KENYA AGRICULTURAL MARKETING AND POLICY ANALYSIS PROJECT

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DETERMINANTS OF AGRICULTURAL PRODUCTIVITY IN KENYA

by

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1. INTRODUCTION

Agriculture in Kenya accounts for about a third of gross domestic product; 76 percent of the population live in rural areas; agriculture employs 85 percent of the rural labour force. Rural labour force has been growing at 3.5 percent while agriculture has been growing at 2.6 percent (World Bank 1991; GOK 1993). Seventy percent of Kenya's merchandise exports are agricultural; and 33 percent of manufacturing sector output is based on agricultural products (Pearson 1995). Because of agriculture's contribution to total output and employment, for sometime to come, attempts to improve living standards must give particular attention to increased incomes and productivity in the agricultural sector. Enhancement of agricultural productivity is thus an important condition in alleviating rural poverty, and increasing household food security and stimulating growth in non-farm activities. Unfortunately, there is limited household-level information available in Kenya to allow planners, policy makers and donors to make a comprehensive assessment of the factors that determine agricultural productivity in Kenya. Such information would be extremely valuable in identifying major constraints on productivity growth and in formulating strategies to overcome them. This is especially important as the country adjusts to market liberalisation process. Kenya like many countries in the Eastern and Southern Africa region, is undergoing rapid transition and adjustment in its agricultural sector. Throughout the adjustment process, concerns have arisen regarding the overall implications of the market liberalization process for national agricultural growth and food security.

This paper examines the determinants of agricultural productivity variations across households. The main objectives of this paper are threefold: (1) to describe agricultural productivity across households; (2) examine factors that explain variations in agricultural productivity across households; and (3) to identify strategies for enhancing smallholder agricultural productivity in Kenya.

2. DATA AND METHODS

2.1. Sampling Methodology

This paper uses data for 1,540 households that derive from detailed rural household survey conducted in 1997. A multi-stage probability proportional to size (PPS) sampling design was used to select farm households. Rural population of households and agro-ecological zones (AEZ) were the major factors considered in identifying the sampling frame. Using the latest population census all the districts and administrative divisions were identified and AEZ assigned to them using information from Farm management handbook (Jaetzold and Schmidt 1983). Thirty-five distinct AEZ were identified and regrouped into 8 contiguous clusters from which the sample was drawn. In summary, the sampled households came from eight provinces, and 24 districts in Kenya.

Data collected comprised of physical quantities of inputs used in the production process, quantities of production, marketed production and farm-gate output prices. Input and output data for both the long rains and short rains were computed and aggregated for 1996.

2.2. Concept of Agricultural Productivity

A conventional agricultural productivity index is a measure of output divided by a measure of inputs. Total factor productivity (TFP) is defined as the ratio of value of output over the value of all inputs used. However, TFP measures are difficult to construct since it is often difficult to value key inputs where markets are not well-functioning.[1] An alternative approach is partial factor productivity (PFP). PFP measure divides physical output (Q) by physical factor input, X_i:

$$\text{Thus } PFP_i = Q/ X_{i...}$$

Variations in PFP may arise from differences in technology (t) or variations in other (unmeasured inputs) given a production function defined by:

$Q = f(X_1, X_2, \ldots X_n; t)$.

Partial factor productivity index has a weakness in that it does not account for all the inputs used in production. However, a carefully constructed partial measures are legitimate measures of the variations in measured output attributable to measured to variations in measured factors (Alston, Anderson, and Pardey 1994).

Two indices of partial factor productivity are used in this paper, land and family labour. A practical problem encountered by analysts in computing partial factor productivity in smallholder agriculture is the issue of shared resources. Many households practise inter-cropping and family labour is shared among many activities. Obtaining accurate measure of physical quantities of factor inputs used for individual enterprises become problematic. This was resolved by aggregating value of crop output. Because individual output is measured in different units the aggregation was by revenue. The other problem that arises in aggregating revenue is what price to use for output because different households experience different prices. Price differences are due to inter-temporal and spatial factors. This shortcoming was mitigated against by assuming that households in the same geographical zone faced the same output price. Farm-level prices were used. Two steps were involved in calculating regional prices. First, the sampled households were grouped into nine agro-regional zones. The grouping was based on agro-ecological and geographical factors that impact on production and input-output prices. The regions are:

1. North arid (Turkana and Garissa districts).
2. Coastal lowlands(Taita-Taveta, Kwale and Kilifi districts).
3. Eastern lowlands (Machakos, Kitui and Makueni districts).
4. Western lowlands(Kisumu and Siaya districts).
5. Western transitional (Kakamega, Bungoma districts).
6. High potential maize zone (Nakuru, Narok, Bomet, Trans-Nzoia, Uasin-Gishu, Kakamega, Bungoma districts).
7. Western highlands (Kisii and Vihiga districts).

[1] For example, without well functioning land and labour markets, rental values and wage rates for hired labour cannot be measured with accuracy and hence TFP measures become intractable.

8. Central highlands(Nyeri, Muranga and Meru districts).
9. Marginal rain shadow (Laikipia district).

Secondly, for each zone prices for individual crops were grouped into 10 deciles. The first and the last deciles were discarded and the mean price for the eight deciles was used as the zonal price for all households.

3. RESULTS

3.1. Effect of Commercialization and Crop Mix on Land Productivity

Commercialization is the percent value of marketed output to total production. Commercialization enhances agricultural productivity by encouraging shifts in crop mix towards high value crops and the use of productivity enhancing inputs like certified seeds and fertlizer. In 1996 the value of crop output per acre ranged from Ksh 29,948 in north arid zone to Ksh 4,839 marginal rain shadow zone. Inter-regional variation in value of crop output per acre is partly attributed to differences in the degree of commercialization. Regions with high commercialization exhibit high crop revenues per acre. Commercialization is above fifty percent in three out of the nine regions. In these three regions crop revenue per acre is above Ksh 10,000. This is consistent with evidence from elsewhere that commercialization of agriculture increases agricultural income (Kennedy and Cogill 1987; von Braun, Kennedy, and Bouis 1990).

Although the degree of commercialization in high potential maize zone and central highlands is about the same, land productivity is higher in central province. Low crop revenue per acre in high potential maize zone relative to central highlands and is attributed to differences in crop mix.

Table 1. Value of Crop Output Per Acre by Degree of Commercialization

Region	Value of crop/acre	Percent Commercialization
North arid	29,948	50
Coastal lowlands	6,843	13
Eastern lowlands	5,149	20
Western lowlands	6,761	22
Western transitional	10,965	40
High potential maize	14,126	51
Western highlands	8,275	34
Central highlands	21,653	50
Marginal rain shadow	4,839	17

Regions with high share of cereals in total crop revenue relative to industrial and horticultural crops have low revenues per acre. In High potential maize zone cereals account for over eighty percent of crop revenues. Industrial and horticultural crops account for 7 and 8 percent of the share of total crop revenue respectively. In central highlands cereals account for twenty nine percent of the total crop revenue while industrial and horticultural crops account for 45 and 25 percent of crop revenues respectively.

What is striking in Table 1 is the difference in commercialization and crop revenues per acre between central highlands and western highlands. Although both regions are endowed with similar agro-climatic conditions, crop revenue in central highlands is almost thrice the revenue in western highlands. This is partly attributed to differences in crop mix in the two regions. Cereals account for seventy one percent of crop revenues western highlands whereas in central highlands cereals account for twenty nine percent of crop revenue. In central highlands industrial and horticultural crops account for 45 and 25 percent share of crop revenue respectively. However, in western highlands industrial and horticultural crops account for 24 and 4 percent share of crop revenue respectively. But the share of revenues by crop is a function of land allocation decisions. In central highlands 53 percent of the cropped area is under cereals and 46 percent of the cropped area is under industrial and horticultural crops. In western highlands 72 percent of the land is under cereals and 28 percent of the remaining cropped land is under industrial and horticultural crops. The low share of industrial crops in total cropped area in western might be related to constraints in investment capital. Kodhek (1995) observes that the apparent reluctance of many small-scale farmers in Kisii (part of western highlands) to adopt crops like tea and coffee is inability to finance the establishment of such crops. Farmers in Kisii are able to self-finance much of their cash needs from payments for tea, coffee and bananas. However, the costs associated with the establishment of new tea and coffee mean that those depending entirely on their smallholdings are unable to finance shifts to these crops.

Table 2. Revenues Per Acre by Percent Share of Crop

		Percent share of revenue by crop type		
Regional zone	Ksh per acre	Cereals	Industrial	Horticultural
North arid	29,948	46.5	2.3	51.2
Coastal lowlands	6,843	44.2	0.0	55.8
Eastern lowlands	5,149	15.7	11.8	72.5
Western lowlands	6,761	58.9	34.7	6.4
Western transitional	10,965	36.8	51.0	12.2
High potential maize	14,126	84.7	7.2	8.1
Western highlands	8,275	71.4	24.1	4.2
Central highlands	21,653	28.9	45.7	25.4
Marginal rain shadow	4,839	34.0	0.0	66.0

Only farm-households with significant off-farm income can meet these costs. Kodhek's observation implies that the higher share of land allocated to industrial crops in central highlands relative to western highlands has a lot to do with off-farm income between these two regions.

Smallholders in central highlands receive significantly higher levels of off-farm income than western highlands. On average, smallholders in central highlands received Ksh 4,117 per month from off-farm income compared with Ksh 1,496 per month in western highlands. Low off-farm income in western highlands might be constraining them to shift to more value added crops like tea, coffee and horticultural crops.

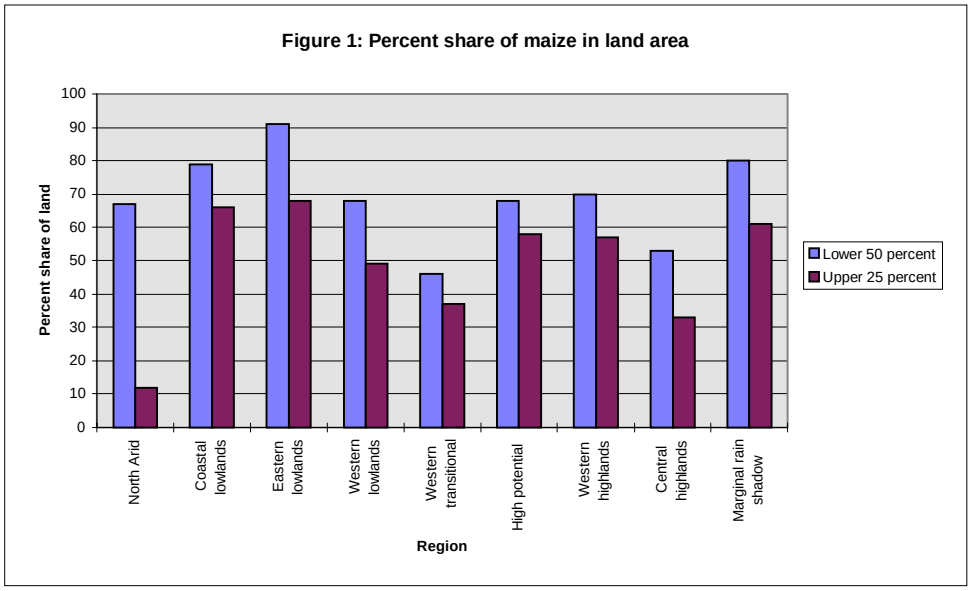
The evidence indicates that off-farm income plays an important role in allowing farmers to shift to higher-valued crops and hence increase their agricultural productivity per unit of land. The previous section has shown that inter-regional regional differences in crop revenue per acre is attributed to variations in commercialization and crop mix. But are there intra-regional variations associated with commercialization and crop mix? Land productivity figures shown in Table 1 conceals important intra-regional variations. A clear understanding of key issues in raising smallholder incomes and productivity within regions in Kenya require a disaggregated view where not only mean value of crop output per acre is required, but also information on the distribution of productivity within a region. This disaggregation allows for examination of household specific information that is concealed by inter-regional variations. One way of disaggregating land productivity within each region is to arrange crop revenues per acre in ascending order and then divide the population into distinct groups. In this analysis groups were divided into four (quartiles) in order of ascending magnitude of aggregate crop revenues per acre. The first and second quartiles were merged together to form the lower 50 percent of the population and their mean revenue compared with the fourth quartile (the upper 25 percent).

The striking thing in this disaggregation is the big difference in land productivity between the lower 50 percent and the upper 25 percent of the population in each region. In all the regions, the mean crop revenue for the upper 25 percent of the population is more than triple the revenues for the lower 50 percent of the population The big difference in revenue between these two groups is attributed to the degree of commercialization and crop mix. In all the regions except Eastern lowlands the value of crop sold relative to total value of output is more than 50 percent.

Table 3. Intra-regional Land Productivity Variations by Degree of Commercialization

	Revenue (Ksh/acre)		Percent commercialization (% value of marketed production)	
	Crop revenue quartile		Crop revenue quartile	
Region	Lower 50 %	Upper 25 %	Lower 50 %	Upper 25 %
North arid	2,381	107,053	35	88
Coastal lowlands	1,597	19,501	6	20
Eastern lowlands	1,775	12,498	11	38
Western lowlands	2,295	17,156	11	51
Western transitional	3,254	27,416	17	83
High potential maize zone	8,433	24,694	39	66
Western highlands	4,425	15,040	26	43
Central highlands	9,271	44,548	38	63
Marginal rain shadow	445	15,733	12	30

The low commercialization in the lower 50 percent of the population in all the regions is attributed to the growing of maize. All households in the lower 50 percent quartile put a higher share of their land to maize. This is depicted in Figure 1.



The emerging evidence from this section shows that in Kenya value of crop output varies from region to region. Regional differences in crop value are associated with variations in the degree of commercialization and crop mix. Regions and households with higher share of cereals (maize in particular) in total crop value and cropped land exhibit low crop revenue per acre. However, the determinants of agricultural land productivity are multifaceted and go beyond simply crop mix. Other factors hypothesised to be important in determining land productivity are intensity of fertilizer use, rainfall, soil fertility, the extent of improved seed usage, and perhaps socio-demographic characteristics such as the education of household decision makers, age and gender structure of the household, and access to farm credit. In the next section the influence of intensity of fertilizer use in agricultural land productivity is discussed.

3.2. Influence of Intensity of Fertilizer Use on Land Productivity

Fertilizer is one of the land augmenting inputs that is likely to enhance land productivity. Increased use of fertilizer leads to higher crop yields. Given the prevailing price levels, increased cropped yield translates into higher revenues per acre. It is hypothesised that fertilizer use is one of the factors determining variations in crop revenues in Kenya. This

section describes overall fertilizer use in Kenya and relates it to agricultural land productivity across regions.

The use of fertilizer is more pronounced in four out of the nine zones. These four zones are wetter and the rains are more reliable than in the other five. The minimal fertilizer use in Coastal lowlands, Eastern lowlands, Western lowlands and Marginal rain shadows could be attributed to production risk associated with rainfall. Where rainfall ie adequate, most crops will respond to fertilizer, and it becomes worthwhile to adopt better crop varieties bred specifically to respond to fertilizer. Where water supply is inadequate, most crops may not respond at all, or fertilizer may actually harm the crop by burning it. In these regions to promote fertilizer use attention needs to be geared first towards research on soil, water, and plant management under risky conditions that improves the effectiveness of water supply use. Secondly, there is need to improve smallholders' access to fertilizer through the distribution system. In the North arid region for example, despite the presence of irrigation to mitigate against rainfall unreliability, fertilizer use is minimal because the smallholders in the irrigation scheme rely on the Ministry of agriculture to provide fertilizer.of inherent fertile soils along the banks of rivers Tana and Turkwell. In the four regions, higher levels of fertilizer use are associated with higher revenues per acre. This is revealed by examining intra -regional variations in fertilizer use and crop revenue.

Table 4. Regional Fertilizer Use (Kg/acre)

Region	Value of output/acre	Fertilizer (kg/acre)
North arid	29,948	3.3
Coastal lowlands	6,843	1.4
Eastern lowlands	5,149	10.5
Western lowlands	6,761	6.3
Western transitional	10,965	22.0
High potential maize	14,126	56.5
Western highlands	8,275	28.0
Central highlands	21,653	106.0
Marginal rain shadow	4,839	9.6

Table 4 gives a comparison of fertilizer use per acre between the lower 50 percent of the income quartile and the upper 25 percent of the quartile. In all the zones, households in the upper 25 percent quartile use significantly higher amounts of fertilizer than those in the lower 50 percent.

Intra-regional differences in fertilizer use are linked to variations in crop mix. High levels of fertilizer use are associated with the growing of horticultural and industrial crops. In Eastern lowlands the variation in fertilizer use is attributed to the growing of horticultural crops (French beans in particular). Horticulture occupies 26 percent of the cropped land in the upper 25 percent quartile. In the lower 50 percent quartile horticulture is negligible. The

growing of horticultural crops by households in the upper 25 percent quartile could be attributed to climatic endowment and proximity to output market outlet. In eastern lowlands farmers in the upper 25 percent quartile are close to Nairobi-Mombasa main road and are thus contracted to grow French beans for export market.

Table 5. Intra-regional Fertilizer Use (kg/acre)

	Fertilizer use (kg/acre)	
	Crop revenue quartile	
Region	Lower 50 %	Upper 25 %
Eastern lowlands	0	35
Western lowlands	0	21
Western transitional	18	34
High potential maize zone	42	87
Western highlands	17	40
Central highlands	58	194
Marginal rain shadow	0	29

Table 6. Intra-regional Variations in Crop Mix

	Percent share in cropped land			
	Revenue/acre quartile			
	Lower 50 %		Upper 25 %	
Region	Indust.	Hort	Indust.	Hort
Eastern lowlands	1	3	4	26
Western lowlands	6	0	19	3
Western transitional	37	3	41	7
High potential maize zone	4	4	15	5
Western highlands	13	11	16	22
Central highlands	20	12	31	17
Marginal rain shadow	0	0	0	36

In the Western lowlands the difference in fertilizer use is attributed to the growing of industrial crops. Industrial crops (sugarcane) occupies 19 percent of the cropped land. In the lower 50 percent quartile industrial crops occupies 5 percent of the land. Households in the upper 25 percent quartile are close Chemelil sugar factory where they are contracted to grow sugarcane. In Western transitional zone the reasons for the difference in fertilizer use are not obvious. The share of industrial crops (sugarcane) between the two groups are not significantly different. The share of sugarcane in land area is 37 percent and 41 percent in the lower 50 percent and upper 25 percent quartiles respectively.

In the High potential maize zone the share of industrial crops is 15 percent in the upper 25 percent quartile while it is negligible in the lower 50 percent quartile. In the Western highlands the difference in fertilizer use between the two groups is attributed to the share of horticulture in the land area. Horticulture occupies 11 percent and 22 percent of the cropped land in the lower 50 percent quartile and the upper 25 percent quartile. In Central highlands the difference in fertilizer use is attributed to the share of industrial crops. Industrial crops occupy 20 percent of the land in the lower 50 percent quartile and 31 percent in the upper 25 percent quartile. In the marginal rain shadow the difference in fertilizer use is attributed to horticulture. Horticulture occupies 36 percent of the land area in the upper 25 percent quartile while it is negligible in the lower 50 percent quartile.

These results emphasize the importance of differences in crop mix in influencing variations in fertilizer use across regions. However, crop mix is partially a function of growing conditions such as rainfall and soil fertility. Institutional factors such as contracting arrangements that influence smallholders' access to fertilizer is important.

3.3. Partial Labour Productivity

Partial agricultural labour productivity measures the influence of labour in the value of crop output. Agricultural labour is comprised of family and hired labour. Data for hired labour for all crops were not available. So only the productivity of family labour was computed. The data used in the analysis is the size of the family in adult equivalents. Only members of the family involved in agricultural activities and are above 10 years old lived in the farm throughout the year (12 months) were included.

The results of the determinants of family labour productivity are consistent with those of land productivity. Agricultural land and family labour productivities are positively correlated and significant (0.64, 0.01). In all the regions family labour productivity rises with the degree of commercialization and fertilizer use (see appendix 1). The results of the the previous sections have shown that agricultural productivity varies with the degree of commercialization, crop mix and intensity of fertilizer use. What then are the strategic implications to enhance agricultural productivity?

3.4. Strategies to Enhance Agricultural Productivity

3.4.1. Crop Mix

The variations in partial land productivity in each region depends on crop mix. Households with higher share of industrial and horticultural crops in their cropped land exhibit higher agricultural productivity. A crucial agricultural productivity issue is whether to encourage food crop production or to promote production of cash crops. To identify the importance of various crop categories in enhancing overall agricultural productivity in Kenya, an estimate was made of the share of each crop category in total revenue relative to its share in overall land allocation in each region. The results are summarised in Table 7. A striking impression from Table 7 is the share of cereals in total cropped area relative to their share in revenue. In

all the regions except High potential maize zone and Western highlands, cereals occupy more cropped land than their share of revenue. Overall cereals account for 47 percent of crop revenue and occupy 78 percent of the cropped land.

Table 7. Share of Crop Category in Revenue and Land Allocation

	Percent share of revenue per acre			Percent share of crop in total crop area			
Region	Cereals	Industrial	Hort	Maize	Other cereals	Industrial	Hort.
N. arid	46.5	2.3	51.2	69.4	10.5	5.4	14.7
C. lowlands	44.2	0.0	55.8	77.7	5.7	0.0	16.5
E. lowlands	15.7	11.8	72.5	86.7	4.3	2.5	6.4
W. lowlands	58.9	34.7	6.4	56.4	27.7	14.3	1.6
W. transition	36.8	51.0	12.2	39.2	11.8	43.4	5.5
HPMZ	84.7	7.2	8.1	54.2	38.9	3.6	3.3
W. highlands	71.4	24.1	4.2	66.3	5.7	16.6	11.4
C. highlands	28.9	45.7	25.4	42.1	11.6	26.9	19.3
MRS	34.0	0.0	66.0	72.7	14.7	0.0	12.7
Mean	**47%**	**20%**	**33%**	**63%**	**15%**	**13%**	**10%**

Maize alone occupies 63 percent of the cropped land and accounts for 32 percent of the total crop revenue per acre. In all the regions except Western transitional and Central highlands, maize occupies more than 50 percent of the cropped land. This implies that smallholders in Kenya put a high premium in producing their own food in their land allocation decisions.

What then are the implications for the cropping pattern exhibited by the Kenyan households? There is evidence that agricultural productivity in the lower 50 percent income quartile could be enhanced by a shift from maize growing to industrial and horticultural crops. But why are poor households putting a higher share of their land to food crops? Crop mix is a function of rainfall pattern, resource endowment, market incentives/disincentives and other exogenous factors. To identify household level constraints, respondents were asked to specify which crops to grow if they were given additional land. Secondly they were asked to identify specifically which crops to grow for sale. The evidence from Table 8 shows that maize is an important crop. However, horticultural and industrial crops are important cash crops.

Table 8. Crops to Plant on Additional Land

Crops to plant			Crops to plant for sale	
Region	Crop	% Hhs	Crop	% Hhs
Northern arid	Maize	48	Vegetables	41
	Bananas	15	Maize	22
	Sorghum	11	Cotton	15
	Vegetables	18		
Coastal lowlands	Maize	52	Vegetables	28
	Coconut	11	Beans	25
	Beans	9	Coconut	15
	Vegetables	8		
Eastern lowlands	Maize	50	French beans	26
	Beans	12	Beans	25
	French beans	9	Vegetables	25
	Vegetables	9		
Western lowlands	Maize	50	Sugarcane	17
	Sugarcane	11	Cotton	13
	Sorghum	7	Vegetables	10
	Vegetables	5		
Western transitional	Maize	57	Sugarcane	33
	Sugarcane	16	Maize	15
	Vegetables	8	Vegetables	13
High potential zone	Maize	42	Maize	31
	Wheat	24	Wheat	26
	Vegetables	7	Vegetables	11
Western highlands	Maize	45	Vegetables	32
	Tea	23	Tea	29
	Vegetables	14	Maize	20
Central highlands	Maize	31	Tea	22
	Tea	11	Vegetables	17
	Fodder	18	Fodder	11
Marginal rain shadow	Vegetables	36	Vegetables	39
	Wheat	19	Wheat	19
	Potatoes	14	Potatoes	17

But if these crops are important for cash households what constraints them from growing them in the land allocated to other crops? Household level constraints to shift to cash cropping is given in Table 9.

Table 9. Endogenous Constraints to Increased Cash Cropping

Region	Constraint to grow cash crops	% Hhs
Northern arid	grow food first	15
	yield/disease risk	23
	Can't get right seed	15
	too little land	15
Coastal lowlands	grow food first	20
	yield risk	18
	too little land	13
Eastern lowlands	grow food first	21
	yield risk	11
	too little land	10
Western lowlands	grow food first	12
	yield risk	10
	too little land	10
Western transitional	grow food first	33
	yield risk	12
High potential maize zone	grow food first	32
	too little land	10
Western highlands	too little land	35
	grow food first	18
Central highlands	is not food	28
	too little land	14
	yield risk	12
Marginal rain shadow	Vegetables	39
	Wheat	18.6
	Potatoes	16.9

What is emerging from Table 9 is that rural households in Kenya put more emphasis in producing part of their food needs rather than wholly relying on the market. This means that if the food market was more reliable or less costly, they would be more willing to diversify into more profitable crops. However, they can't rely on the market to obtain their food needs, it

may be risky, and thus they forgo more profitable cropping patterns in order to reduce their risks of feeding themselves.

What is the implication for this? There is need to reduce costs in the food system given that many rural households are net buyers of staple foods, and require more efficient and less risky markets in order to take advantage of crop diversification.

3.4.2. Exogenous Constraints by Crop

Horticulture: Besides the endogenous constraints mentioned above there are other important external factors beyond the households control. Important cash crops mentioned above are vegetables, sugarcane, cotton and tea. Profitable vegetable growing requires that it is grown during the dry season when the prevalence of pests and diseases is minimal. But this requires the development of water resources since households mentioned weather risk constrain them from growing horticultural crops. Lack of proximity to water supply could be constraining domestic horticulture. Distance to the nearest piped water supply was used as a proxy to access to water resource.

Table 10. Households Access to Water

Region	Mean distance (km) to piped water
North arid	26.0
Coastal lowlands	8.5
Eastern lowlands	14.0
Western lowlands	8.0
Western transitional	7.0
High potential zone	10.0
Western highlands	8.0
Central highlands	1.7
Marginal rain shadow	18.0

The growing of more horticulture in Central highlands could partly be attributed to close proximity to water supply among other factors. The mean distance of households to water supply in Central province is 1.7 km by contrast 14 km in Eastern lowlands and 8 km in western highlands. low income households are far from water resource. Increased land productivity through the growing of more horticultural crops could be exploited by investments in the development of basic water infrastructure.

Cotton: Massive imports of duty free second hand clothes and cotton lint have dampened demand for local textile goods. This has resulted in the collapse of cotton industry. There

should be enforcement of policies with regard to duties on imported lint and second hand clothes.

Sugarcane: There are harvesting delays resulting in reduced income. This is a disincentive. Farmers in the sugar industry experience delayed payments from the sugar factories. The sugar factories are unable to sell their products because of cheap imported sugar. There should be enforcement of the policy with regard to duty on imported sugar.

3.4.3. Off-farm Employment

The transition to high value crops and increased fertilizer use is probably constrained by inadequate off-farm income. Poor household would be reluctant to shift to cash crops unless they are assured of income for purchasing food in the transition process. The purchase of fertilizer is related also to off-farm income.

Forty five percent of households finance their fertilizer purchase primarily by income from farming. Twenty five percent and 15 percent of households finance their fertilizer purchase typically from off-farm income/remittances and co-operative societies respectively.

Households in the lower 50 percent quartile receive significantly lower income than those in the upper 25 percent.

Table 11. Monthly Off-Farm/Remittance Income (Ksh) by Region

	Crop value quartile	
Region	Lower 50 %	Upper 25 %
Western transitional zone	1283	1744
High potential maize zone	1732	3666
Western highlands	992	1981
Central highlands	3088	4973

The evidence indicates that off-farm income plays an important role in allowing farmers to shift to higher-valued crops and hence increase their agricultural productivity per unit of land.

4. CONCLUSION

The determinants of agricultural productivity in Kenya are multifaceted and vary from region to region. However, in general poor households perceive the market to be too risky for the purchase of their food needs. This implies that these households can't rely on the market to obtain their food needs. The policy implication is that there is need to reduce costs in the food system so that households may be enabled to shift into higher-valued crops and increase their agricultural income without putting their families in jeopardy of acquiring food. More reliable food markets for rural consumers is a precondition to exploit opportunities for commercialization.

The evidence shows there is positive correlation between off-farm income and crop value per unit of land in Western transitional zone, Western highlands, High potential maize zone and in Central highlands. The evidence indicates that off-farm income plays an important role in allowing farmers to shift to higher-valued crops hence increase their agricultural productivity per unit of land. Policies that are geared towards the growth of off-farm income would enhance further commercialization and increase agricultural productivity.

Horticultural production is highest in Central province. This is related to proper distribution of water supply. There is need to develop basic water infrastructure to further commercialization in domestic horticulture.

There is need to enforce policies with regard to duty on imported textile and sugar to achieve further commercialization among cotton and sugarcane growing households.

REFERENCES

Alston, J.M., J.R. Anderson, and P.G. Pardey. 1994. Perceived Productivity, Forgone Future Fruitfulness, and Rural Research Resource Rationalisation. Paper presented at the Agricultural Competitiveness, Market Forces and Policy Choice, XXII International Conference of Agricultural Economists, Harare, Zimbabwe.

Government of Kenya (GOK). 1993 *Seventh Development Plan, 1994-1996*. Nairobi: Government Printers.

Jaetzold, Ralph, and Helmut Schmidt. 1983. *Farm Management Handbook of Kenya*. Vol. 2. Nairobi: Ministry of Agriculture.

Kennedy, Eileen, and Bruce Cogill. 1987. *Income and Nutritional Effects of the Commercialization of Agriculture in Southwestern Kenya*. Research Report 63. Washington, D.C.: International Food Policy Research Institute.

Kodhek, Gem-Argwings.1995. Kisii: Mixed Performance in a High-Potential , Small Farm District: In *Agricultural Policy in Kenya, Applications of the Policy Analysis Matrix*. Ithaca: Cornell University Press.

Pearson, Scott.1995. Introduction. In *Agricultural Policy in Kenya, Applications of the Policy Analysis Matrix*. Ithaca: Cornell University Press.

von Braun, Joachim, Eileen Kennedy, and Howarth Bouis.1990. Commercialization of Smallholder Agriculture: Policy Requirements for the Malnourished Poor. *Food Policy* 15 (February):82-85.

World Bank. 1991. *Trends in Developing Economies*. Washington, D.C.

APPENDIX

Table 12. Family Labour Productivity (Ksh/Adult Equivalent)

Regional	Crop value (Ksh per adult equivalent)				
	Mean	1st quartile	2nd quartile	3rd quartile	4th quartile
North Arid	12,046	904	1,934	4,548	39,630
Coastal lowlands	3,050	304	1,168	2,452	8,139
Eastern lowlands	9,176	1,108	2,442	4,816	28,608
Western lowlands	4,517	705	1,773	3,489	12,101
Western transitional	10,670	1,181	3,386	8,308	29,806
High potential maize zone	19,309	2,365	6,370	13,849	54,488
Western highlands	5,561	1,075	2,710	5,455	13,005
Central highlands	19,636	2,960	7,529	16,571	51,484
Marginal rain shadow	4,084	95	666	1,865	13,445

Table 13. Fertilizer Use (kg Per Adult Equivalent)

		Fertilizer use kg/ae Crop value per adult equivalent quartile			
Regional	Mean	1	2	3	4
North Arid	0.8	0.0	1.0	0.0	1.8
Coastal lowlands	0.6	0.0	0.0	0.0	2.3
Eastern lowlands	7.9	0.7	2.2	6.1	22.6
Western lowlands	5.4	0.2	0.2	5.4	15.9
Western transitional	22.6	8.3	15.0	22.5	44.6
High pot. Maize zone	74.0	14.0	24.0	66.0	190.0
Western highlands	20.0	3.8	10.0	24.8	41.0
Central highlands	96.0	18.0	46.0	83.9	237.0
Marginal rain shadow	7.0	0.0	0.1	5.4	22.9
Total	43.0	8.5	17.8	39.0	107.9