

**A MICRO LEVEL ANALYSIS OF AGRICULTURAL
INTENSIFICATION IN KENYA: THE CASE OF FOOD STAPLES**

Final Report Prepared

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SEPTEMBER 2003

1. The research inputs by S. K. Wambugu, and Lucy W. Ngare and the field enumerators are highly appreciated.

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1. INTRODUCTION

Sub-Saharan Africa (SSA) is about the only region in the world where many development indicators are declining or stagnant. It continues to exhibit weak growth in productive sectors; poor export performance; mounting internal and external debts; deteriorating social conditions; environmental degradation; crisis of confidence; institutional decay and political instability.

During the past four decades, the contribution of agriculture to production has declined. Agricultural production grew at a rate slower than that of population. This decline in agricultural production has been attributed to severe droughts, low farm prices, labour and capital flow into cities, cheap imports of food and neglected agricultural research. With per capita food production declining, higher commercial food imports and food aid have become necessary. Hunger has become more wide spread, life expectancy has been declining, food security and access to proper diets have been deteriorating and growing open unemployment has been increasing. Environmental degradation has posed a serious threat to food production and rural livelihoods. There is poor physical condition of institutions, breakdown of judicial systems in a number of countries, poor state of roads and railways, corruption, oppression, tribalism and nepotism are increasingly evident. Many people feel a growing sense of hopelessness, which is perpetuated and reinforced by the negative external image of Africa in the global scene, which portrays Africa as a den of economic, social and political woes.

Of all the challenges facing African communities, their governments, and the international community that of endemic hunger is the most pressing. According to the World Bank (2000), just under half of the region's population suffers from some level of food deprivation, with serious consequences for health and productivity. Chronic localized food shortages caused by war and drought are the most visible aspects of Africa's food and agricultural crisis. But the greatest long-term source of food insecurity has been poor agricultural performance. This is made worse by high transportation costs, inadequate market infrastructure, weak institutions and support services, and inadequate diversification and limited vertical integration (Delgado 1998).

However, despite the poor agricultural performance in SSA, there is potential for resource mobilization and enhancing productivity through use of modern packages. Sustainable options for unraveling this potential lie in a well-concocted African green revolution (AGR). However, farmers will only utilize the modern packages if they know them and if the necessary inputs are available when needed (Elz, 1987). Markets have a role to play in providing input supplies and providing signals about products and crops in which to specialize. Considering the fact that between 50 and 90 percent of the total production comes from small-scale farmers, the performance of smallholder producers is vital.

Kenya like other SSA countries, displays the hallmarks of a developing economy. Agriculture still dominates the national economy with most of the output coming from small-scale producers (Odhiambo, 1998). Growth of the sector has deteriorated and this has been attributed partly to an increasing shortage of land suitable for agriculture (Kenya, 1986) and cultivation of marginal areas. Expansion of farm labour has not

helped either. Agricultural intensification is needed for growth in the sector since the actual yields of major crops in Kenya are far below the potential yield. The low agricultural productivity has been attributed to several factors, among them poor policies, harsh environmental factors, poor infrastructure, insufficient or lack of use of modern inputs and poor crop and animal husbandry (Nyiira 1987, Kenya 1997).

The green revolution (GR), which swept the world as a storm in the 1960s, is widely seen as panacea to world's food problems. However, while Asia has greatly benefited from the GR, sub-Saharan Africa has generally been by-passed by it and markedly lags behind the other world regions in terms of social and economic development including food production.

In the light of the deteriorating agricultural and food productivity in Kenya, the current study aimed at examining the factors that facilitate or impede agricultural intensification. The study attempted to capture the dynamics of Kenyan agriculture and delineate the factors that drive it. The process of agricultural intensification was captured at the farm, village and regional levels.

2. RESEARCH OBJECTIVES

The overall objective of this study was to analyze the factors that facilitate or impede agricultural intensification at the household level. This was achieved by pursuing the following specific objectives:

- (a) Analyzing the differences and trends in yields, technology adoption and crop marketing at household level by considering the changes in the village specific factors such as physical endowment and natural resources, market access, state initiatives, development of markets and other farmers' characteristics.
- (b) Assessing the extent to which differences and trends in production/yields, technology adoption and crop marketing can be explained by household resources and characteristics;
- (c) Examining the local changes in productivity, technology adoption and crop marketing that can be traced back to different interventions by the state over the pre-SAP, SAP and post SAP periods;
- (d) Finding out changes in productivity, technology adoption and crop marketing that can be traced back to the different roles and initiatives of the private sector in relation to small-scale farming over the pre-SAP to post-SAP period; and
- (e) Capturing the changes in productivity, technology adoption and crop marketing that can be traced back to the (changing) role and production conditions of the small-scale farmers over the pre-to post-SAP period.

3. METHODOLOGY

3.1 Study Area, Sampling and Data Collection.

Administratively, Kenya is divided into eight provinces and seventy-two districts. Each district is further sub-divided into divisions, 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 was used from the

province down to the household. In selecting the provinces, districts, divisions, sub-locations and the villages, this study 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 were selected for this study. The larger Kakamega District in Western Province was selected as an area with a very high population density. Nyeri District in Central Province was chosen for its considerable variability in agro-ecological potential and market access. Five villages 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 Nyeri District

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.

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 Aberdares. Kabarua 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, 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 Mukurweini 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 grown 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 divisions except in Kieni East and West divisions. Tea is also a major cash crop grown in Mathira, Othaya and Tetu divisions, i.e. on the well drained slopes of the Aberdare ranges and Mt. Kenya. The poor state of roads in the tea growing areas causes a lot of wastage 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, Mt. 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 Mt. 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 has to be addressed if the full productive potential is to be realized.

Nyeri district is also highly endowed in Tourism potential, but this 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 Nyeri District (in particular the Northern part of Kieni Division) suffer from 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 Kakamega District

The larger Kakamega District today comprises of the districts 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. The high population density and the high population growth rate are some of the obstacle 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 a high 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 divisions are the major produces of maize and beans which are sold to the other divisions, 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 a 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 Mumia 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 distributions of indices of the road network namely density, accessible distance, beta, eta, 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 relayers 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 city of Kenya). The district also has a higher road density. Consequently, its agriculture is relatively 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 selected. Five villages were then selected from each district. In total ten villages were selected as shown in Table 1.

Table 1: Sampled districts, divisions and villages

District	Divisions	Villages
Nyeri	Mathira	Thegenge/Gatondo Ichuga/Gathumbi Kiambii
	Kieni East	Gatagati Irigithathi
Larger Kakamega	Tiriki West	Shikomoli
	Mumias	Ekeru
	Kabras	Chegulo
	Lugari	Munyuki
	Likuyani	Mukuyu

Source: Field Survey, 2002

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-ecological 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. Ekeru 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. Ekeru 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 (poor)	2000	UM1	Medium	Medium	Coffee, tea maize
Ekeru	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
Mukuyu	Small	373	Good	1200	UM4	Good	Poor	Maize
Thegenge	Small	494	Good	1400	LH1	Good	Good	Tea & Horticultural products
Ichuga	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)

3.1.4 Data Collection Instruments

The main micro-study data collection instruments were a household survey questionnaire directed at three hundred sampled households and a village diagnostics questionnaire containing both pre-coded questions and issues that required careful probing in interviews with key informants and farmer groups. The main respondents to the household survey were the household heads or the farm managers.

The village diagnostic questionnaire administered in the ten villages 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, and gender aspects. The questionnaire also contained a number of open-ended questions of a qualitative nature 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 to recollect how the situation was like when the household was formed (as reflected in the indicators of intensification) in the village diagnostic questionnaire. The household questionnaire had questions linking various kinds of farm management, resource access, crop strategies and productivity to various demographic and socio-economic characteristics of the household.

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 300 households from ten villages. No serious problems were reported in relation to the administration of the household questionnaire. It 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. Some inconsistencies in the household questionnaire also caused some minor problems in the

initial stages of the survey but this were detected and corrected on time. Thus, 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 10.0. 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. 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 analyse 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. RESULTS AND DISCUSSION

4.1 Village Diagnostics Survey Results and Discussion

4.1.1 Land Use and Agro-ecology

The average land area under cultivation was 62.8%. 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 pattern of land use in the various villages is shown in Table 3.

Table 3: Land use patterns in the sample villages

Type of Land Use (%)	Shikomoli	Ekeru	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: Field Survey, 2002

In Kakamega district the area of land irrigated was very small. It ranged from 0% in Shikomoli village to only 9.87% in Ekeru village. In Nyeri district, most of the villages were practicing some sort of irrigation as depicted in Table 4.

Table 4: Land under irrigation in the sampled villages

Village	Mean land under irrigation (%)
1. Shikomoli	0.00
2. Ekeru	9.87
3. Chegulo	0.26
4. Munyuki	0.16
5. Mukuyu	0.61
6. Thegenge/Gatondo	19.22
7. Ichuga/Gathumbi	6.11
8. Kiambii	0.69
9. Gatagati	67.52
10. Irigithathi	60.22

Source: Field Survey, 2002

In Gatagati and Irigithathi villages horticultural farmers have organized themselves into a group to manage the use and control of irrigation water. In these two villages the irrigation technology is small scale, and farmer constructed. The water control devices are managed by associations of households at local level. In the other villages the irrigation systems are also small scale but managed by individual households.

In most of the surveyed villages, rainfall amounts were reported to be below average for the three consecutive seasons (1999 to 2001) as shown in Table 5.

Table 5: Rainfall conditions in the sampled villages

Rainfall Condition	Reference Season		
	Most recent season	Season before the most recent one	Two seasons before the most recent one
Above Average	Ekeru, Irigithathi	Shikomoli	Shikomoli, Ekeru, Chegulo, Munyuki, Mukuyu
Average	Chegulo, Thegenge/Gatondo, Ichuga/Gathumbi	Ekeru, Chegulo, Munyuki, Mukuyu	None
Below Average	Munyuki, Mukuyu, Kiambii, Gatagati	Ichuga, Gathumbi, Kiambii, Gatagati, Irigithathi	Thegenge/Gatondo, Ichuga/Gathumbi, Kiambii, Gatagati, Irigithathi

Source: Field Survey, 2003

As shown in the table above, the rainfall conditions are perceived to have been worsening over time especially in Nyeri. Farmers however, have responded by engaging in applying irrigation practices as shown earlier in Table 4. Below average rainfall conditions are a constraint to agricultural intensification.

In terms of soil quality endowment, only Gatagati village is not well endowed with good soils. Seven villages are well endowed with soils suitable for agriculture. Two villages had average soil fertility. The reported soil quality by villages is shown in Table 6.

Table 6: Soil Quality Endowment in the Sampled Villages

Village	Village Soils Qualities (fertility and suitability for cultivation)
Shikomoli	Average
Ekeru	Well endowed
Chegulo	Well endowed
Munyuki	Well endowed
Mukuyu	Well endowed
Thegenge/Gatondo	Well endowed
Ichuga/Gathumbi	Well endowed
Kiambii	Well endowed
Gatagati	Less endowed
Irigithathi	average

Sources: Field Survey, 2002

With regard to topography eight of the villages (Ekeru, Chegulo, Munyuki, Mukuyu, Ichuga/Gatondo, Kiambii, Gatagati and Irigithathi) are located on flat and gently undulating slopes and flat terrain. Thegenge/Gatondo village is located on fairly steep slopes adjacent to Mount Kenya. The fairly steep slopes in Thegenge/Gatondo make the soils well drained and consequently suitable for the growing of tea and coffee.

Combining information on rainfall patterns, presence of irrigation, soil qualities and topographical aspects, nine villages namely Shikomoli, Ekeru, Chegulo, Munyuki, Mukuyu, Thegenge/Gatondo, Ichuga/Gathumbi, Kiambii and Gatagati have good agricultural potential, while one village namely Irigithathi has average potential. Consequently, none of the villages was judged to have low agricultural potential.

4.1.2 Infrastructure and Market Access

Five villages (Shikomoli, Chegulo, Mukuyu, Ichuga/Gathumbi and Irigithathi) had no regular public transport while the other five (Ekeru, Munyuki, Thegenge/Gatondo, Kiambii and Gatagati) had regular public transport. Information on the distances from the village centres to the nearest all weather road; permanent crop outlets; town-based and permanent markets; places with permanent electricity; and places serviced by permanent or mobile telephone connection is summarized in Table 7.

Table 7: Distances from village centres to various service centres (km)

Village	All Weather Road	Permanent Crop Outlet	Town-based/Permanent Market	Permanent Electricity	Permanent or Mobile telephone
Shikomoli	6	8	10	1	2
Ekeru	2	0	4	3	2
Chegulo	4	4	16	8	4
Munyuki	4	6	30	01	12
Mukuyu	20	20	50	20	20
Thegenge/Gatondo	4	10	10	00	0
Ichuga/Gathumbi	2	2	4	01	0
Kiambii	0	2	17	2	0
Gatagati	1	0	54	3	0
Irigithathi	0	0	27	0	0
Mean	4.3	5.2	22.2	3.9	4.0

Source: Field Survey, 2002

In terms of market access five villages (Shikomoli, Kiambii, Gatagati, and Irigithathi) had average market access while three villages (Ekeru, Ichuga/Gathumbi and Thegenge/Gatondo) had good market access. Two villages (Chegulo and Mukuyu) are marginal in terms of market access.

4.1.3 State Initiatives

Nine out of the ten villages had received public food relief in the past. The food relief had been given to the very needy households. Only one village (Munyuki) had not received public food relief. The public food relief was distributed in the drought years of 1980 and 1984. In all the ten villages the focus groups reported no price support or input subsidies directed at food crops. Private extension services were reported in five out of the ten villages. Government extension service was available in six out of the ten villages. NGO or donor extension service was reported in three out of ten villages (Table 8).

Table 8: Availability of agricultural extension services

Village	Private	Government	NGO /Donor	Farmer Groups or Organizations
Shikomoli	Yes	No	No	No
Ekeru	No	Yes	Yes	No
Chegulo	No	No	No	No
Munyuki	No	No	No	No
Mukuyu	Yes	Yes	No	No
Thegenge/Gatondo	No	Yes	No	No
Ichuga/Gathumbi	Yes	Yes	No	No
Kiambii	Yes	Yes	No	No
Gatagati	Yes	Yes	Yes	Yes
Irigithathi	No	No	Yes	No

Source: Field Survey, 2002

Only one village (Gatagati) had farmer groups or organizations offering extension services. In this village farmers have come together because of the jointly manage the use and control of the irrigation water from natural streams flowing from Mt Kenya. Knowledgeable farmers in the village provide agricultural advice to their fellow farmers.

The main channel through which farmers sell the food crops is the private marketing channel. The public sector is no longer active in buying farm produce in the survey villages. It was only in one village (Munyuki) where the government involvement was reported. In this area the government buys maize through its agent, the NCPB. This board has maize silos in the nearby Kipkarren River market which is a very vibrant maize market. No donor or NGO marketing channels were reported in the survey villages. Only in one village (Gatagati) have farmers organized themselves into groups for purposes of selling their horticultural products. Table 9 summarizes the various marketing channels in the survey villages.

Table 9: Marketing channels for agricultural products

Village	Private	Government	NGO/Donor	Farmer Groups or Organizations
Shikomoli	Yes	No	No	No
Ekeru	Yes	No	No	No
Chegulo	Yes	No	No	No
Munyuki	Yes	Yes	No	No
Mukuyu	Yes	No	No	No
Thegenge/Gatondo	Yes	No	No	No
Ichuga/Gathumbi	Yes	No	No	No
Kiambii	Yes	No	No	No
Gatagati	Yes	No	No	Yes
Irigithathi	Yes	No	No	No

Source: Field Survey, 2002

Following the economic reforms beginning in the mid-1980s and comparing the pre-SAP and post-SAP periods the transport infrastructure seems to have improved in the post-SAP period. This has enabled private traders (market intermediaries) to operate in the villages and buy farm produce. However, the private traders were reported to offer low prices.

Input costs have gone up in the post-SAP period. This is primarily as a result of removal of input subsidies with the onset of economic reforms. Agricultural inputs are mainly provided by private traders. The private traders were however, reported to be offering poor quality inputs. The focus groups reported that the government, NGOs, and donor agencies are not playing any role in input provision. It was in one village only (Gatagati) where farmer groups or organization provides inputs. Table 10 shows the various actors in agricultural inputs provisioning.

Table 10: Agents involved in agricultural input provisioning

Village	Private	Government	NGO/Donor	Farmer Groups or Organizations
Shikomoli	Yes	No	No	No
Ekeru	Yes	No	No	No
Chegulo	Yes	No	No	No
Munyuki	Yes	No	No	No
Mukuyu	Yes	No	No	No
Thegenge/Gatondo	Yes	No	No	No
Ichuga/Gathumbi	Yes	No	No	No
Kiambii	Yes	No	No	No
Gatagati	Yes	No	No	Yes
Irigithathi	Yes	No	No	No

Source: Field Survey, 2002

4.1.4 Farmer Organizations, Contract Farming and Outgrower Schemes

The existence of cooperative societies, outgrower schemes and small farmers' organizations were reported in seven out of the ten villages. However, three villages (Munyuki, Mukuyu and Irigithathi) have no farmer organizations. These organizations are involved in a variety of agricultural services which include offering extension services, input provisioning, marketing and provision of credit. The functions of the various farmer organizations are summarized in Table 11.

Table 11: Types of farmer organizations and their functions

Village	Type of farmer organization	Major functions
Shikomoli	Contractual	Provision of inputs and marketing of tea and coffee
Ekeru	Outgrowers	Provision of sugarcane inputs and marketing
Chegulo	Outgrowers	Provision of sugarcane inputs and marketing
Munyuki	None	-
Mukuyu	None	-
Thegenge/Gatondo	Contractual	Provision of inputs and marketing of tea
Ichuga/Gathumbi	Contractual	Provision of inputs and marketing of coffee
Kiambii	Contractual	Provision of inputs and marketing of coffee
Gatagati	Small farmers organization	Controlling and Managing irrigation water; extension services and marketing of horticultural produce
Irigithathi	Small farmers organization	Controlling and Managing irrigation water; extension services and marketing of horticultural produce

Source: Field Survey, 2002

4.1.5 Land Tenure and Gender Issues

The only means by which newly formed households and those already established acquire land in all the villages is through inheriting land already under cultivation. In two villages (Shikomoli and Ekeru) the major means of increasing farm size for already established households is through buying land. However, in the rest of the villages, the major means of increasing farm size is through renting or borrowing land. In all the villages, land has been surveyed, consolidated and registered and all the small scale farmers hold a formal title deed for their parcels of land. As regards availability of land reserves six villages (Shikomoli, Ekeru, Munyuki, Thegenge/Gatondo, Ichuga/Gathumbi and Kiambii) the land frontier is exhausted and fields are permanently cultivated throughout the cropping season. However, in four villages (Chegulo, Mukuyu, Gatagati and Irigithathi) the land frontier is still open but can be foreseen to close in the near future.

In Shikomoli, Ekeru, Chegulo and in 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. In the villages in Nyeri, women enjoy equal land rights as men. This increases farm productivity as there is no tenure insecurity.

4.1.6 Credit

In Shikomoli village farmers reported that there are very few opportunities for them to obtain credit. A number of factors prevent small scale farmers in this village from securing adequate loans from financial institutions. First, asset based institutional lending policies discriminate against small scale farmers whose only collateral could be the land they own. Secondly, the transaction costs associated with the borrowing deters many small scale farmers from going to these institutions. However, KTDA provides seasonal credit for farm inputs which is recovered on delivery of tea (i.e. from tea proceeds). This credit is dependent on quantity of tea that the farmer is able to deliver and on the land area under tea. Credit is also supplied in the form of farm inputs (especially fertilizers). Credit is mainly available for cash crops and those farmers growing food crops have little or no access to credit. Another form of credit is the merry go round arrangement which is practised mainly by women groups. There is no collateral required and the schemes operate on mutual trust amongst the members. Informal borrowing from friends and relatives was also reported. Lack of effective credit systems has adversely affected agricultural development in this village. Farmers require credit for farm investment, production and for marketing.

In Ekeru Village the formation of Mumias Outgrowers Company (MOCO) has changed the scenario of credit acquisition. MOCO provides farm inputs and extends credit to farmers. The credit advanced to farmers depends on land area planted under sugarcane; farmers must also have signed a contract with the Mumias Sugar Company. Money from the sugar proceeds is deducted to pay for the credit that was advanced. To acquire credit there is no collateral required and MOCO (a go between the sugarcane farmers and Mumias Sugar Co.) administers the credit.

In Chegulo village KWFT provides loans to a few women to engage in business. West Kenya Outgrowers Company (WEKOCO) gives farmers credit in the form of inputs (fertilizers). A long time ago the Agricultural Finance Corporation (AFC), a state financial institution used to provide credit; title deeds were used as collateral; farmers who failed to repay the loans lost their farms and so nowadays farmers fear to get loans from AFC lest they lose their land.

In Munyuki village the Agricultural Finance Corporation (AFC) used to advance loans to maize farmers. Title deeds were used as collateral and many farmers lost land for not repaying the AFC loans. Farmers now fear to go for these loans. There are no credit organizations in this village. Women merry go round groups advance small amounts of credit to their members.

In Mukuyu village credit is not readily available. AFC can give loans but farmers cannot meet the conditions set. Interest on loans is also very high. Farmers fear acquiring loans lest they lose their farms on failing to repay. AFC prefers giving big loans (> Ksh. 500,000) which is not attractive or within the reach of small scale farmers. Opportunities for acquiring credit are very few if not non-existent in this village.

In Thegenge/Gatondo village KTDA is the only organization that extends credit to farmers. Credit is in form of inputs (fertilizers and seeds) and cash to carry out various agronomic practices. The credit is dependent upon tea deliveries and the number of tea bushes that a farmer owns. Credit is recovered from the tea proceeds. Commercial Banks and AFC used to offer credit to farmers but this has become unpopular due to collateral requirements (in form of title deeds), cumbersome bureaucratic procedures and high interest rates. Consequently farmers in this village have very few opportunities to obtain credit.

In Ichuga/Gathumbi village, it was relatively easy for farmers to obtain credit facilities in the pre-SAP period to purchase farm inputs. Of late farmers do not obtain these credit facilities since all the organizations which used to lend money to farmers have collapsed. Instead farmers have formed some small groups composed primarily of women (called in Kikuyu language *ngumbato*) whereby members contribute money to the group and the group then lends to needy members. Only group members qualify for these loans. The groups have experienced some difficulties whenever some members are unable to repay the loans as the groups are forced to sell household items to recover their money. This has led to the collapse of some groups and also compromised community cohesion.

In Kiambii village before economic reforms, credit used to be offered by the co-operative societies (coffee and dairy) and repayment done later through deduction from the proceeds of produce delivered. The amount of credit was determined by the volume of your produce. AFC also used to offer credit to farmers. Currently the co-operative societies, and in particular the dairy ones including the KCC, have collapsed and no longer in a position to provide credit to farmers.

In Gatagati village the opportunity for obtaining credit has been deteriorating. With the collapse of the KCC and the AFC farmers have very little access to credit.

Commercial banks which are the only source of cash credit charge high interest rates and require collateral in the form of title deeds.

In Irigithathi village small scale farmers used to obtain credit from the collapsed KCC. The AFC also used to offer credit. Nowadays, there are very few opportunities for farmers to access credit. Commercial banks were reported not be good sources of credit as they require collateral (title deeds) and also charge very high interest rates.

4.2 Household Data Analysis

4.2.1 Household characteristics

Three hundred households were selected in Kakamega and Nyeri regions and most of the respondents (about 83%) were the farm managers. About 84% of the households are male headed and 16% of the households are female headed. The average age of household heads is 51.1 years. 69% of the households are nuclear types. The rest were *de jure* female headed (10%), extended (10%), polygamous (5%), and *de facto* female headed (5%). Table12 shows the gender of the household head.

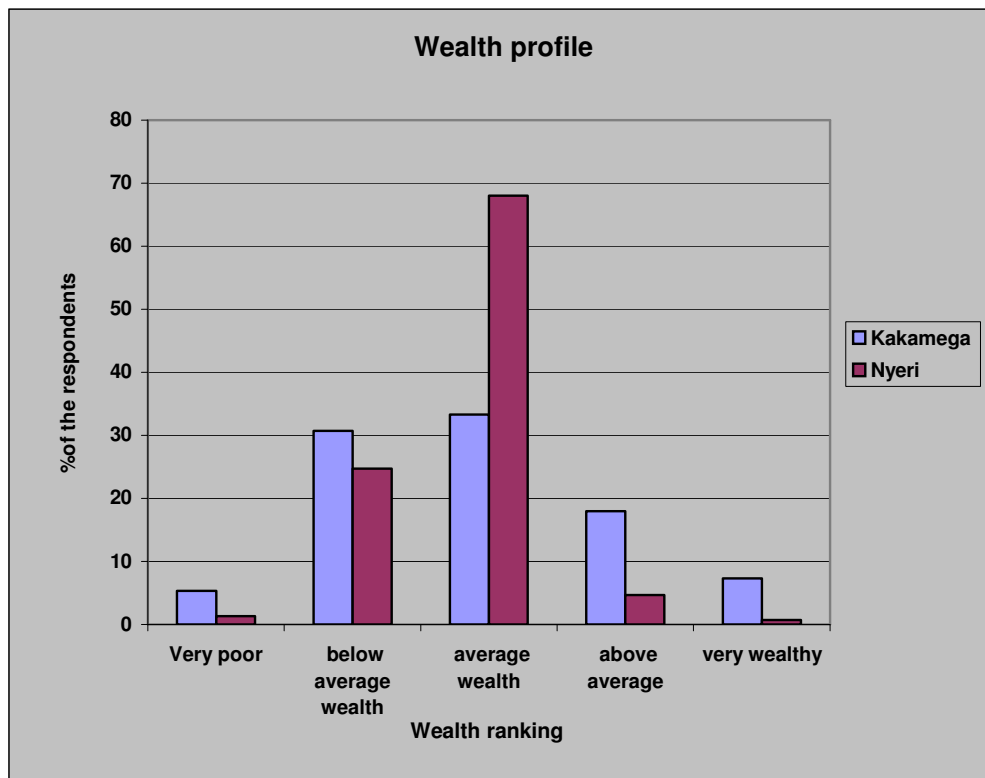
Table 12: Gender of household head by region

	Region		
	Kakamega (n=150)	Nyeri (n=150)	Whole sample (n=300)
Male	82	85.3	83.7
Female	18	14.7	16.3
Total	100	100	100

Source: Field Survey, 2002

On average, a household has 4 adult members out of whom 2 are male and 2 are female, 3 are children below 15 years of age and 1 adult over 61 years of age. 3 of the adults are able workers; 1 adult regularly works on the farm, 1 is regularly employed outside the farm while 1 is regularly involved in some kind of micro business. The main occupation of the household heads is farming. Most of the respondents in the 2 regions are of average wealth with a few considered very rich or very poor. Figure 1 shows the wealth distribution of households.

Figure 1: Distribution of households by wealth categories.



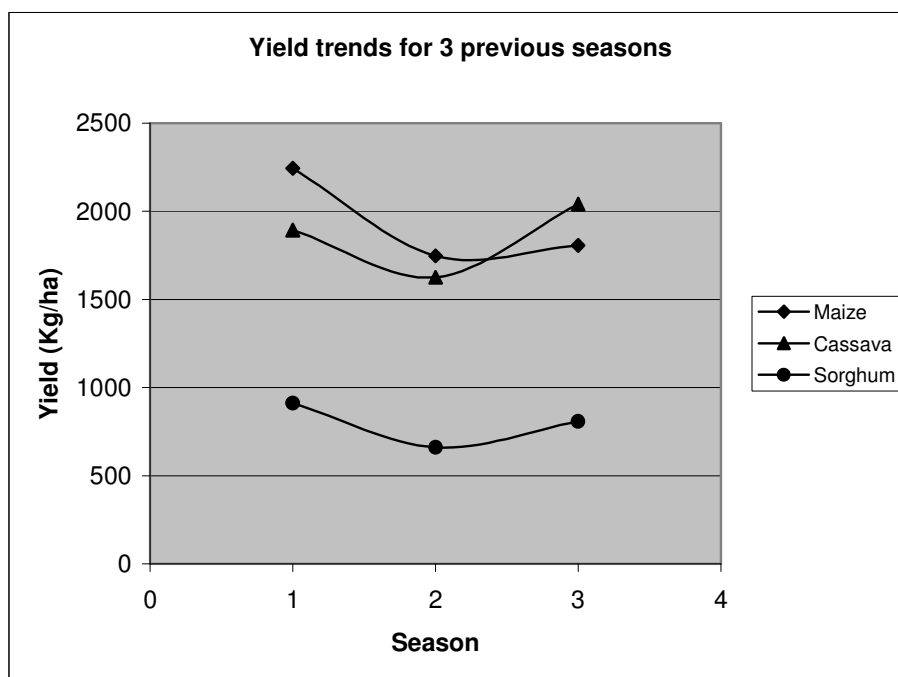
Source: Field Survey, 2002

4.2.2 Trends in Productivity Changes

4.2.2.1 Changes in Yields

Three food staples (maize, sorghum and cassava) were grown in the recent seasons and also in the reference year with maize leading in terms of the number of farmers growing it. Rice was neither grown in the reference year nor in the recent seasons in the sites considered for this study. As shown in Table 13, more farmers are growing maize in the recent seasons than when the households were formed but for cassava and sorghum, more farmers grew them when the households were formed. This perhaps reflects changes in consumer preferences as well as time available for food preparation. It is noted that sorghum based dishes are perceived to require more time for preparation and processing technologies have not developed fast enough with changing household priorities. Maize and cassava yields have declined but sorghum yields have increased in comparison with the reference year. This is shown figure 2.

Figure 2: Trends in yields



Source: Field Survey, 2002

The major factors contributing to yield reduction are declining soil fertility, bad weather and poor seed. Increases in yields are mainly as a result of increased chemical fertilizer use (Table 14).

Table 13: Pattern of Crop Production

		Maize	Cassava	Sorghum	Rice
Grown previous season (%)		99.3	2.7	3	0
Grown in reference year (%)		97.7	33.7	27	0
Mean yields (kg/ha)	Current	1749	1904	704	0
	1 season ago	1747	1625	744	0
	2 seasons ago	2244	1893	1027	0
Yields comparison with reference year (%)	No difference	14.3	1	0.3	0
	More then	53	1.7	1.7	0
	Less then	32	0	0	0
	More now	0	0	0.7	0
	Do not know	0	0	0	0

Source: Field Survey, 2002

Table 14: Factors perceived as contributing to changes in yields

Factors increasing yields (% of farmers reporting)			
	Maize	Cassava	Sorghum
New seed	3	0	0
Chemical fertilizer	5	0	0.7
Irrigation	0.3	0	0
Conservation farming	0.7	0	0
Other	0.7	0	0
Factors reducing yields (% of farmers reporting)			
	Maize	Cassava	Sorghum
Poor seed	18.7	0	0.3
Declining fertility	38.3	1.7	2
Pests/weeds	3	0.3	0
Inadequate land prep.	5	0	0
Untimely planting	2.7	0	0
Bad weather	22.3	0	0

Source: Field Survey, 2002

4.2.3 Technological change

According to Table 15, technologies associated with fertility improvement and soil conservation are the most common for the production of food staples both in the recent seasons and at the time when the households were formed. These include intercropping with nitrogen fixing crops, animal manure, green manure and soil/water conservation. In the production of other food and cash crops, chemical fertilizer and animal manure are the major technologies.

Table 15: Technologies used by the farmers (% of the respondents reporting)

	Maize		Cassava		Sorghum	
	Recent season	Ref. Year	Recent season	Ref. Year	Recent season	Ref. Year
Fertilizer	75.3	73.3	0	1.0	0	0
Pesticides	6	12	0	0	0.3	0
Rotation	48	53.8	0.7	1	1.3	1
Intercropping	89.7	92.3	0.7	0.3	0.7	0.3
Fallowing	21.7	27.7	0.3	0.3	0.3	0.3
Animal manure	80.7	84	0.3	0.7	0.7	1
Conservation tillage	4	3	0	0	0.3	0
Green manure	50.3	46.7	1.3	0.7	1	1.3
Soil/water conservation	75.7	68.7	1.3	1	1.7	1.7
Traditional varieties	21.7	27.3	2	2.3	2.3	2.7
Improved varieties	1	0.3	1	0	0	0
Hybrid varieties	75.3	70.3	0	0	0	0
Unknown variety	0.7	1	0	0	0	0
Hoe ploughing	69.3	62.7	2.3	1.3	2.7	1.7
Ox ploughing	26.7	24	0.3	0.7	0.3	1
Tractor ploughing	4	10.3	0	0	0	0
Irrigation	5	8.4.	.	.	0	0

Source: Field Survey, 2002

Most farmers grow hybrid maize varieties and the proportion using them is higher for the recent season. These hybrids were first introduced in the villages in 1961. A few farmers use OPVs, which were first introduced in 1962, although their number is increasing. The QPM varieties have never been released to farmers but already a few farmers have planted them in the recent season perhaps as participants in field trials. Most cassava and sorghum growers use the traditional varieties. None of the farmers used improved cassava or sorghum varieties during the reference year but a few are using them now. Hybrid sorghum varieties have not been introduced in the villages considered in this study.

Land preparation is mostly done using hoes while a few farmers use ox-ploughs. A few farmers use tractor ploughing but only in maize production and the number is decreasing. Chemical fertilizer is also used only in maize production where on average farmers use 80kg/ha which is higher than what was used in the reference year.

4.2.4 Commercialization

A larger number of farmers purchase food staples than the number that sells. This also applies to other food crops (Table 16). Rice is not cultivated in the surveyed villages but most farmers buy it. Sorghum is cultivated for subsistence use as none is sold. Although the proportion of farmers selling maize has decreased since the reference year, it still remains the most marketed food staple. Further analysis showed that most of the households in Munyuki and Mukuyu villages engaged in marketing of maize.

In these villages maize is in fact an important cash and food crop. Much fewer households in Nyeri District engage in maize selling, preferring to grow other cash crops (tea, coffee and horticultural crops). The main buyers of the grain are private traders (Table 17). This is in great contrast to the pre-liberalization period where the National Cereals and Produce Board was the main grain buyer. The proportion of harvested cassava sold has also declined over the last three seasons.

Table 16: Market participation by households over three seasons

	Current season			One season ago			Two seasons ago			Reference Year	
	% sold	Average who amount sold (kg)	% sales	% sold	Average who amount sold (kg)	% sales	% sold	Average who amount sold (kg)	% sales	% who sold	
Maize	23.3	632.7	7.7	20.9	1060.7	43	25	1355.2	38	34	
Cassava	0.7	202.5	16.4	0.7	202.5	58.9	0.7	157.5	25.9	1	
Sorghum	0	0	0	0	0	0	0	0	0	0.3	
Rice	0	0	0	0	0	0	0	0	0	0	

Source: Field Survey, 2002

About 45% of the farmers grow cash crops. The major cash crops are sugarcane in Kakamega District and coffee and tea in Nyeri District. The cash crops are mainly sold to processing companies through formal contracts or on behalf of farmers through cooperatives. Farmers considered sugarcane to be the most profitable cash crop. The villages have outgrower schemes dealing with cash crops only. Generally, the sale of non-food staples constitutes the main source of cash income for most of the households. This reflects a declining importance of traditional cash crops.

Table 17: Market outlets (% of farmers selling)

Market outlet	Maize	Cassava	Sorghum	other cash crops	cash crops
Farmer cooperatives	0.3	0	0		
Private trader	18	0	0		
Marketing board	0.7	0	0		
Own piecemeal	3.7	0.7	0		
Contract with processing Companies	0.7	0	0	3.3	14

Source: Field Survey, 2002

Agricultural inputs (fertilizer, seed and other agrochemicals) are available in most of the villages. However their use is low and the farmers cite the high input price as the major factor that constrains their use in the production for the market. For instance, expenditure on chemical fertilizer is considered to be the most significant input in terms of cash requirements. Farm labour is regularly hired mostly for land preparation, planting, weeding and harvesting.

4.2.5 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. Other variables reflecting intensification over the whole farm were also considered. These were the use of chemical fertilizers and irrigation technology on the farm. There were two variables representing changes in yield per unit area of land: average yield over the last three seasons; and perceptions of yield increases since the household was formed. Intensification was also considered in terms of the application of purchased yield increasing technologies including use of hybrid seed on maize, use of chemical fertilizers pesticides and irrigation on maize. The results of the analysis are presented in the sections that follow.

4.2.5.1 Effects of Natural Resource Endowments on maize Yields, Trends in Yields, Technology Adoption and Agricultural Commercialization.

The effects of natural resource endowments on various indicators of intensification were analyzed by correlating the intensification measures with factors representing natural resource endowments of households. The correlation matrix is presented in Table 18.

Table 18: Correlation Coefficients between intensification variables and natural resource endowment factors.

Intensification Measure	Cultivated Land Area (Ha)	Cultivation of Cash and non Food Crops	Cultivation of High Value Vegetables	Irrigation on maize	Villages (with Significant Association)
Average Maize Yield (Kg/Ha)	0.177**	-0.224**	0.092	0.072	Munyuki, Mukuyu (+ve) Shikomoli, Thegenge, Kiambii (-ve)
Increases in Yields	0.216**	-0.06	0.116*	0.084	Shikomoli, Chegulo, Mukuyu, Ichuga (+ve) Kiambii (-ve), Gatagati (-ve) Irigithathi (-ve)
Use of Hybrid Maize	0.076	0.145*	-0.029	-0.021	Shikomoli (-ve), Ekeru (-ve), Mukuyu (+ve), Thegenge (+ve), Kimabii (+ve)
Use of Chemical Fertilizers on Maize	0.189***	-0.06	0.03	-0.005	Mukuyu (+ve)
Use of Pesticides	0.74	0.082	0.31	0.326**	Munyuki (+ve)
Application of Irrigation	0.66	-0.283**	0.112	0.101	Shikomoli (-ve), Chegulo (-ve), Munyuki (-ve), Mukuyu (-ve), Ichuga (-ve), Kimabii (-ve), Gatagati (+ve), Irigithathi (+ve)
Use of Chemical Fertilizers on other crops	-0.006	-0.0103	-	0.113	Ekeru (-ve), Shikomoli (-ve), Ichuga (+ve), Gatagati (+), Irigithathi(+)
Chemicals Fertilizer in cash crops	-0.095	0.022	-	0.095	Ekeru(-ve), Chegulo (-ve), Munyuki (-ve), Thegenge (+ve)

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

Source: Field Survey, 2002

The correlation analysis results show that maize yields are positively associated with the cultivated land area and the villages of Munyuki and Mukuyu where maize is an important food and cash crop. There is a significant negative association between maize yield and the cultivation of cash and non-food crops. This shows that households that engaged in the production of cash and non-food crops allocated their resources away from maize production to produce crops that raised their incomes. Farmers in Shikomoli, Thegenge/Gatondo and Kiambii obtained lower yields than average perhaps because of the small farm sizes and also because they concentrated more on other food crops.

Those farmers that reported increasing trends in maize yields were the ones who had larger cultivated land area and also cultivated high value vegetables. Yields were also reported to be increasing in Shikomoli, Chegulo, Mukuyu and Ichuga. Yields were reported to be decreasing in Kiambii, Gatagati and Irigithathi villages. The results suggested that yields are increasing in the western region of the country and decreasing in the central region.

Use of hybrid maize seed is positively associated with the cultivation of cash and non-food crops. Those farmers with cash and non-food crops probably have sufficient incomes to purchase hybrid seed which have become very expensive as reported in this study. Most farmers in Mukuyu, Thegenge, and Kiambii villages planted hybrid seed as opposed to farmers in Shikomoli and Ekero villages who did not. In Shikomoli and Mukuyu the use of hybrid varieties has led to yield increases for most farmers. Most of the farmers in the other villages who use the hybrid varieties reported a reduction in yields. In Shikomoli there is a high use of traditional varieties, which have also led to yield increases for most of the farmers using them. In Chegulo, Munyuki and Mukuyu, very few farmers use traditional varieties and for those using, they have mostly reported an increase in yields. A few farmers in Gatagati and Irigithathi grow improved varieties but these varieties did not have any relationship with increases in yields. The QPM hybrids are only grown in Munyuki and they also have no relationship with increase in yields.

Use of chemical fertilizers on maize was positively associated with cultivated land area and Mukuyu village. Other villages did not show any relationship with fertilizer use on maize. Further analysis showed that chemical fertilizer is used in the production of other food crops than in staple food production. More farmers used chemical fertilizer when the households were formed than in the recent seasons. This is significant in that fertilizers were reported to be very expensive and of poor quality two factors which have been a disincentive to fertilizer use. For those farmers that used fertilizer, the amount used is higher now than what was used at that time when the household was formed. However, this increase in chemical fertilizer use has not increased maize yields for most of the farmers.

A positive association was found between application of pesticides and the use of irrigation on maize. There was also a significant use of pesticides in Munyuki village.

Overall, when the natural resource factors affecting intensification are considered, it is clear that total cultivated land area is very important in explaining agricultural intensification. This raises the important question as to whether declining land sizes will work against agricultural intensification. It seems likely that there is a minimum cultivated land area below which intensification based on food crops may not be profitable. This is supported by the observed negative association between the presence of cash crops and intensification of food staple production. It would appear that in areas that have comparative advantage in cash crop production, intensification might take the form of crop switching to high value crops and away from staple food crops. Considering the geographical locations, it is clear that in areas such as Munyuki and Mukuyu where maize is an important cash crop, intensification has been embraced. The village variable also captured the suitability of agro-climatic conditions for maize production.

Application of irrigation technology on the whole farm was more prominent in Gatagati and Irigithathi villages. These villages lie on the leeward side of Mt. Kenya and therefore receive low rainfall. However, they can obtain water for irrigation by gravity from the mountain slopes. There is therefore great small-scale irrigation potential which is currently only partially being exploited. The cultivation of cash and

non-food crops is negatively associated with irrigation use reflecting the absence of crops such as tea, coffee, and sugarcane where irrigation is practiced. Irrigation, where it was present, was mostly used for the production of vegetable crops.

4.2.5.2 Labour Factors Affecting Agricultural Intensification

The results of the correlation analysis between intensification variables and household labour resources are presented in Table 19. The results show that availability of able workers is positively associated with intensification measures of average yield, increasing trend in yield, and pesticide use. Curiously, the presence of able workers on the farm is negatively associated with irrigation use but positively correlated with the frequency of hiring labour. It can be concluded that irrigation use was found in those farms where there were fewer able workers and therefore these farms have to rely on hired labour.

Table 19: Correlation matrix of Labour Factors and Agricultural Intensification Measures

	No. of able workers	Female members	Male members	Hired labor	Machinery cost
Average Yield	0.167**	0.148*	0.130*	0.0124*	0.204**
Trends in Yields	0.155*	0.105	0.144*	-0.015	0.212**
Hybrid Maize	-0.023	-0.100	-0.013	0.169**	-0.078
Fertilizer	0.053	0.039	0.076	0.083	0.148*
Pesticides	0.126*	0.185**	0.18	0.055	0.048
Irrigation	-0.165**	-0.084	-0.115*	0.130*	-0.138*

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

Source: Field Survey, 2002

The availability of female and male members of the household and ability to hire labour are positively associated with intensification variables. Machinery cost is associated with high and increasing yields, and high level of fertilizer use. This implies that machinery use is only profitable where intensification is possible.

4.2.5.3 Institutional Factors Affecting Agricultural Intensification

Table 20 presents the results of the correlation analysis between agricultural intensification variables and institutional factors. The results show that many of the institutional factors are negatively associated with intensification of maize production. Membership to farmers' organization, availability of credit, access to extension, secure land tenure are all negatively associated with intensification of maize production. These results support the earlier observation that farmers may intensify, not by growing staple food crops, but by switching to other perhaps more profitable crops. This is clearly the case when one considers that these institutional factors are

positively associated with the adoption of irrigation on the farm as opposed to those technologies that are specific to maize. The importance of the institutional factors for the adoption of expensive technologies such as farm irrigation is therefore strongly demonstrated by this result.

Table 20: Correlation coefficients between institutional factors and agricultural intensification

	Member of Organizations	Credit	Access to Extension	Individually owned land	Control	Inherited Land	Purchased land
Average Yield	-0.201**	-	-0.090	-0.008	-0.011	-0.142*	0.191**
Trends in Yields	-0.123*	0.175**	-0.138*	-0.056	-0.075	0.51	-0.061
Hybrid Maize	0.049	0.12	0.087	0.217**	0.016	-0.141*	0.127
Fertilizer	-0.109	-0.092	-0.069	0.023	-0.014	-0.128*	0.160**
Pesticides	0.007	-0.058	0.002	0.009	-0.115*	-0.026	0.38
Irrigation	0.144*	0.119*	0.161**	0.100	0.045	-0.116*	0.119*
Fertilizer on other food crops	0.006	0.022	0.151**	0.046	0.022	-0.025	-0.049
Fertilizer on cash crops	0.000	0.589**	0.160*	0.038	0.001	0.040	-0.103

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

Source: Field Survey, 2002

4.2.5.4 Household Social and Wealth Factors Affecting Agricultural Intensification

Table 21 shows the results of the correlation analysis of social and wealth factors that affect agricultural intensification. The results show that household wealth is positively associated with intensification measures of average yields, increasing yield trend, use of hybrid seed and use of fertilizer. The education level of household head is also important in determining the use of hybrid seed and application of fertilizers on other crops.

Households that had non-farm salaried employment income were not likely to intensify the production of maize. This result is contrary to recent findings on the positive role of non-farm income on agricultural development. A distinction between salaried employment in urban areas and non-farm income in rural areas may have to be made to reconcile this result with the new emerging consensus. It is to be noted that remittances are significantly associated with intensification of agriculture and these are mainly obtained from family members who work in the modern urban

sector. The result above may suggest that part-time farmers are more likely to intensify agriculture than absent farmers.

Table 21: Correlation coefficients between household social and wealth factors and agricultural intensification

	Household wealth	Age of farm manager	Education level of farm manager	Salaried employment	Dependence	Micro business	Large scale business	Rent/interest	Pension	Remittances
Average yield	0.188**	0.00	0.101	0.014	0.169**	0.051	-0.019	0.151*	0.019	0.31
Yield trends	0.143*	0.094	-0.063	-0.002	0.155**	0.54	0.075	0.093	-0.025	0.130*
Hybrid seed	0.161**	0.059	0.215*	-0.163**	-0.050	0.030	0.060	-0.026	0.033	-0.055
Fertilizer use on maize	0.164*	0.056	0.019	-0.067	0.139*	0.087	-0.009	-	-	-0.002
Pesticides	0.028	0.072	-0.002	0.011	-0.161**	0.040	-0.025	0.254**	0.271**	0.039
Irrigation	0.089	-0.109	0.112	-0.017	-0.242**	0.001	0.277**	0.112	0.020	-0.083
Fertilizer on other crops	0.113	-0.089	0.236**	0.041	0.113	-0.018	-0.022	-0.005	-0.049	0.020
Fertilizer on cash crops	0.043*	-0.063	-0.013	-0.174*	0.043	0.009	-0.040	-0.018	0.058	-0.075

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

Source: Field Survey, 2002

Households with a high dependence ratio as represented by children under 15 and adults over 61 years had high and increasing yields and also high fertilizer application levels on maize. However, these same families did not apply pesticides or irrigation technology. In general, income from large-scale businesses and rent (or interest) was positively associated with agricultural intensification. However, those with high rent/interest income did not apply high levels of fertilizer. Further analysis may be required to disentangle this rather conflicting association between certain social and wealth factors and different measures of intensification.

4.2.5.5 Commercialization Factors and Agricultural Intensification

It is widely acknowledged that 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 22.

Table 22: Correlation coefficients between commercialization variables and agricultural intensification variables

	Sale of food staples	Sale of other food crops	Sale of non-food and cash crops	Sale of animal products	Distance to market	Production under contract
Average yield	0.338**	0.129**	-0.197**	0.039	0.368**	-0.042
Yield trends	0.150**	-0.096	0.106	-0.001	0.398**	-0.136
Hybrid seed	0.92	0.054	-0.039	0.065	0.238*	0.093
Fertilizer use on maize	0.195**	0.065	-0.100	0.052	0.240*	-0.037
Pesticides	0.207**	0.082	0.008	-0.047	0.007	0.208
Irrigation	-0.065	0.218**	-0.274**	0.098	-0.451**	0.215
Fertilizer on other crops	-0.043	0.158**	0.098	0.145*	0.134	-0.144
Fertilizer on cash crops	-0.012	-0.095	0.204*	0.038	-0.011	-

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

Source: Field Survey, 2002

Sale of food staples and other food crops are positively associated with agricultural intensification. On the other hand sale of non-food cash crops is negatively associated with intensification of maize production. It is clear that households that have an opportunity to sell food staples will intensify their production and those that have comparative advantage in the production for sale of cash crops will allocate more resources to the latter crops and will therefore intensify food crop production. Surprisingly intensification is positively correlated with distance to markets implying that intensification of maize production is not favored by improved market access. This result is consistent with other results reported earlier in this study that when commercial opportunities are present other high value crops may be preferred by farmers.

Farmers reported that farm product prices have been declining over the years. Apart from Ekeru, Chegulo and Mukuyu, the prices that the farmers receive for their maize was worse than the way it was when the households were formed. Most of the farmers who felt that the maize price had increased also reported an increase in maize yield. Access to market outlets has also worsened for most farmers. This is with an exception of Ekeru, Chegulo and Mukuyu villages, where a bigger proportion of farmers felt that the prices and access to maize market outlets is now better than in the reference year. In Shikomoli, Chegulo, Thegenge/Gatondo and Mukuyu, most of farmers whose access to markets has improved also experienced an increase in yields. In all the villages, the respondents felt that profitability of maize has declined in comparison with the reference year.

4.2.6 A Causal Analysis of Adoption of Hybrid Maize Varieties, Chemical Fertilizers, Irrigation and Pesticide Technologies

The foregoing analysis highlights factors that are associated with intensification but does not indicate causality or 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. It is clear that technology adoption is a key determinant of intensification of maize production. To analyze the effect of various agro-ecological and socio-economic variables on technology adoption probit models were estimated to assess the influence of some selected variables on the adoption of hybrid maize seed (Table 23), adoption of pesticides in maize production (Table 24), adoption of fertilizers in cash crop production (Table 25) and adoption of fertilizer in other food crop production (Table 26). A Tobit model was used to analyze the factors that influence the probability and intensity of adoption of fertilizer in maize production (Table 27).

Results in Table 23 clearly show that distance to market has a significant negative influence on adoption of hybrid maize. Education level and individual ownership of land positively and significantly affect the adoption hybrid maize. Farmers who have markets closer to their farms, have education and own the land on which they farm are more likely to invest in yield increasing hybrid seed. Inheriting land showed a significant but negative influence on the adoption of hybrid maize. Acquiring land by means other than inheritance may mean that those who choose to become farmers rather than being so by default are likely to adopt hybrid maize varieties. Being a farmer in Mukuyu and Thegenge/Gatondo villages was positively and significantly related to adoption of hybrid maize. However, farming in Ekeru is negatively and significantly correlated to the use of hybrid maize.

Table 23: A probit model of factors affecting adoption of hybrid maize varieties

Variable	Coefficient	Std error	t
Constant	0.359990151	0.514873	0.699
Cash crop farming	0.230179893	0.20257	1.136
Use of hired Labour	7.19E-02	0.190058	0.379
Machinery cost	3.78E-02	8.49E-02	0.445
Individually owned farm	0.105644034	0.402887	0.262
Inherited land	-0.239257596	0.231175	-1.035
Wealth	2.20E-04	5.44E-04	0.405
Education level	4.42E-02*	2.38E-02	1.856
Non farm salaried employment	-1.37E-04	2.33E-04	-0.588
Distance to the market	-0.372510514**	0.186064	-2.002
Shikomoli	-1.169655025***	0.351492	-3.328
Ekeru	-0.903662562***	0.327556	-2.759
Mukuyu	0.733314859*	0.419519	1.748
Thegenge/Gatondo	0.931107719*	0.483426	1.926
Kiambii	0.36606753	0.352767	1.038

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

Source: *Field Survey, 2002*

Table 24 shows that the factors that were significant in adoption of pesticides were irrigation of maize, sale of staple food and belonging to Munyuki village. Production of maize, a staple food, for the purpose of selling increases the adoption of pesticides in the production of maize.

Table 24: Probit model of factors affecting adoption of pesticides in maize production

Variable	Coefficient	Standard error	t
Constant	-1.40864	1.376171	-1.024
Irrigation of maize	1.350785***	0.372378	3.627
Munyuki	0.986863***	0.343909	2.87
No. of able workers	0.107488	0.116788	0.92
No. of female adults	-0.18481	0.191482	-0.965
Full control of the farm	-0.96846	1.362787	-0.711
No of dependants	-1.00E-03	1.37E-03	-0.731
Rent and interest income	4.25E-02	0.255146	0.166
Sale of staple food	0.907088***	0.293451	3.091

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

Source: *Field Survey, 2002*

From Table 25 it is noted that sale of cash crops and access to credit positively and significantly influenced the adoption of fertilizer in cash crop farming. The coefficients for Ekeru and Thegenge/Gatondo are positive and significant showing that being a farmer in the two villages positively influenced the adoption of fertilizer in cash crop farming. The role of the MOCO and KTDA in providing credit in the form of inputs and readily buying the cash crop is well captured in these results. On the other hand, farming in Chegulo negatively and significantly influenced the adoption of fertilizer in the production of cash crops.

Table 25: Factors affecting adoption of fertilizer in cash crop production

Variable	Coefficient	Standard error	t	Z
Constant	-2.173757938	0.274945	-7.906	0
Credit	0.983676055	0.245091	4.014	0.0001
Wealth	6.14E-04	7.72E-04	0.795	0.4267
Non farm salaried employment	-0.194130503	0.234881	-0.827	0.4085
Sale of cash crop	2.158377317	0.262257	8.23	0
Ekeru	1.078687186	0.486441	2.218	0.0266
Chegulo	-0.851463382	0.373785	-2.278	0.0227
Munyuki	-0.411636992	0.512215	-0.804	0.4216
Thegenge/Gatondo	0.87282276	0.378893	2.304	0.0212

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

Source: *Field Survey, 2002*

According to the results in Table 26, the level of education of the farm manager positively influences the adoption of fertilizer in the production of other food crops. Educated farm managers are likely to adopt and use fertilizer in food crops other than maize probably due to their ability to acquire, interpret and use technical advice from extension officers. Access to extension services provides greater access to information concerning fertilizer usage. However, the coefficient was not significant. Sale of the food crops increased the adoption of fertilizer in their production. It appears that income from the sale of food crops is in turn invested in acquiring the technologies required for their production. This suggests that availability of a ready market is a good incentive for farmers to adopt yield increasing technologies. Farming in Gatagati and Ichuga villages significantly increased the adoption of fertilizer in the production of other food crops. However, farming in Ekeru negatively influenced the adoption of fertilizer in the production of other food crops.

Table 26: Factors affecting adoption of fertilizer in other food crops production

Variable	Coefficient	Standard error	t
Constant	1.29E-02	0.25419	0.051
Machinery cost	-3.52E-04	7.16E-02	-0.005
Extension	0.33060525	0.223949	1.476
Education level	3.94E-02*	2.29E-02	1.719
Sale of other food crops	0.336852239*	0.197365	1.707
Sale of animal produce	0.116295072	0.189351	0.614
Ekeru	-0.566037603**	0.28149	-2.011
Shikomoli	-0.410825197	0.272495	-1.508
Ichuga	0.818850351**	0.390145	2.099
Gatagati	1.073490623**	0.490666	2.188
Irigithathi	0.47096873	0.400296	1.177

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

Source: *Field Survey, 2002*

As shown in Table 27, the variables that significantly explain the intensity of adoption of fertilizer were village (Mukuyu), rent and interest income, pension income and sale of staple food. These factors positively influenced the intensity of adoption of fertilizer in maize production. The coefficient for Mukuyu was positive and significant showing that being a farmer in Mukuyu increased the intensity of adoption of fertilizer. The marginal changes reveal that being a farmer in Mukuyu raised the probability of adoption by 46% and an increase in the quantity of fertilizer used by 149kg in the entire sample and by 25kg among the adopters. Access to rent/interest and pension income would raise the probability of adoption by 86% and 65% in the entire sample and among the adopters, respectively. The result suggests that this income is invested in improving maize production. Rent and interest income would increase the quantity of fertilizer used by 278kg in the entire sample and 46kg among the adopters. On the other hand, pension income would increase fertilizer use by 209kg in the entire sample and 35kg among the adopters. Sale of staple food raised the probability of adoption by 20% and increased the quantity of fertilizer used by 64kg in the entire sample and 35kg among the adopters. Maize was found to be the most marketed crop among the staple foods and this may imply that production of maize beyond households' requirements increased the adoption intensity of fertilizer.

Table 27: Tobit maximum likelihood estimates and marginal effects of factors influencing the intensity of adoption of fertilizer in maize production

Variable	Coefficient	t-ratio	Total change in adoption	Change in adoption intensity	Change in adoption intensity probability (%)
Constant	-158.438**	-1.974	-158.44		
Land size	21.27337	1.161	21.27	3.559679	6.584392
Mukuyu	148.6896**	2.514	148.69	24.88028	46.02143
Machinery cost	-9.27746	-0.753	-9.28	-1.5524	-2.8715
Inherited land	14.69021	0.234	14.70	2.458118	4.546817
Purchased land	75.12973	1.085	75.13	12.57148	23.25366
Wealth	8.966148	0.45	8.97	1.500308	2.775143
No of dependants	9.500196	1.223	9.5	1.589671	2.940438
Rent and interest income	277.5314***	3.587	277.53	46.43941	85.89967
Pension income	208.6158***	2.809	208.62	34.90774	64.56937
Sale of staple food	63.8277*	1.636	63.83	10.68031	19.75553

Ratio of adoption = 0.477

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

Source: Field Survey, 2002

4.3 Changes in the Role of the State

The village and household surveys revealed that the sampled villages have never received any form of price support, input subsidies and credit subsidies directed at food crops from the government. However, nine out of the ten villages have received public food relief. Six villages receive government extension services, which have benefited about 29% of the farmers. The government marketing channels are only available in one village and this is in the form of a maize marketing board where 0.7% of the farmers have sold their maize. Agricultural inputs are now readily available but the government is not involved in their provision.

The state was previously responsible for providing free regular extension services during the pre-SAP period. Currently however, extension services are absent in most villages and where available, they are often irregularly provided. A number of farmers get the services from private agents at a cost. The cash crop farmers get the extension services from their outgrower companies or the buyers of their produce. As most farmers do not access this essential service, they are unaware of many of the yield improving farming techniques.

Credit facilities have become very scarce for most farmers in the post-SAP period. In the pre-SAP period the Government used to extend credit to farmers through the Agricultural Finance Corporation (AFC). Dairy farmers could also obtain credit from the Kenya Co operative Creameries (KCC). However, this credit has declined significantly. Farmers have to meet very stringent conditions and provide collateral mostly in the form of land title deeds. Many farmers who are apprehensive of losing their land have opted not to seek agricultural loans. In situations where farming is risky and returns not guaranteed, farmers are likely to under invest in risky, but yield increasing, technologies. Only the cash crop farmers, who can obtain credit through their cooperatives or outgrower schemes, are able to intensify production by employing modern technologies.

The state is responsible for providing transport infrastructure in the villages. In tea growing areas, the Kenya Tea Development Authority (KTDA) is also involved in road improvement. Where roads are well maintained, access to input and output markets has greatly improved and transport costs are much lower. In such areas agricultural intensification was much higher.

Before liberalization the input and output markets were state controlled. Inputs were made available through the Kenya Farmers Association (KFA). With the onset of liberalization, more private traders are providing inputs and with little government control, the inputs are sometimes of low quality. The inputs are more available but farmers have to pay higher prices for them. This has translated to reduced profitability. In the pre-SAP period, marketing farm products through Government parastatals such as the National Cereals and Produce Board (NCPB) provided a reliable market and offered uniform prices.

4.4 Changes in the role of the private sector

With liberalization, the government provision of extension services has declined significantly. Private extension services are available in half the number of villages for the farmers who are willing to pay for them. Although the services are sometimes of low quality, they are accessible to the farmers.

In all the villages, maize is the only food staple that is solely marketed through private marketing channels. The private traders provide a maize marketing outlet for 18% of the 23% of farmers who sell maize in the market. Milk producers also have to sell to private traders since the collapse of the KCC. Although the farmers feel that the prices offered by private traders are too low, they are of the view that the traders provide a useful and reliable market. Trader also pay promptly compared to government agencies that used to delay payments for long periods. The private sector is solely responsible for provision of agricultural inputs in the areas studied. With liberalization, the number of input suppliers has increased and this has improved input availability to farmers. However the higher prices that farmers have to pay now and the low quality of the inputs are major causes of concern to farmers. The surveys also revealed that contract farming and outgrower schemes are available in most of the villages.

4.5 *Changes in the role of NGO or donor*

Only two villages reported having received some form of support from NGOs or donors. This support came in the form of input subsidies, credit, extension and conservation farming. For instance, the Kenya Women Finance Trust (KWFT) has advanced loans to a few women to enable them engage in business. The donors are however not involved in marketing of agricultural output, provision of input and provision of input subsidies.

4.6 *Changes in the role of farmer groups/organizations*

Six villages reported having small farmers' organizations to which 46% of the farmers belong. These organizations are not involved in marketing of food crops. The farmer organizations are instead involved in the marketing of cash crops mainly coffee, tea sugarcane and horticultural crops. They are also involved in provision of inputs, extension services and credit to their members. Membership is limited only to those growing the relevant cash crop. Non-cash crop growers are not members of these organizations and this is considered a hindrance to agricultural intensification for this category of farmers.

In Shikomoli and Thegenge/Gatondo villages, KTDA collects tea from designated tea buying centres, processes and sells the tea on behalf of the farmers. The organization also extends credit in the form of inputs (fertilizers and seeds) and cash for farming activities, which is recovered from the tea proceeds. Apart from marketing tea, the organization is also involved in improving the infrastructure, especially roads. In Ekeru and Chegulo where sugarcane is the major cash crop, all the sugarcane farmers belong to outgrower schemes. These schemes market the sugarcane and also provide inputs (fertilizers), credit and extension services. These organizations have enabled the tea and sugarcane farmers to intensify production.

Coffee farmers in Ichuga/Gathumbi and Kiambii have formed themselves into cooperative societies managed by elected members. The main objective is to market the coffee and provide credit in form of inputs and cash. Of late, the cooperatives have had problems of mismanagement. Provision of credit has greatly diminished and with poor prices for coffee, low investment has caused agriculture intensification in the coffee growing areas to suffer.

Munyuki, Mukuyu, Gatagati and Irigithathi villages reported having no contractual or outgrower farmer organizations. In addition, these villages had the lowest number of farmers growing cash crops. The Farmers in Munyuki and Mukuyu are mainly maize producers who sold their produce to middlemen at low prices. Farmers no longer deliver their maize to the National Cereals and Produce Board (NCPB) the parastatal that used to buy maize during the pre-SAP period. Farmers complained that the conditions for acceptance of maize by NCPB were too stringent and most of them were unable to meet them. This coupled with delays in payment was a major source of frustration to the farmers. Lack of farmer organizations has hindered agricultural intensification because farmers lack credit, farm inputs, organized marketing and processing. In Gatagati, horticultural farmers have informal groups that control irrigation water, offer extension services and assist in marketing of farm produce.

Chegulo has a few women groups, which are involved in income generating projects, providing livestock and training for their members.

5. CONCLUSIONS AND RECOMMENDATIONS

The results of this study reveal a broad range of conditions that must exist for Kenya and other SSA countries to raise agricultural and food productivity and achieve a sustainable green revolution. Research and extension services will continue to be critical for agricultural development. The two must be set up to generate and transmit fully tested and relevant research results from the experimental plots to the farmers' fields. Without these key inputs agriculture can get nowhere. High yielding varieties are highly demanding in knowledge and they will give the high yields only when cultivated strictly in accordance with prescribed recommendations. Raising the farmers' education levels must receive more attention. In the meantime, the extension service must equip farmers with the requisite knowledge.

Increases in productivity and production are sustainable if there is concomitant development of markets for the agricultural products. Market development will require increased investments in infrastructure, including roads and transport systems, warehouse and storage facilities, communications systems, and electricity. Unless markets develop, farmers will have no incentives to raise their agricultural productivity through investing in high yielding seeds. Why should farmers put in extra labour and incur the extra costs if there are no market outlets for the products? Market towns within easy reach, farm-to- village-to-market roads, and transportation and warehouse facilities are the first prerequisites to lift agriculture to the modern green revolution age. If agricultural products remain locked within the village precincts, intensification will not occur and agriculture will remain condemned to a predominantly subsistence-rather than a market orientation. Input markets must also develop to supply quality inputs in timely fashion. In addition, when increases in yields and cropping intensity are realized, seasonal labour bottlenecks are bound to develop, and these can best be overcome with carefully selected farm equipment.

Rural credit and financial systems are also critical for agricultural intensification. Modern farm inputs are expensive and most farmers need substantial credit to finance them. Production is also seasonal and farmers need consumption credit to overcome cash flow problems which make them to either sell their staple at harvest time when prices are low (only to buy back later when prices are high) or fall back to subsistence production. Price policies must recognize that farmers must make a fair profit and must be assured of it well in advance. The right mix of price stabilization policies must be identified and implemented.

The conditions outlined above are complementary, and act and react among themselves. They must therefore, all be satisfied at one and the same time. If one of these elements is ignored, agricultural development will come to a halt. When all are satisfied agriculture will swiftly move to a high and sustainable level of productivity.

Land tenure and other institutions must be adjusted to reflect the farming reality. Women continue to be the main players in the agricultural sector yet they do not have the leeway to make decisions on resource use and management. As is widely acknowledged, farmers will only sweat without complaining when they know that what they earn with their sweat will accrue to them. This reality must be recognized especially in the case of women who despite contributing more than 75% of the

farming effort in many cases enjoy a disproportionately small fraction of the proceeds from farming.

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