practices and strategies aimed at more intensive land use. These include, in particular crop rotation, intercropping, use of animal manure, soil and water conservation and use of herbicides. Less common strategies include breaking the hard pan, integrated nutrient management and integrated pest management. In the case of some of these strategies, such as use of tractors for ploughing and value addition techniques, it appears the main motivation behind their adoption is not land use intensification, perse, but rather the desire to obtain higher returns to labour. Nevertheless, these practices have a positive impact on yields.

It is worth mentioning also that the adoption of some of these practices, such as the use of green manure and the cultivation of perennials in agroforestry systems, is being promoted by extension agencies working in the villages. However, this study found out that adoption levels for some of these practices are very limited in some villages. The study points to a number of factors operating at both the farm household scale and the regional scale that influence farmer strategy and the adoption of these more intensive practices. Consistent with findings elsewhere (Shriar, 2000) these factors relate to the need to intensify, perceived benefits or disbenefits of intensification and diversification and available household resources.

10.0 Extension Services

All the surveyed villages reported that extension services are currently available to the farmers. Extension services were reportedly being directed to staple food crops, other food crops and vegetables, non-food cash crops, cattle, small stock, fowls and bee-keeping. In Shikomoli village the key informant reported that extension services target certain categories of villages mainly the progressive farmers.

In all the surveyed villages, it was established that the government agencies (MoA) were the main providers of extension services. The various extension service providers in the surveyed villages are shown in Table 28.

Table 28: Extension Service Providers in the Surveyed Villages

Village	Extension service Provider
Shikomoli	Government agencies (MoA), NGOs, farmers' organizations or co operatives, private traders
Ekero	Government agencies (MoA), NGOs, Farmers' organizations or co operatives, private traders
Chegulo	Government agencies (MoA), NGOs, Outgrower schemes, private traders
Munyuki	Government agencies (MoA), NGOs, private traders
Mukuyu	Government agencies (MoA)
Thegenge/Gatondo	Government agencies (MoA), farmers' organizations or co operatives, Outgrower schemes
Ichuga/Gathumbi	Government agencies (MoA), Outgrower schemes,
Kiambii	Government agencies (MoA), NGOs, farmers' organizations or co operatives
Gatagati	Government agencies (MoA), Outgrower schemes, private traders
Irigithathi	Government agencies (MoA), NGOs, Outgrower schemes, private traders

Source: Field Survey, 2008.

Information presented in Table 30 depict labour migration to the major urban areas. Population growth and poverty in many rainfed lands of Kenya have reached the point where serious land shortage and resource degradation is occurring. In the long term, migration and economic diversification will be needed to provide a better balance between people and natural resources. However, current trends in population and non farm employment are such that the absolute numbers of agriculturally dependent people will continue to grow. Therefore, the need to increase agricultural productivity and to diversify the sources of rural livelihoods is urgent.

Reliable nonagricultural sources of income will be a critical component of stable livelihood systems for most farmers. However, because agricultural growth is the prime driving force behind the rural nonfarm economy, inter regional migration and remittances are likely to provide the most important sources of nonfarm income.

It was established that the main provider of extension services (i.e Government agencies) also provided seeds (certified), herbicides, veterinary services and pest treatment services. Farmers in the surveyed villages also reported that they received various trainings ranging from integrated pest management, through value addition to business skills. These trainings are summarized in Table 29. It was established that farmers in the surveyed villages do not pay for extension services. Extension service was also reported to have been there even in the year 2002, and the main providers were government agencies (MoA). It was established that farmers did not ay for extension services even in the year 2002.

Table 29: Trainings Provided by Main Extension Service Provider (Government Agencies)

Village	Training provided by main Extension service provider
Shikomoli	Integrated pest management, planting practices, animal fattening, poultry-rearing, bee-keeping, business skills.
Ekero	Planting practices, processing, animal fattening, poultry-rearing, bee-keeping, business skills, standards, eg. EU production standards.
Chegulo	Integrated pest management, planting practices, processing, animal fattening, poultry-rearing, bee-keeping, business skills, standards, e.g EU production standards.
Munyuki	Integrated pest management, zero/minimum tillage, planting practices, processing.
Mukuyu	Integrated pest management, planting practices, processing, animal fattening, poultry-rearing, bee-keeping, business skills.
Thegenge/Gatondo	Planting practices, animal fattening, poultry-rearing, bee-keeping, business skills standards, e.g EU production standards
Ichuga/Gathumbi	Integrated pest management, zero/minimum tillage, planting practices, processing, animal fattening, poultry-rearing, bee-keeping, business sills, standards, e.g EU production standards.
Kiambii	Integrated pest management, zero/minimum tillage, planting practices, processing, animal fattening, poultry-rearing, bee-keeping, business skills, standards, e.g EU production standards
Gatagati	Integrated pest management, Zero/minimum tillage, planting practices, animal fattening, poultry-rearing, bee-keeping, business skills, standards, e.g. EU production standards
Irigithathi	Integrated pest management, zero/minimum tillage, planting practices, animal fattening, poultry-rearing, bee-keeping, standards, e.g EU production standards.

Source: Field survey, 2008

The information presented in Tables 28 and 29 point to a very vibrant extension sector providing a wide range of services. However, extension in Africa has been heavily criticized for being top-down, inefficient, resource demanding and blind to farmers' needs and local conditions, and has by some been seen as part of the problem of the low performance of African agriculture. Kenya has adopted a form of decentralized, demand-driven system of extension provision which seems flexible and open to farmer' needs. However, its success seems to be conditioned by a number of factors which are not immediately present in the Kenyan context.

11.0 Rural-Urban Linkages

In all the surveyed villages it was reported that people leave the villages to seek seasonal work in the urban areas. The number of villagers who do this per year ranged from 15 to 300. The proportion of these villagers who are female ranged from 55 to 70%. The destinations of these labour migrants include such urban areas as Nairobi, Naivasha, Kakamega, Webuye, Eldoret, Bungoma, Nyeri, Nanyuki and Karatina. It was reported that people who had permanently moved to urban areas do return to live in the villages especially after retirement. The number of persons who return to the villages from the urban areas every year ranged from 2 (in Chegulo village) to 110(in Gatagati village). The proportion of these returning migrants who were estimated to the females ranged from 0% (in Kiambii and Irigithathi villages) to 50%

(in Chegulo village). It was further established that the returning migrants come from the very major urban areas they had migrated to namely Nairobi, Naivasha, Kakamega, Webuye, Eldoret, Bungoma, Mombasa, Nyeri, Nanyuki and Karatina. This information on labour migration is summarized in Table 30.

Table 30: Information on Labor Migration in the Surveyed Villages

Village	Approx. No. of villagers who seek work in urban areas per year	% of villagers who are female	Important destinations	Approx. No of returning migrants	% of returning migrants who are female
Shikomoli	15	5	Nandi, Nairobi, Kakamega.	3	30
Ekero	50	20	Nairobi, Kakamega, Bungoma	10	30
Chegulo	40	10	Naivasha, Webuye, Eldoret	2	50
Munyuki	15	65	Nairobi, Eldoret, Nakuru	6	25
Mukuyu	50	20	Naivasha, Eldoret Nairobi.	4	25
Thegenge	125	60	Karatina, Nairobi, Nyeri	15	30
Ichuga	300	40	Nanyuki, Naivasha, Mweiga.	5	1
Kiambii	25	70	Chuka, Karatina, Kiamariga.	5	0
Gatagati	150	27	Nairobi, Nyeri Nanyuki	110	10
Irigithathi	200	60	Narumoru, Nanyuki, Nyeri	10	0

Source: Field survey, 2008

The food security threats presented in Table 29 and the strategies presented in Table 30 have a number of implications on agricultural productivity and intensification. They generally affect the farmers' capacity to produce in future.

12.0 Food Security Indicators

Apart from Munyuki and Mukuyu villages, all the others reported having received public food relief caused by food shortages at one time or another since 1980. The most important means of obtaining food in the villages were reported as own production and purchasing from the market. Famine crops were reportedly being cultivated in all the villages except Thegenge/Gatondo, Ichuga/Gathumbi, Gatagati and Irigithathi villages. The famine crops grown were cassava, sweet potatoes and yams. The length of the lean season ranged from 2 to 7 months, and farmers have to reduce the number of meals per day during the lean season. It was reported that farmers in the surveyed villages face a number of food security problems and threats as depicted in Table 31.

Table 31: Food Security Problems/Threats in the Surveyed Villages

Village	Major food security problems/threats
Shikomoli	Other natural hazards (floods, landslides, bush fires), thefts
Ekero	Other natural hazards (floods, landslides, bush fires), thefts, in-migration
Chegulo	Other natural hazards (floods, landslides, bush fires), post harvest losses
Munyuki	Prolonged dry spells, human epidemics, thefts, in-migration, post harvest losses
Mukuyu	Prolonged dry spells, human epidemics, thefts, post harvest losses
Thegenge/Gatondo	Animal pests and diseases
Ichuga/Gathumbi	Prolonged dry spells, unpredictability of weather (climate change)
Kiambii	Prolonged dry spells, animal pests and diseases
Gatagati	Prolonged dry spells, unpredictability of weather (climate change), crop pests and diseases, animal pests and diseases
Irigithathi	Prolonged dry spells, unpredictability of weather (climate change), thefts, post harvest losses

Source: Field Survey, 2008

These programmes have in some instances been found to undermine agricultural productivity. They encourage dependency where farmers become lazy, others sell all the food they have, in any case public relief food will come and in some instances public relief food is clandestinely diverted into the market depressing food prices.

Farmers in the surveyed villages cited a number of strategies that they employ to cope with threats to their food security. These strategies include inter alia: selling of crops, mortgaging of unharvested crops, selling of livestock, selling of portions of their land, selling of assets, labour, engaging in petty trade, collecting of wild fruits and hunting, relying on family support, food aid and out-migration. Selling of livestock, labour, engaging in petty trade and family support were cited as the most widely used strategies for coping with threats to food security. These strategies were reported by virtually all the villages.

Households in the surveyed villages also engage in a number of strategies to cope with actual food shortages. These strategies are summarized in Table 32.

Table 32: Strategies for Coping with Actual Food Shortages in the Surveyed Villages

Village	Strategies
Shikomoli	Consume less preferred/expensive food, sell animals, out-migration
Ekero	Consume less preferred/expensive food, out-migration
Chegulo	Consume less preferred/expensive food, out-migration
Munyuki	Consume less preferred/expensive food, sell assets
Mukuyu	Consume less preferred/expensive food, sell assets
Thegenge/Gatondo	Consume less preferred/expensive food, reduce the number of meals/limit portion sizes, purchase food, sell assets
Ichuga/Gathumbi	Consume less preferred/expensive food, reduce the number of meals/limit portion sizes, purchase food, sell animals
Kiambii	Consume less preferred/expensive food, sell assets
Gatagati	Consume less preferred/expensive food, reduce the number of meals/limit portion

	sizes, purchase food, sell animals
Irigithathi	Consume less preferred/expensive food, out-migration

Source: Field Survey, 2008

Apart from Munyuki the other villages reported that households, at various times since 1980, due to local food shortages have received public food relief and cash for food purchases. Apart from the food security threats reported in table 31 there are other factors that may affect food security necessitating food aid eg poor agronomic practices and environmental conditions. Other programmes that households have engaged in include food for work and cash for work. This information is summarized in Table 33.

Table 33: Programmes Villagers Engage in to Cope with Food Shortages

Village	Programme	Year
Shikomoli	Public food relief	2007
Ekero	Public food relief, cash-for-work	2005
Chegulo	Public food relief	2007
Munyuki	None	-
Mukuyu	Public food relief, cash-for-work	1980
Thegenge/Gatondo	Public food relief	2005
Ichuga/Gathumbi	Public food relief, food-for-work	1984
Kiambii	Public food relief	2008
Gatagati	Public food relief, cash-for-work	1984
Irigithathi	Public food relief, food-for- work, cash-for-work,	2007

Source: Field Survey, 2008

13.0 Gender Dynamics in Relation to Crops

Apart from Ekero, Ichuga/Gathumbi and Gatagati villages, all the other villages reported that there are crops that are considered “women crops”. These crops include sweet potatoes, indigenous vegetables bens, exotic vegetables, Irish potatoes, kales and garden peas. These crops are grown for subsistence and for sale. Equally, there are some crops that are considered “men crops”. These include maize, sugarcane, tea and coffee. In Irigithathi village, Irish potatoes, cabbages and carrots are considered “men crops”. These information on ‘women’ vis – a – vis ‘men’ crops is summarized in Table 34. The ‘men crops’ are mainly for cash.

Table 34: ‘Women’ and ‘Men’ crops in the Surveyed Villages

Village	Women crops	Men crops
Shikomoli	Sweet potatoes, vegetables,	Maize, tea, sugarcane
Ekero	-	Sugarcane
Chegulo	Indigenous vegetables	Sugarcane
Munyuki	Sweet potatoes, vegetables,	Maize
Mukuyu	Beans, vegetables,	Maize
Thegenge	Vegetables	Tea
Ichuga	-	Coffee
Kiambii	Irish potatoes	Coffee
Gatagati	-	-

Irigithathi	Beans, Kales, garden peas	Irish potatoes, cabbages carrots.

Source: Field survey, 2008.

As table 34 depicts Gatagati village is the only one where we do not have ‘women’ and ‘men’ crops. Men crops are the major cash crops grown in the country namely tea, coffee and sugarcane.

This disaggregation of crops into ‘women’ and ‘men’ crops has a number of implications on agricultural productivity and intensification. It is well known that female farmers, inspite of their crucial role in agricultural production, especially food production, are discriminated against in a variety of ways .their land tenure rights are less secure, they receive less extension services, and have less access to complementary inputs and credit.

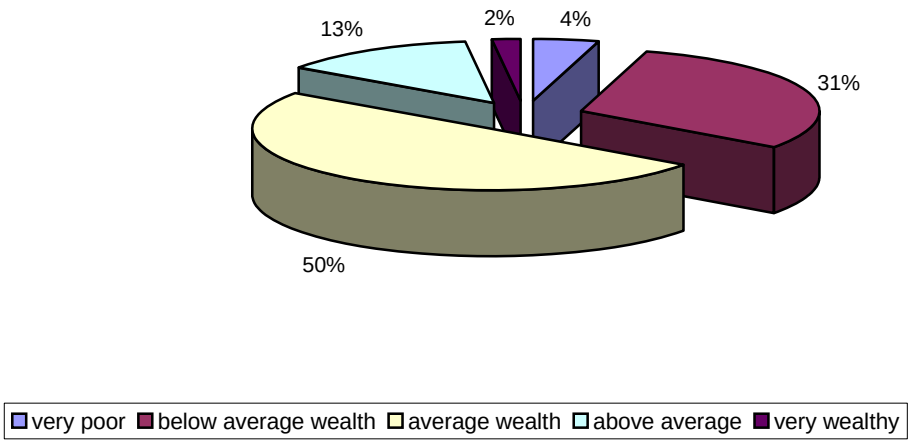
14.0 Household data analysis

14.1 Household Characteristics

Three hundred households were selected from Kakamega and Nyeri Districts. Most of the respondents were farm managers (67%), who were mostly male (65.3%). The farm mangers had an average age of 54 years old and had been to school for about 7.5 years. 81% of the households were male headed with an average age of 55 years. The main occupation of farm managers and household heads is farming. Most of the households were nuclear types (76%) while the rest were extended (8.7%), polygamous (4.7%), *de jure* female headed (5.7%), *de facto* female headed (1.7%).

Most of the households (88%) were the same ones that interviewed in 2002. The rest were as a result of attrition and selection of descendants of original households. For the reinterviewed households, 74% of the farm managers were the same person as 2002. The households were on average formed 24 years before the date of the interview. Half the number of households is of average wealth while the other half is considered to be of below average (31%), above average (13%), very poor (4%) and very wealthy (2%) as shown in the figure below.

Figure 1: Wealth profile



Source: Field survey, 2008

14.2 Trends in productivity changes

14.2.1 Changes in yields

The three main food staples (maize, sorghum, and cassava) were grown both in the recent seasons and when the households were formed. Maize is the most popular food crop grown by 96% and 94% of the households in the years 2008 and 2007 respectively. However, this is a reduction in the number of households growing in comparison with 2002 and the reference year. Sorghum has had the smallest proportion of farmers growing over the seasons and the proportion has declined drastically from 27% in the reference year to 3% and 7.7% in 2002 and 2008 respectively. None of the respondents grew rice. The proportion of respondents growing maize and cassava has generally increased during the last two seasons while that of sorghum recorded a drop as shown in the table below. The proportion of respondents growing other food crops, vegetables and cash crops has generally remained the same for the past 2 seasons, with the lowest being in the year 2002.

Table 35: Pattern of Crop production

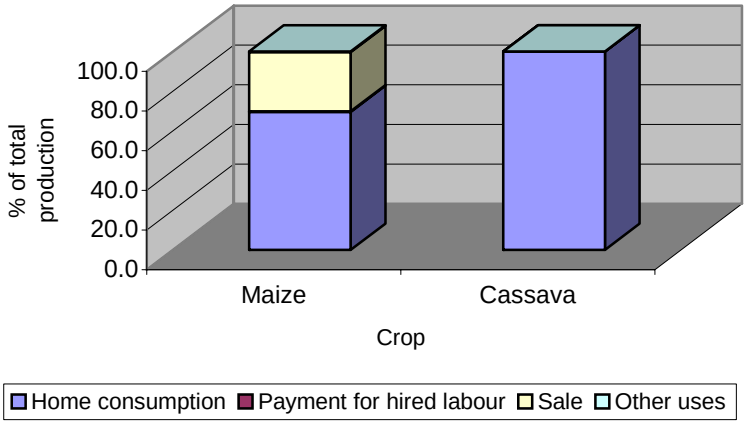
		Maize	Cassava	Sorghum	Other food crops and vegetables	Cash crops
% of responds growing	2008	96.3	31.3	7.7	93.0	56.0
	2007	93.7	30.7	8.7	93.3	56.0
	2002	99.3	2.7	3.0	100.0	56.3
	Ref year	97.7	33.7	27	92.7	45.0
Mean yields	2008	1419	243	243		
	2007	1735	306	306		
	2006	1937	267	267		
	2002	1749	1904	704		
	2001	1747	1625	744		
	2000	2244	1893	1027		
Yield comparison with year 2002 (%)	Decreased	69	5.3	17.3		
	Unchanged	23	2.3	13.3		
	Increased	8	1.3	0.3		
Yield comparison with Reference year (%)	Decreased	53	1.7	1.7		
	Unchanged	2.3	0.7	0.7		
	Increased	2.7	0	0.7		

Source: Field survey, 2008

The yields of main food crops have generally decreased during the last 3 growing seasons. Maize recorded the biggest drop in yields from 2.2 tons/ha in 2000, 1.9 tons/ha in 2006 to 1.4 tons/ha in 2008. This downward trend was also experienced between 2000 and 2002 cropping seasons. Cassava recorded a very sharp decline in yield from 1904 kg in 2002 to 243 kg in 2008. This is in agreement with the view of most of the farmers that yields of the main food crops have decreased in comparison with both 2002 and year when the households were formed. This drop in yields was reported despite the fact that more farmers are now using hybrid seed, soil fertility improvement practices and irrigation, which is expected to increase yields. The drop in yield is likely to be as a result of physical and environmental conditions other than farmers'agronomic practices.

The food that is produced is put in a variety of uses. Home consumption takes the biggest proportion of the total production. Cassava is grown purely for subsistence whereby the total output is consumed at home. Maize is produced mainly for subsistence where 69.6 % is used for home consumption. Maize is also the only food crop that has a considerable proportion of output that is sold whereby 29.9% is sold to different market outlets. A very small proportion (<1%) of the maize produced is used to pay hired labour or put to other uses (including seed, animal feed, brewing, gifts etc)

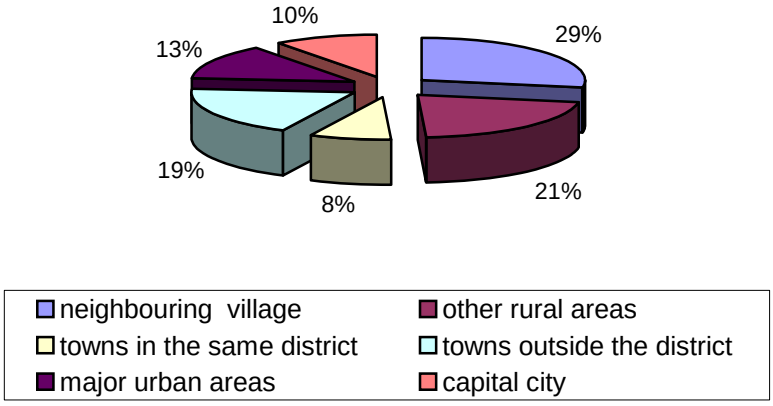
Figure 2: Distribution of output from food crops



Source: Field survey, 2008

Apart from the uses mentioned above, part of the staple food produced is shared with relatives living away from the farmers' villages. The staples are either sent out to the relatives (22.7 %) or the relatives come to the farms to collect (18.3 %). On average, 87.4 kg of maize, 3.1 kg of cassava and 0.7 kg of sorghum are given out to relatives annually.

Figure 3: Residence of relatives receiving staples



Source: Field survey, 2008

About 50% of the shared staples end up with relatives living in rural areas either in the neighbouring villages or far away villages. These relatives who reside in rural areas are also likely to be producers of similar or other food crops. This sharing goes a long way in maintaining the rural to rural and rural to urban linkages thereby increasing food availability to more households both in the rural and urban areas.

14.3 Technological change

Technologies associated with improvement of soil fertility are the most popular among other technologies used both in recent season and reference year. These technologies are crop rotation, intercropping with nitrogen fixing crops, animal manure, soil and water conservation, intercropping, IPM and agroforestry.

The growing of maize and sorghum is mostly intercropped while cassava is grown mainly as a pure stand. Irrigation is done only in maize where 14% of respondents irrigated on at least one half of the portion planted to maize. Irrigation of maize has enabled 74% of the farmers practicing it to harvest more than one maize crop per year. After harvesting the food crops, most of the land is used to grow more food crops.

There are more farmers using the various technologies during the recent season than they were in the 2002. The proportion of farmers practicing crop rotation, fallowing, intercropping with nitrogen fixing crops and animal manure increased between 2002 and 2008 while those practicing soil and water conservation declined during the same period.

Table 36: Technologies used by the farmers (% of the respondents reported)

	Maize		Cassava		Sorghum	
Technology	2008	2002	2008	2002	2008	2002
Pesticide	27.7	6	0.1	0	0.7	0.3
Crop rotation	54.0	48	5.8	0.7	6.0	1.3
Intercropping with N fixing crops	88.0	6.3	2.8		5.7	0.7
Fallowing	25.0	21.7	2.6	0.3	1.0	0.3
Improved fallowing	8.0		0.6		1.0	
Animal manure	91.3	80.7	6.5	0.3	6.7	0.7
Conservation tillage	0.0	4	0.0	0	0.0	0.3
Breaking the hard pan	68.0		1.2		2.7	
Manure/compost/residue incorporation	78.7	50.3	5.8	1.3	4.7	1
Soil and water conservation	62.7	75.7	1.2	1.3	2.7	1.7
Zero/minimum tillage	13.0		0.9		0.7	
Improved planting practices	47.7		0.5		0.7	
Intercropping	86.3	89.7	5.4	0.7	8.0	0.7
INM	52.0		0.5		0.7	
IPM	42.0		1.6		1.3	
Pesticides/herbicides	0.0	6	0.4	0	0.7	0.3
Agroforestry	66.7		2.5		3.3	
Traditional varieties	9.6	21.7		2	7.6	2.3
Improved varieties	3.3	1		1	0.3	0
Hybrid varieties	86.6	75.3		0	1	0
Unknown varieties	0.3	0.7		0	0.3	0
Hoe ploughing	75.6	69.3	19.3	2.3	8.3	2.7
Ox ploughing	22.3	26.7	23	0.3	1	0.3
Tractor ploughing	10.6	4	0	0	9	0
Irrigation	14.0	5	0.0	0	0.0	0

Source: Field survey, 2008

More farmers grow hybrid varieties than the improved and traditional varieties. The proportion of farmers growing hybrid maize varieties increased from 75.3% in 2002 to 86.6% in 2008. Most of this seed is purchased from the market. Most cassava and sorghum growers use the traditional varieties.

There is generally a high rate of knowledge about the different technologies. This is despite the fact that most of the farmers have never received any extension either from the government (57%) or NGOs (66%). Although extension services are available in all the sampled villages, the service does not cover all the farmers. Knowledge is mostly passed to the farmers from their parents and relatives. The most popular technology is intercropping which known and practiced by 98% of the respondents. Improved fallowing is the least known and practiced at 40% and 10% respectively. Minimum tillage although known by 56% of the farmers, it is only practiced by 18%.

Table 37: Technologies used and practiced by the farmers

Technique	Knowledge	Practice
Crop rotation	75.0	65.7
Intercropping	99.7	98.3
Intercropping with nitrogen fixing crops	95.3	95.7
Fallowing	85.0	27.7
Improved fallowing	39.3	10.3
Animal manure	98.3	97.0
Zero or minimum tillage	55.7	17.7
Breaking the hard pan	80.7	70.7
Manure/compost/residue incorporation	84.3	81.3
Chemical fertilizer	96.7	84.3
Soil and water conservation	81.7	64.0
Improved planting practices	60.3	48.0
INM	54.3	50.7
IPM	58.0	50.0
Agroforestry	79.0	69.7
Pesticides/herbicides	85.7	62.7
Rainwater harvesting	73.3	32.3
Irrigation	81.3	30.7

Source: Field survey, 2008

The use of chemical fertilizers is high with 84% of the farmers using it. According to the farmers, the use of chemical fertilizer in maize and sorghum has been declining over the years. Cassava farmers are now using chemical fertilizer, something that they did not do in the reference year.

There are 63% of farmers using of pesticides and herbicides in food crop production. However, their use has dropped during the recent seasons. Land preparation is done mainly using hoes while a few farmers use ox-ploughs. A few farmers use tractor ploughing but only in maize production.

14.4 Commercialization

The proportion of farmers selling food crops has not changed much during the recent 3 seasons. Maize leads in terms of the proportion of farmers selling followed by cassava. None of the respondents sold sorghum in 2002 and 2008 but a small proportion did sell in the reference year. The sale of food staples has provided 11.3% of the households with most of the cash generated during the past year.

Table 38: Market participation by households over five seasons

% Sold

Crop Year	2008	2007	2006	Ref. year	2002
Maize	31	31	30.3	34	23.3
Cassava	2	1.3	1.3	1	0.7
Sorghum	0	0.3	0	0.3	0
Rice	0	0	0	0	0

Source: Field survey, 2008

Commercialisation of food crops is very low with the produce being sold mainly at the farm gate and village markets. Only maize is sold to state marketing board and other markets. None of the food crops were sold on the basis of a pre-arranged contract with a private trader. Contract farming is found in cash crop farming (62.8%) and other food crops farming (4.3%).

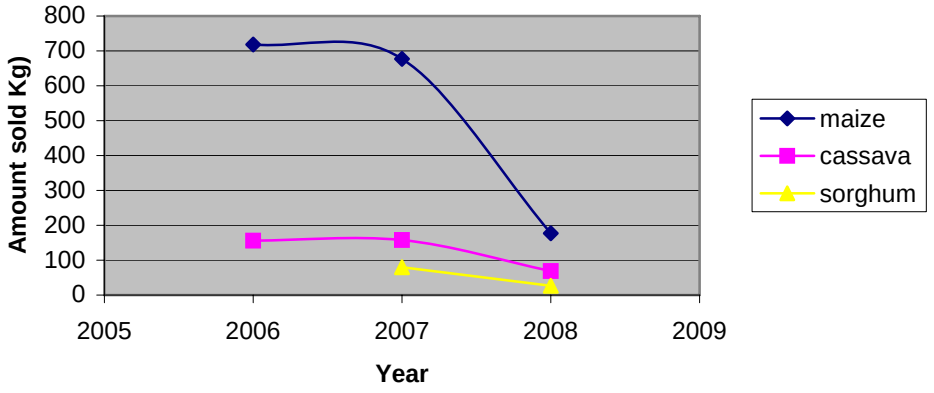
Table 39: Main marketing outlets for food staples (% of farmers selling)

	Maize	Cassava	Sorghum
Farm gate	14.3	1.3	0
Village market	10.3	0.7	0.3
Market outside the village	4.3	0.3	0
State marketing board	0.3	0	0
Others	1.3	0	0

Source: Field survey, 2008

In addition to low commercialisation of food crops, the amount of sales has been reducing over the years. The biggest drop in the amount of maize sold was between 2007 and 2008 where amount sold dropped from 677kg to 178kg. The drop in sales is likely to be as a result of a drop in yields during the recent 3 seasons. The other reason may be as a result of increased dependence on sale of other food crops, cash crops and animal products for most of the household income. Small quantities of sorghum are now sold to the market as compared to 2002 where none of the sorghum produced was sold.

Figure 4: Trends in amount of food staples sold



Source: Field survey, 2008

14.5 Income, expenditure and welfare

Farmers involve themselves in a number of activities to generate income. One of the most important sources of income is cash crop farming mainly tea, sugarcane, and coffee. Sale of non-food cash crops generated most cash for 46% of the households; sale of food staples and sale of other crops generated most of the cash for 11% and 30% of the household respectively. Sale of animal and animal produce generated most cash for 11% of the households. Sugarcane is considered the most profitable cash crop by majority of the farmers. Most farmers believe that prices of the most profitable cash crops have increased over the seasons.

Livestock farming constitutes another important source of income. The livestock kept are mainly cattle, sheep/goats, pigs and poultry. Most of the income from livestock is from sale of their products other than selling of the animals themselves.

Table 40: Income from various sources

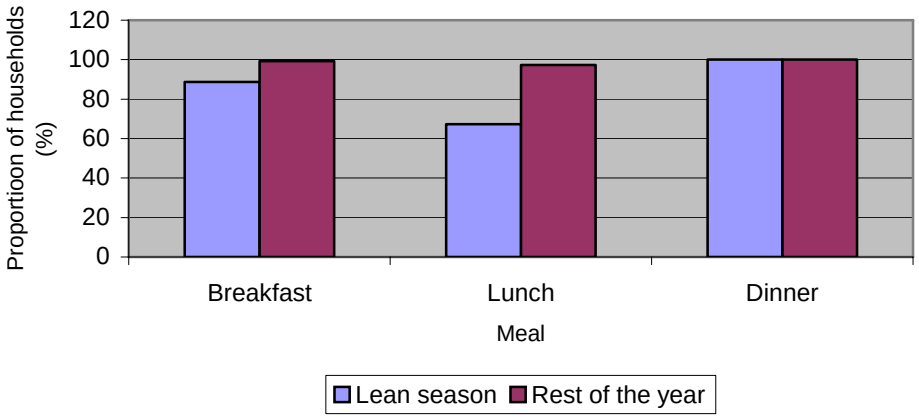
Source of income	Mean income (USD)	Std. Deviation
Sale of food staples	72.0	564.4
Sale of other food crops	343.2	732.9
Sale of non-food cash crops	421.5	1227.9
Sale of animals/animal produce	407.6	1041.9
Leasing out farm machinery and/or equipment	0.6	9.7
Work on others' farms /agricultural labour	75.9	419.3
Non-farm salaried employment	265.6	993.8
Micro business	64.9	493.1
Large-scale business	28.9	416.8
Rent, interest	11.7	175.6
Pensions	53.3	508.0
Remittances	39.8	180.2

Source: Field survey, 2008

Table 40 shows that the highest mean income was obtained from sale of agricultural commodities mainly cash crops, other food crops and animal and animal produce. The highest non-agricultural source of income was salaried employment. The income generated by the households is used for purchase of food staples and also reinvested back in the farms. Although rice is not cultivated by any of the sampled farmers, it is considered an important food crop whereby 93.3% of the families purchased rice. In Kenya, rice is grown in Mwea, Ahero and West Kano irrigation schemes, which were not considered in the current sample. At the same time, the largest proportion of consumed rice is imported. Maize is purchased by 63.3% of the households while 19.7% and 32.3% of the households purchased cassava and sorghum respectively.

Production for home consumption coupled with purchasing of food has enabled most households to take regular meals. All households have dinner both in the lean season as well as the rest of the year. Breakfast had a small drop in proportion of households taking during the lean season. The biggest drop is that of lunch where about 33% of the families reported not taking during the lean season.

Figure 5: Meal intake during different seasons



Source: Field survey, 2008

Part of households' income is spent in agricultural production. The highest proportion of the farmers belonged to the category of those who spent no money on agricultural inputs. On average, the proportion of households who spent no money in agricultural inputs increased from 42.2% in the year 2002 to 47.9% in 2008.

Table 41: Expenditure on Agriculture

	No cash outlay	A low/ small cost	A moderate cost	A very significant cost
Seed	3.7	9.7	27.7	59
Chemical fertilizer	9.3	5	9	76.7
Pesticides	28.3	3.3	17.7	50.7
Hired labour	46.3	6.7	34.3	12.7
Land rented	88	2.3	5	4.7
Machinery/implements for land preparation	78.7	5.3	11.3	4.7
Transport	56.7	9	22	12.3
Land improvement measures	72	10.7	13.7	3.7
Average in 2008 (%)	47.9	6.5	17.6	28.1
Average in 2002 (%)	42.2	18.2	16.9	22.6

Source: Field survey, 2008

The purchase of seed, chemical fertilizer and pesticides is considered to constitute a very high cost by a large proportion of the respondents. This is likely the reason why farmers reported a reduction in the use of these agricultural inputs. Some farmers spent no money in agricultural production. Most of the farmers had no expenditure mostly in machinery/implements for land preparation, renting land and land improvement measures (Conservation structures and irrigation). These are investments that are needed for long-term improvement in agricultural production.

Due to the high expenditure on food and agricultural inputs, 60% of the respondents had to borrow money to be able to cover their expenditures, an improvement since 2002 when only 35% of the households

could access credit facilities. This is important for the household since only 45% of them are able to save some money for their future needs.

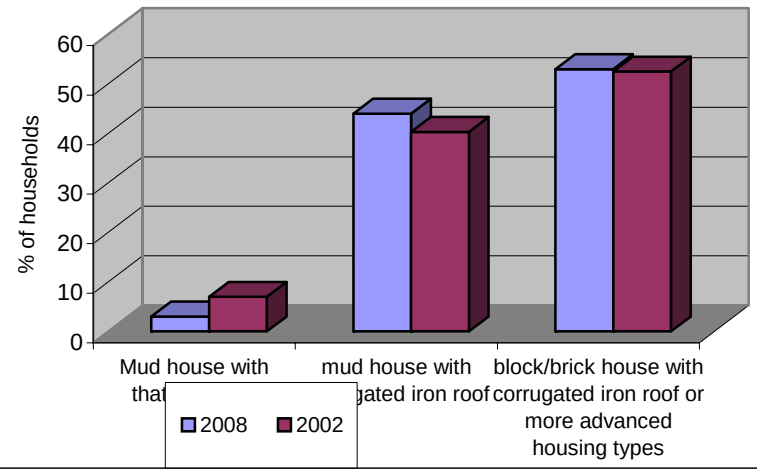
Apart from purchase of food and agricultural inputs, the households spent part of their income on a variety of assets to enhance their welfare. The most owned asset is mobile/stationery phone, radio, bicycle and battery torch. More households owned the assets in 2008 than they did in 2002 as shown in table 42.

Table 42: Assets owned by households

Asset	Year	
	2008	2002
Wired electricity	10.3	9.7
Mobile/stationery phone	59.7	8.4
Power generator	5	6.7
Piped water	28.7	22.7
TV set	45.3	29.3
Radio	95.3	91.3
Tape recorder	19.3	47.7
Bicycle	67.3	54
Sewing machine	11.7	19.3
Kerosene/modern stove	49.7	60
Battery torch	91.3	89

On average most of the households lived in improved housing both in 2002 and 2008. Few households still live in traditional mud houses with thatched roof and the proportion living in such houses recorded a decline from 7% in 2002 to 3% in 2008. This is an indication that households have good and improving standards of living with respect to housing standards.

Figure 6: Change in housing standards



14.6 Land resources

On average, the farmers were cultivating on 1.18 ha pieces of land. Those who were able to expand land under cultivation were able to put an extra 0.5 ha under cultivation. Most of the farmers feel that there has been no change in the size of land under cultivation since their households were formed.

Most of the farmers had inherited land already under cultivation. The land is individually owned by the households, with 96% of the farmers having full control over it. Control of the land is enhanced by the fact that 76% hold a formal title to their parcels of land. The farmers see an opportunity to expand the land under cultivation. According 81% of the farmers, the most appropriate means to expand farm size is either to rent or borrow land. The children are expected to obtain land by inheriting from their parents.

Irrigation is practiced by 24% of the respondents. These farmers have put 10% of the land owned under irrigation, which according to most of them is a reduction in amount of land irrigated as compared to the reference year. The main source of irrigation water for these farmers was mainly community owned irrigation system. Others were privately owned wells and privately owned river diversion.

14.7 Explaining intensification

Intensification was measured using a number of measures. Since maize was the most important crop grown in all the villages considered in the study, the discussion is couched mostly in terms of maize. The variables reflecting intensification that were considered include the use of chemical fertilizers, pesticides, choice of variety, irrigation, intercropping, manure and soil/water conservation. The variables that represented changes in yields were perception of yield increases since the year 2002 and since the households were formed. The results of the analysis are presented in the sections that follow.

14.7.1 Effects of intensification variables on maize yield and yield changes

The effects of indicators of intensification were analysed by correlating the intensification measures and yield and yield changes.

The correlation analysis results show that maize yields are positively and significantly associated with irrigation, variety, fertilizer and use of pesticides. This shows that the use of these technologies enables farmers to increase yields of maize. There is a negative association between yields and intercropping and use of manure meaning that the technologies had a negative effect on yield increases.

Table 43: Correlation coefficient between intensification variables and maize yields

	Irrigation	Variety	Fertilizer	Pesticide	Intercrop	Manure	Soil/water conservation
Yield	0.137*	.0194**	0.152**	0.116*	-0.049	-0.018	0.091
Yield (ref)	0.144	0.002	0.083	0.042	0.324	-0.06	-0.091
Yield (2002)	0.177**	-0.045	0.081	-0.072	0.141*	-0.035	-0.113

** or * indicates that the coefficient is statistically significant at 1% and 5% level, respectively

Source: Field survey, 2008

Most farmers reported a decrease in maize yields since the year 2002. The trend in yield since 2002 is positively and significantly correlated with irrigation and intercropping. The other technologies were not significant meaning that they did not influence the trend in yields since 2002. None of the technologies had significance influence on changes in yields since the reference year.

14.7.2 Labour factors affecting agricultural intensification

The result of the correlation analysis between intensification variables and household labour resources are represented in table 44. The results show that use of hired labour is positively and significantly associated with intensification measures of irrigation, variety, pesticide and fertilizer. The same intensification measures did not show any significant relationship with number of able workers in the family. It can be concluded that irrigation, variety, pesticides and fertilizer was found in those farms which rely on hired labour. The proportion of work done by the farm manager is positively associated with intensification variables. This may mean that when the farm managers do most of the work in the farm, chances are that they use more of yield enhancing technologies, probably because of the prior knowledge required for the use of these technologies. Use of exchange labour is positively associated with use of pesticides and fertilizers.

Table 44: Correlation coefficient between intensification variables and labour factors

	No of able workers	Occupation of manger	Hired labour	Exchange labour	% of work done by manager
Irrigation	-0.027	0.032	0.152**	0.016	-0.196**
Yield (ref)	0.181	0.395*	0.112		-0.103
Variety	0.032	0.03	0.270**	0.023	-0.177**
Pesticide	-0.014	-0.044	0.181**	0.149**	-0.193**
Fertilizer	0.053	-0.01	0.247**	0.120**	-0.197**

** or * indicates that the coefficient is statistically significant at 1% and 5% level, respectively

Source: Field survey, 2008

14.7.3 Institutional factors affecting agricultural intensification

Table 45 represents results of the correlation analysis between agricultural intensification variables and institutional factors. The results show that most of the institutional factors are positively associated with intensification of maize production, thus demonstrating their importance in the adoption of these technologies that are considered expensive. Membership to farmer group and agricultural credit are positively associated with irrigation, variety choice, use of pesticides and fertilizer. This means that these institutional factors provided the resources and the knowledge required for the use of the technologies. Irrigation which is a very expensive technology was positively and significantly correlated with NGO extension, membership to farmer group and credit. NGO rather than Government extension may have had influence on irrigation because NGOs were reported to be providing loans to the farmers in some villages.

Table 45: Correlation coefficient between intensification variables and institutional factors

	Government extension	NGO extension	Group membership	Credit	Control over land	How obtained land
Irrigation	0.027	0.248**	0.228**	0.197**	-0.082	0.308
Yield (ref)	-0.18	-0.057	-0.102	-0.015	-0.082	0.308
Variety	0.132*	0.085	0.190**	0.212**	-0.086	0.095
Pesticide	0.011	0.116**	0.115*	0.145*	-0.087	0.114
Fertilizer	0.073	0.103	0.163**	0.120*	-0.025	-0.01

** or * indicates that the coefficient is statistically significant at 1% and 5% level, respectively

Source: Field survey, 2008

14.7.4 Household and wealth factors affecting agricultural intensification

Table 46 shows the results of the correlation analysis of social and wealth factors that affect agricultural intensification. The results show that age is negatively but significantly correlated with irrigation. This means that older farmers are less likely to invest in irrigation. Education level was positively and significantly correlated with irrigation and variety meaning more educated farmers would be willing to invest in the technologies. Salaried employment was the highest non farm income source. However, non farm salaried employment did not show significant relationship with any of the intensification variables meaning that the income is used on other expenditures and not in the farm.

Table 46: Correlation coefficient between intensification variables and household social and wealth factors

	Age	Education level	Salaried employment	Micro business	Large scale business	Agricultural labour	rent/ interest	Pension	Remittances
Irrigation	-0.172**	0.180**	0.084	0.200**	-0.028	-0.071	-0.027	0.163**	-0.077
Yield (ref)	-0.143	0.004	0.179	0.255		0.098		0.276	0.024
Variety	0.025	0.153**	-0.014	0.05	0.0026	0.044	0.025	0.04	0.059
Pesticide	0.022	0.094	0.043	0.006	-0.01	-0.077	-0.028	0.027	0.238**
Fertilizer	-0.073	0.113	-0.056	0.028	0.06	0.095	-0.008	0.06	-0.019

** or * indicates that the coefficient is statistically significant at 1% and 5% level, respectively

Source: Field survey, 2008

14.7.5 Commercialisation factors affecting agricultural intensification

Commercialization of Agriculture is determined by the ease with which farmers can access markets. Measures of commercialization were correlated with intensification measures and the results are presented in table 47. Sale of maize, vegetables and animal produce are positively associated with intensification of maize production. It is clear that households that that have an opportunity to sell food staples, other food products and animal products will intensify their production. Although the sale of food staples generated the lowest income as compared to other agricultural commodities, the sale of maize had a significant influence on its intensification variables.

Farmers reported that maize prices have increased in comparison to the year 2002 and when the households were formed. However, the amount of maize that is sold is less now as compared to the year 2002 and when the households were formed. Access to market outlets for maize has also improved over the years for most of the farmers.

Table 47: Correlation coefficient between intensification variables and commercialization variables

	Sale of maize	Sale of vegetables	Sale of fruits	Sale of animal produce
Irrigation	0.083	0.262**	0.047	0.174
Yield (ref)	0.296	-0.008	0.118	0.126
Variety	0.138*	0.095	0.03	0.211**
Pesticide	0.155**	0.154**	0.058	0.072
Fertilizer	0.117*	0.143*	0.09	0.099

** or * indicates that the coefficient is statistically significant at 1% and 5% level, respectively

Source: Field survey, 2008

14.8 A causal analysis of adoption of chemical fertilizers, irrigation and pesticide technologies

The foregoing analysis highlights factors associated with intensification but does not indicate the magnitude of the influence of such factors. In this section a causal analysis is carried out to determine which factors determine agricultural intensification and their relative importance. Technology adoption is a key determinant of agricultural intensification. To analyse the effect of various socio-economic and institutional variables on technology adoption probit models were used to assess the influence of some selected variables on the adoption of fertilizers in maize, cash crops and other food crops production.

Results in table 48 show that variety of maize, proportion of land irrigated, wealth status and use of fertilizer on cash crops positively and significantly affect the adoption fertilizers in the farms. Farmers who irrigate a larger proportion of their farms, more wealthy and used fertilizer on cash crops were more likely to invest in fertilizer. Membership to farmer group and having registered land showed a significant but negative influence on use of fertilizer. Negative relationship between membership to farmer groups and use of fertilizer may mean that the groups were not offering services that are expected to enhance fertilizer use such as credit facilities and extension services. Most of the land was inherited, individually owned registered giving the farmer full control over it. This may be the reason why control over land may have had no effect in use of fertilizer.

Table 48: Probit model of factors affecting adoption of fertilizers among farmers

Variable	Coefficient	Std Error	t
Constant	-0.14872	0.562349	-0.264
Distance to village center (km)	-0.00347	0.014454	-0.24
Variety of maize	0.484668***	0.140367	3.453
Proportion of land irrigated (%)	0.645168**	0.277887	2.322
Advice from extension staff	0.283064	0.176325	1.605
Membership to farmer group	-0.57649*	0.305178	-1.889
Agricultural input credit	0.452322	0.329998	1.371
Land registration	-0.55623**	0.25599	-2.173
Source of farm income	-0.12823	0.115142	-1.114
Wealth rank	0.265274*	0.140577	1.887
Use of fertilizer on cash crops	0.000535**	0.000238	2.25

***, **, * Indicates that the coefficient is statistically significant at 1%, 5% and 10% level, respectively.

Source: Field survey, 2008

Table 49 shows that the factors that were significant in adoption of fertilizer in maize production were variety of maize, farm income generating most cash, wealth ranking and having a non farm salaried employed. The variety of maize grown had a positive influence on the use of fertilizer in that those who grew improved varieties were more likely to use the fertilizers than those who planted local varieties. Wealth ranking positively influenced use of fertilizer in maize production in maize production in that wealthy farmers are more likely to invest in purchasing fertilizers. Non-farm salaried employment had a negative influence on use of fertilizer in maize production, which may mean that such income is not used in purchasing fertilizer.

Table 49: Probit model for factors affecting adoption of fertilizers in maize

	Coefficient	Std. error	t
Constant	-1.90116***	0.654137	-2.91
Land status	0.307787	0.199748	1.54
Proportion of land that is irrigated (%)	0.177604	0.134992	1.32
Variety of maize	0.813051***	0.146069	5.57
Farm income generating most cash	-0.2164**	0.099959	-2.16
Wealth ranking	0.229836*	0.11961	1.92
Remittances	-0.0005	0.000474	-1.06
Salary	-0.00026***	9.82E-05	-2.65
Distance to the village center (km)	-0.09908	0.105115	-0.94
Household type	0.001382	0.081289	0.02

***, **, * Indicates that the coefficient is statistically significant at 1%, 5% and 10% level, respectively.

Source: Field survey, 2008

Table 50 shows that the factors that were significant in adoption of pesticides were irrigation, variety and the farm income that generated most cash. Pesticides were considered to be very significant cost by 51% of the farmers. Use of irrigation and proper choice of variety ensured farmers of better yields thus were more willing to invest in pesticides. Although the sale of food staples generated most cash for 11% of the households, their sale had a positive influence on the use of pesticides.

Table 50: Probit model for factors affecting adoption of pesticides in maize

Variable	Coefficient	Standard Error	t
Constant	-2.66042	1.19567**	-2.225
Distance to the village centre	0.095811	0.115223	0.832
Irrigation	0.515434	0.27233**	1.893
Variety	0.715485	0.386777**	1.85
Extension	0.14144	0.14808	0.955
Membership to farmer group	0.075989	0.316756	0.24
Agricultural input credit	0.408322	0.315567	1.294
Control over land	-0.09679	0.115343	-0.839
Farm income generating most cash	-0.41988	0.128584***	-3.265
Salary	-0.0002	0.000146	-1.391
Wealth ranking	0.073066	0.132444	0.552

***, **, * Indicates that the coefficient is statistically significant at 1%, 5% and 10% level, respectively.

Source: Field survey, 2008

From table 51 it is noted that membership to a group, credit for agricultural input and income obtained from sale of cash crops positively and significantly influenced the adoption of fertilizer in cash crop farming. Some form of credit facilities were available in all the sampled villages mostly provided by micro credit institutions. The credit has increased the use of fertilizer in cash crop production. 6 villages reported to have contract farming/out grower schemes for agricultural produce. Most of these schemes target non-food cash crops and provide, among other inputs fertilizers. Membership to such schemes may have increased the use of fertilizer in cash crop farming. Income from the sale of the cash crops may have

a positive influence on use of fertilizer meaning that income is reinvested back in the production of the cash crops.

Table 51: Probit model for factors affecting adoption of fertilizers in cash crop farming

Variable	Coefficient	Standard Error	t
Constant	-0.61209***	0.16988104	-3.603
Total land under irrigation (ha)	0.153118	0.44873128	0.341
Extension	0.039046	0.12827055	0.304
Membership to farmer group	0.464545**	0.22471262	2.067
Credit	0.564497**	0.23736574	2.378
Control over land	0.000778	0.00078745	0.988
Income source generating most cash	-0.01571	0.04003167	-0.393
Income from cash crop farming	0.000608***	0.00015287	3.977

***, **, * Indicates that the coefficient is statistically significant at 1%, 5% and 10% level, respectively.

Source: Field survey, 2008

According to the results in table 52, selling of fruits, availability of agricultural input credit and the income from the sale of other food crops had a positive and significant influence on the use of fertilizer on other food crops. Selling of fruits and other food crops increased the adoption of fertilizer in their production. It appears that the income from the sale of the food crops is in turn invested in acquiring the technologies required for their production. This suggests that availability of a ready market would be a good incentive for farmers to adopt yield enhancing technologies such as fertilizers.

Table 52: Probit model for factors affecting adoption of fertilizers in other food crops

Variable	Coefficient	Standard Error	t
Constant	1.00164***	0.346849	-2.888
Sell of other food crops	0.385271	0.383313	1.005
Sell of fruits	0.485087*	0.258367	1.878
Irrigation on other crops	0.302659	0.92602	0.327
Contract	7.639367	191224	0
Other cash crops	-0.00026	0.000189	-1.379
Extension	0.143804	0.131934	1.09
Membership to farmer group	0.410354	0.251856	1.629
Credit	0.544743**	0.257159	2.118
Control over land	0.000657	0.000923	0.711
Source generating most income	-0.0511	0.041815	-1.222
Income from sale of other food crops	0.000551**	0.000237	2.321
Wealth ranking	0.162923	0.109173	1.492

***, **, * Indicates that the coefficient is statistically significant at 1%, 5% and 10% level, respectively.

Source: Field survey, 2008

15. Conclusions and Policy Recommendations

The results of this study reveal a range of condition that must exist for Kenya to rise agriculture and food productivity and achieve a sustainable green revolution. Key agricultural inputs remain an important condition to intensification. The use of these inputs will require knowledge and skills for them to give required output. This means that farmers need to be well educated. Extension services will play a major role in equipping the farmers with the required knowledge in use of inputs within the prescribed recommendations. Investment in research will also play an important role in availing technologies that will suit the different needs of the farmers. Research and extension services should play the critical role in promoting production of food crops such as rice whose demand is quite high while its production remains very low.

Increased productivity requires the developments of efficient markets. Market outlets provide the incentive for farmers to invest in yield enhancing technologies. If agricultural products remain within the village precincts, agricultural intensification will not occur since production will remain mostly for subsistence needs other than for sale to outside markets. Markets need to be within easy reach of the farmers. Well-developed input markets will also ensure regular supply of quality inputs in order to enhance intensification. Transport and ware house facilities are therefore important in a market oriented agriculture. Developing the markets will require heavy investment in infrastructure such as roads, storage facilities, communication systems, electricity etc.

Investing in agricultural inputs is expensive and farmers need a credit system in order to finance their purchase. Agricultural production is seasonal while consumption income is needed throughout the year. Farmers need credit to overcome cash flow problems so as to minimize sale of staples at harvest time when the prices are very low and later buy back when prices are higher. Efficient pricing policies are important in stabilizing both input and output prices so that farmers are assured of good returns from their farming activities. Non-food cash crops, non-staple food crops and livestock farming have the potential to provide high incomes to most farmers and their production and marketing needs to be strengthened.

Land tenure systems and other institutions that give rights to ownership and control over use of land need to be strengthened in order to guarantee farmers that the income generated will accrue to them. Women who provide most of the family's labour in he farms rarely get the chance to make any decision on farm resource use and management.

16.0 Bibliography

Karugia, J.T (2003). A micro-level Analysis of Agricultural Intensification in Kenya: The case of Food staples: A report submitted to Lund university, Sweden.

Kenya, Republic of, (1997). National Development Plan, 1997-2001, Government printers, Nairobi.
Nyiira, M.Z. (1987). "Policy Structures and crop productivity in Third World countries" Agricultural Administration and Extension, 27, 1- 11.

Odhiambo, W. (1998). Productivity, Market orientation and agricultural intensification: A comparative analysis of smallholder farmers in Meru and Machakos districts of Kenya. Verlag Ulrich E. Grauer. Stuttgart.

WB (2008). World Development report 2008: Agriculture for development. The WB, Washington, DC.

17.0 Annexes

Focus group discussion participants

Ekero village

Name	Designation	Telephone contact
Dunstan Isieminye	Teacher	0711366694
Francis Chimeyi	Business man	01710591614
Roselida Ogutu	Development crops officer	0737500285
Kayetano Wesonga	Elder	0737955038
Fredrick Ateya Opwora	Asst. Chief	0733274727

Shikomoli village

Name	Designation	Telephone contact
Simeon Odanga	Church leader	0723595272
Peter M. Noyi	Livestock Development	0735278504
Shimekha Hardley	Teacher	0727208233
John Mushivoji	Business man	0724148100
Benjamin O. Azianji	Asst. Chief	0722634501

Chegulo village

Name	Designation	Telephone contact
Imbiauhal L.	Village elder	
Philip K. Chirchir	D.A.E.O	0722934569
Priscillah Naliaka	Social services	0713032272
Samson Otinga	-	0710933096
Margaret Pichisindays	---	0721549571
Hezron F. Barasa	Teacher	0726458338
Haron M. Soita	Asst. Chief	0723653318

Munyuki village

Name	Designation	Telephone contact
Meshack Buronya	Secretary/village elder	0725318977
Protas Musonga	Crops officer	0723141474
Mark Milimo	Chairman	0722544808
Mary Shabaya	Women leader	0713836780
Sosnes B. Imbadu	Teacher	0725206571
Allan Maiguma	Senior elder	0727135336
Erick Kuion	Farmer	20605417

Mukuyu village

Name	Designation	Telephone contact
Haron Injela	Businessman	0720945027
Harzon Ateko	Farmer	0723758338
David Wekesa	Farmer	0724986107
Ann Mugera		0723044293
Margaret Ongombo	Agricultural officer	0721268803
Dishon Imende	Farmer	0724986107

Gatagati village

Name	Designation	Telephone contact
Mary Wankiku Ndimu	Leader	0720400886
Grace Wambui Macharia	Leader	0721957061
Lydiah Wangari Maina	Business man	0721842554
Lydiah Wandia Ngure	Farmer	0725908256
Leonard Mutero	Business man	0721445912
Jackson Kiruthu Wanjohi	Deputy Head teacher	0721286307
John Kinori Muchiri	Elder	0721229229
John Maina Muraya	Asst. Chief	0724290039
Geoffrey Ngechu Wachira	F.E.O	0722418722

Kiambii Village

Name	Designation	Telephone contact
Stephen K. Muriuki	Teacher	0725412010
Harrison Ithenya Wangai	Retired Teacher	0729968661
Michael Mwangi Maina	Head teacher	0721682006
Catherine W. Kimaru	Asst. Chief	0723166310
Virginia Wangui Gitundu	Women leader	0729737724
Laban Weru Warutere	Elder	0721104400
Mercy Wairimu	Elder	0723483426
Charles Mariga Githui		0722425376
Kennedy Mwaniki Mwarari	Field man	0723555730

Ichuga village

Name	Designation	Telephone contact

Esther M .Mambo	Teacher	0725174116
Nancy Kimaru	Women leader	0726547412
Grace Githui	Farmer	0720261107
Abraham Gichuki	Youth leader	0721977798
Wanjau Mwangi	Farmer	07230935330
Lydiah Kihara	Business	07105843003
James Warutere	Farmer	0728681517
Jane Mumbi Wamai	Asst. Chief	0723159249
Lawrence Murathimi	Elder	0720288223

Irigithathi village

Name	Designation	Telephone contact
Joseph Kamaru	Asst. Chief	0721925971
Dickson Gichore	Vice Chairman	0724634202
Charles Murage	Secretary	0720352120
Joseph Kimani	Treasurer	072813016
Anthony Ndiritu	Farmer	0721166262
Simon Kibira Wachira	Member	0721222586
Ndichu Stephen	Member	-
Joyce W. Gakang'a	Chairperson	0723159205
John Maina	-	0724499509
Francis K. Theuri	-	0722907006
Paul K. Manyuira	-	0720879611
Elizaphan Muchemi Kingori	D. crops officer	0721559095
Benson Ndegwa Wachira	Member	0733935461
Stephen Kinyua Ikubu	Agrovet	0728446976
Martin Njoroge Wandahi	-	0710391280
Jane Wanjiru Rukunyi	-	0723590088
Johnson Wambugu Ngare	-	0724631377

Thegenge/Gatondo

Name	**Designation**	**Telephone contact**
Phares Kabugi Njogu	Progressive farmer	0722236941
Joseph Muhoro Mathenge	Asssitant Chief	0720251169
Julieta Muthomi Mucheke	Women Leander	0721112839
Grace Wanjiki Munyua	Farmer	0725269120
Stephen Githinji Ngatia	Agrovet Dealer	0720758451
Patrick Karuri Kamau	Extension officer	0722321264
Jeremiah Nderi Amos	Elderly farmer	0724758352
John Muita Kiboi	Teacher	0722320824
Robert Chinga Mugo	Local authorities	0723371394
John Warui Ndiritu	Village elder	0722864933
Agnes Njeri Kambo	Health officer	0722321079