Chapter 8

Agricultural Enterprise and Land Management in the Highlands of Kenya

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This chapter focuses on the management of agricultural land by smallholder households in the highlands of Kenya. It draws mainly from several recent studies from the central highland areas near to the south and west of Mt. Kenya and the western highland areas to the north and west of Kisumu, which were led by the authors. The chapter also draws from a set of studies under the KAMPAP project.[1] See the appendix for a description of the key papers used in this synthesis. The main purpose of this synthesis is to understand constraints and opportunities for improving agricultural productivity in a sustained manner. The comparison between the central and western highlands offers considerable insights because one area consists of relatively dynamic and productive agricultural systems (central), and the other is relatively stagnant and unproductive (western).

The fact that very diverse agricultural and livelihood outcomes emerge from fairly similar initial physical-climate conditions is not unique to Kenya but occurs throughout the highlands of east and central Africa. It is hoped that this detailed synthesis and analysis will help to indicate research, development, and policy steps that can bring about positive changes in the areas beset by poverty. Specifically, this chapter attempts to:

1. describe agricultural systems in the Kenya highlands including enterprise choice, investment behavior, and impact on productivity and income,

2. identify factors behind different agricultural strategies pursued by households, and

3. develop feasible recommendations that can benefit the development of poor communities and poor households.

The Study Sites

In this study, we focus on the central and western Kenya highlands (see Figure 8.1 in the color insert for a map of the study sites). The reason for this is that they are similar in terms of rainfall and population density. In both cases, rainfall is ample (mainly between 1,400 and 1,800 millimeters) and can accommodate two cropping seasons. Population density ranges between 350 and 1,000 persons per square kilometer in most of the central and western highlands so that average farm sizes are between 0.5 and 2 hectares. The highland areas lying between the central and western parts (i.e., those in the Rift Valley Province) are different in that they are comprised of a disproportionate number of larger commercial farms.

Central Highlands

The central highlands lie between Nairobi and the slopes of Mt Kenya with an altitude ranging from 1,500 to 2,000 meters above sea level. Rainfall is bimodal and averages from 1,300 to 1,800 millimeters per year. There are two cropping seasons, with the long rain season starting from mid-March through July and the short rain season from mid-October through December. Our data are principally from Embu and Kirinyaga Districts, which are positioned to the south and west of Mt. Kenya. Most of the area is covered by clay soils except for a small area that is covered by loam soils. The soils are deep and well drained and are of good fertility. The average annual maximum temperature is as low as 20°C in the upper portions of the districts.

The Tea–Dairy Zone is located at higher elevations with precipitation rates of 1,800 millimeters per year, a very long cropping season, and good yield potential. The Coffee–Tea Zone at a slightly lower altitude has an average annual rainfall of 1,400 to 1,800 millimeters with a long cropping season and a medium-length cropping season. The Main Coffee Zone has a medium and a short to medium cropping season with an average rainfall of 1,200 to 1,500 millimeters. Finally, the Marginal Coffee Zone is at the lowest altitude of the districts and has a medium to short and a short cropping season and an annual average rainfall of 1,000 to 1,250 millimeters.

Population densities are high throughout the two districts, averaging over 400 persons per square kilometer in the more favorable agricultural zones. There is a high-quality tarmac road cutting through the districts and eventually leading to Nairobi. There are few other tarmac roads in the districts, however. Most roads are

dirt and are generally of good quality but, because of their high clay content, can become problematic during the rainy season. Piped water is not uncommon in the districts, but telephone and electricity are generally not available in the rural areas. The trade and marketing sector is quite active and innovative in central Kenya, encouraging the growth of commercial enterprises. All in all, central Kenya enjoys a relatively low rate of poverty compared to other provinces, with rural poverty rates ranging between 30 and 40 percent of the population (Republic of Kenya 1997).

Western Kenya

Similarly to central Kenya, there are two cropping seasons in western Kenya: the long rains from March to July and the short rains from September to November, with rainfall amounts ranging between 1,500 and 1,900 millimeters per annum. During the past decade, rainfall in the western Kenya highlands has been very reliable, perhaps the most favorable in all of Kenya. The altitude in the main study areas of Vihiga and Siaya Districts is between 1,400 and 1,700 meters above sea level. The topography has frequent ridges and valleys with a large area of moderately sloping land. Soils are deep and well drained. The area is considered to be of medium to high potential for agriculture, but soils are highly degraded from agricultural activities.

There is less variation in rainfall among our western Kenya sites than in central Kenya because of the influence of Mt. Kenya near the central Kenya sites. Although a sizable portion of the study area could accommodate tea or coffee as in central Kenya, these are largely absent from the landscape with the exception of sites near the single tea factory in Vihiga District. Instead, the predominant production system is production of seasonal crops during two seasons each year.

Rural population densities in some areas of western Kenya (e.g., Vihiga) are the highest in all of Kenya (at over 1,000 per square kilometer). Two main ethnic groups are found in the area, the Luhya (Vihiga) and the Luo (Siaya). There is a fairly dense road network, but the roads are of poor quality, including tarmac roads that are in disrepair. Other infrastructure such as telephone lines, water, and electricity is equally lacking. The potential for accessing markets is high, but actual commercialization of agriculture is lower in these areas than in nearby districts. The districts host a large number of NGOs that are active in agriculture. In terms of poverty rates, Vihiga and Siaya rank as among the very poorest of the districts with relatively high agricultural potential, with poverty rates of 58 percent and 62 percent, respectively (Republic of Kenya 1997).

Much of the data from western Kenya are derived from studies in 17 villages in Siaya and Vihiga Districts. Some results are from a census of over 1,600 households,

whereas others are from smaller subsets of them. The locations are very representative of most of Vihiga: very small farms and predominance of maize/bean farming.[2] Siaya District contains both highland and midland areas, but our sample is derived exclusively from the higher potential highland areas. There have been numerous studies in these villages, and sampling procedures have differed depending on the objective of the research. The individual studies are cited in the text so that more details of the data and households can be found by the reader. In central Kenya, our samples are drawn mainly from the coffee- and tea-growing areas, where dairy farming is also common. Two of the studies, however, do include some households in the lower-potential areas where maize production becomes more important. Most of the households in these studies were selected at random, although some have used different stratification methods. Again, these are cited in the text.

Household Resources and Agricultural Enterprises

Household Resources

Nuclear households are the main decisionmaking units over farming (in the sense that sons and their wives form their own household and manage their affairs without much influence of the parents) in both the central and western highlands.[3] These independent households are becoming increasingly diverse and complex as a result of the ravaging of HIV/AIDS and the pursuit of alternative livelihood options because of the small farm sizes. Western Kenya households seem to be much more affected, as for many years the number of female-headed households (in which the husband was working off-farm) has been high, around 30 percent of the population (Wangila, de Wolf, and Rommelse 1999). The mobility of individuals along with the effects of high death rates has led to the observance of many households headed by widows or composed of nonnuclear members. On the other hand, monogamous male-headed households are the majority in the central Kenya sites, as shown by recent studies (Murithi 1998; Njuki 2001).

The large outflow of men from households, especially in western Kenya, not only results in loss of male labor but increases the difficulty for households to make certain types of decisions regarding farm investment. Mugo (1999) shows that when husbands are away, there is considerable variation in the extent to which women are able to make decisions over land management. In terms of labor, men generally provide important roles in land preparation, cutting of trees, and caring for livestock. Women can assume these roles too, but their time is squeezed by other demands. The presence of two adults also enables households to simultaneously

practice good husbandry on their own land while earning cash by working off the farm. With a single adult, there are more serious trade-offs in selecting one or the other option.

In terms of available labor, given the high population densities in the highland areas, there is a large aggregate pool of local labor. But this does not translate directly into available labor for agriculture. First, many of the individuals are of school-going age and have only limited hours during the day to assist on the farm. Second, many of the educated young adults show relatively little interest in agriculture.[4] Last, agricultural wages must compete with other types of employment to attract workers. Where wages are attractive, there do not appear to be cases of observed labor shortages in Kenya, even when demand is high or seasonal. Thus, the relatively attractive piece rate wages for tea and coffee[5] harvesting lead to sufficient labor supplies in the central highlands. In western Kenya, there appears to be poor management of farm enterprises despite the presence of high man–land ratios. The reasons seem to be multiple, including lack of interest in working the land by the youth, lack of cash on the part of farmers, and low returns to the predominantly cereal-based production system.

The high population densities in both highlands imply that farm sizes will be small. The average farm size near the slopes of Mt. Kenya is between 1.0 and 2.0 hectares. Murithi (1998) found a mean of 1.9 hectares in the coffee zone. In nearby districts, a mean of 1.3 hectares was reported by Argwings-Kodhek et al. (1999). In most areas of the western Kenya highlands,[6] average farm size is somewhat lower, at between 0.6 and 1.0 hectares (Argwings-Kodhek et al. 1999; de Wolf and Rommelse 2000). As in most places in Africa, there is a noticeable variation in holding size, but there are very few large farms. For example, in the western Kenya sites, the range in farm sizes within a village is generally from 0.2 to 5 hectares. In both regions, farms consist mainly of a single parcel of land that is often in a narrow strip running from the top of a ridge (where the road and house are) down slope, possibly to a valley bottom. Land is acquired mainly through inheritance, but land purchases also occur, and tenure is considered to be secure. One difference is that in central Kenya most farmers hold titles to land, but in western Kenya, many farmers do not bother to update titles that are often in the name of their father.

Although both land and labor are limiting in certain cases, most farmers mention lack of cash as the most critical constraint. This stems from lack or irregularity of income, weaknesses in credit markets, and high demands for expenditures, both anticipated and unexpected. Expenditure needs are relatively high in Kenya because of the need to contribute to education and health services through cost sharing. In addition, unexpected expenditures related to increased numbers of funerals have stretched capacities of many households. Significant amounts of credit are available

only through membership in coffee or tea cooperatives. Other sources are informal, for example, through small community-based groups that generally provide modest resources. Income sources and sizes vary considerably across the highlands of Kenya, and these are analyzed in more detail in a later section. The net result of all these factors is that cash flow is often the main focus of management of households. Cash flow management leads to the foregoing of purchase of inputs, the hiring out of one's labor rather than working on one's land, and the searching for water and firewood over long distances rather than buying the resources on the market.

Current Agricultural Enterprises

Crops. Data on crop enterprises in western Kenya comes from a 1997 survey of all households (about 1,600) residing in a pilot area for agroforestry testing. Maize was the most predominant crop in these 17 villages, with only 10 households not growing any. Other common crops include local beans, bananas, cassava, sweet potatoes, kale/cabbages, and napier. Another set of crops, sorghum, tomatoes, and groundnuts, were grown by fewer than 50 percent of farmers. Sugar cane, which is the major crop produced purely for income, was grown by 31.2 percent of the households. Among the crops in Table 8.1, the mean and median number grown per farm is six.[7] Despite the large number of crops found on a given household, maize or maize–bean intercrops dominate the area under cultivation. For example,

Table 8.1 Crop production in western Kenya for 17 villages in Siaya and Vihiga districts

Crop	Number of valid responses	Percentage of households growing	Percentage mainly for own consumption	Percentage mainly for market
Maize	1,714	99.4	91.4	7.9
Hybrid maize	1,714	14.6		
Local beans	1,714	96.3	89.6	6.7
Bananas	1,713	84.5	68.9	15.5
Cassava	1,711	74.5	70.0	4.4
Sweet potatoes	1,710	74.2	71.7	2.5
Kale/cabbages	1,712	56.5	42.2	14.1
Sorghum	1,713	36.8	35.4	1.4
Tomatoes	1,712	12.1	8.6	3.3
Groundnuts	1,152	5.3	3.7	1.1
Sugarcane	1,147	31.2	23.5	7.5
Woodlots	1,697	79.8	57.9	21.6
Napier	1,710	42.0	36.7	5.2
French beans	1,701	2.1		2.1
Tea	1,607	0.1		0.1

Source: Wangila, de Wolf, and Rommelse (1999).

Owuor (1999) found that 66 percent of cultivated area was under maize in the western highlands.

In central Kenya, the major crops on farms are maize, beans, potatoes, vegetables (kales, tomatoes, spinach, onion, among others), french beans, and yams among annuals and coffee, macadamia, bananas, avocado, mango, tea, passionfruit, sugar, *miraa,*[8] and papaya among perennials. Njuki and Verdeaux (2001) found that farmers were growing an average of six different crops in the coffee and tea zones of Embu and Kirinyaga. This was more than the average number of crops in the adjacent lower zones (with lower rainfall and population density). With respect to the type of crops grown, farmers in the uplands grow crops more for the market than those in the lowlands. Market-oriented crops include tea, coffee, and horticultural commodities such as tomatoes, kales, cabbages, and fruit. Owuor (1999) found that a large portion of area was devoted to traditional industrial crops such as coffee and tea (27 percent) and to horticultural crops (19 percent). On the slopes of Mt. Kenya, the proportion of area under coffee was similar (26 percent) to that of maize monocrop or intercrops (28 percent) (Murithi 1998).

Thus, it is found that farmers throughout the western and central highlands produce a variety of crops, even on small farms, as population pressure intensifies.[9] Commercialization does not appear to alter the number of crops grown by smallholder farmers and indeed appears to increase the level of diversity according to area by reducing the "traditional" high allocation of land to cereals and substituting an array of market-oriented crops in their place. We shall come back to this point later in the analytic sections.

Livestock. Livestock production in the western Kenya system is mainly based on a semi-intensive dairy-meat-draft-manure system. This is largely with indigenous animals, as only 3 percent of the nation's dairy animals are found in the Western Province. On the other hand, the Western Province has 10 percent of the national indigenous herd. Because of land scarcity, confined grazing on farms or roadsides is dominant. This makes it relatively easy to collect manure, and indeed, this is the most widely used crop nutrient source, though in modest amounts (Place et al. 2002a). Livestock production in the area is based on local cattle and poultry, with few sheep, goats, or pigs, as shown in Table 8.2. The livestock population is notably small in the area, most likely because of livestock diseases, lack of veterinary services, and shortage of browse caused by land scarcity. Herd sizes are also difficult to increase or maintain because of cultural obligations such as funerals.

A large majority of households own cattle in the central highlands, as many as 90 percent in some areas. Among the farmers who own cattle, the average number held is 2.3 per household (Murithi 1998), nearly all being improved breeds or

Table 8.2 Livestock numbers in highland households of Siaya and Vihiga Districts, western Kenya

Livestock type	Farms	Animals	Percentage of farms with animals	Average herd/flock size (all households)	Average herd/flock size (households with animals)
Improved cows	1,702	178	4.3	0.11	2.41
Local cattle	1,703	2,051	53.3	1.20	2.26
Sheep and goats	1,703	771	16.9	0.45	2.68
Pigs	1,699	8	0.3	0.01	1.60
Poultry	1,642	7,738	72.3	4.71	6.52

Source: Wangila, de Wolf, and Rommelse (1999).

crossbreeds. All but about 6 percent are managed in zero grazing units (Murithi 1998). Cattle are raised mainly for milk production, with manure being the second most important reason. Farmers in the midlands have the highest number of goats: 1.06 compared to 0.92 in the uplands (the tea zone). Improved dairy goat breeds are increasing in number over recent years, spurred on by the Dairy Goat Association of Kenya. As is common throughout the highlands, central Kenya farmers keep a large number of poultry, and there are more cases of commercial enterprises than in western Kenya.

Tree growing. Western Kenya is characterized by three types of tree-growing practices. The first is the management of small private woodlots by farmers. As shown in Table 8.1, 80 percent of Siaya and Vihiga highland farmers had a woodlot on their farm. The woodlots consist overwhelmingly of *Eucalyptus* spp., which are popular with farmers because of their fast growth, straight trunks, and coppicing ability (regrowth from the stump). Eucalyptus trees are considered to be best for poles, but their use for fuelwood is also growing (as other species become rarer). In addition to eucalyptus woodlots, other timber trees such as cypress and *Markhamia* are grown on boundaries or near homesteads. The other common trees are tropical fruit species such as papaya, mango, and avocado. These are also found on most farms near homes, but are few in number, one or two per household. On average, farmers in Vihiga District had about 160 trees on their farms (Mugo 1999).

In central Kenya, the dominant tree on the landscape is *Grevillea robusta,* which was found to be grown by 86 to 94 percent of households on their boundaries (indeed, it is used to demarcate boundaries) (Mugo 1999; Njuki 2001). On average, there are fewer trees per farm in central Kenya, mainly because of the lack of woodlots as a result of the strong competition with other profitable enterprises. The average reported by Mugo (1999) for Kirinyaga was about 130 per

household, and Njuki (2001) found about 90 trees for wood on farms in the same farming zone.

Apart from *Grevillea,* fruit and nut trees are also common and have been reported on about 64 percent of farms. Among these, macadamia trees are the most well known and provide a good income. Macadamia was first introduced in the 1970s on a very small scale, and later they became more and more popular as an alternative cash crop. The traditional varieties were replaced by the grafted, shorter maturing, and more productive varieties as the market for macadamia grew. Avocado is also common in the central highlands, as are mango, papaya, and guava. Fodder trees are increasing in popularity because of the relatively large proportion of dairy farmers in central Kenya. In one area studied, Murithi (1998) showed that about 20 percent of dairy farmers had planted some type of fodder tree.

Agricultural Investment

In traditional agricultural development models, at low levels of population density and rudimentary access to markets, households would produce a wide variety of foods for subsistence needs. As markets developed, households would specialize into fewer commodities, generating surpluses in some, and obtain desired consumption baskets through market exchanges. In the central Kenyan highlands, this model has not followed to form (see above on the lack of specialization). First, the degree of specialization for the subsistence-oriented households in the highlands is more than might be predicted because maize is the primary staple food, dominating dietary intake. For instance, Rommelse (2001a) found that over 73 percent of energy consumed by households in Vihiga and Siaya comes from maize alone. Thus, a subsistence-oriented household will devote much of its land to maize with small amounts for complementary vegetables.

As population pressure intensified and farm sizes fell, there were essentially four options for households: (1) increase landholdings through purchases, (2) intensify production and increase yields from maize or other existing staples, (3) substitute into new agricultural enterprises, or (4) diversify livelihood strategies off farm. The first option is possible in the highlands, but finding additional land in close proximity to existing landholdings is not simple, and moreover, the poorest households would not afford the selling prices for land. Thus, it is a very limited option viable only for a minority of households.

The second option has been available for many years through the use of improved seed varieties and fertilizer, but high costs and lack of credit have limited the use of this option. More recent organic nutrient management systems have also been developed and disseminated in many highland areas. A major limitation of these components of the second option is that even with an increase in

yields, households with farms of 1 hectare or less will struggle to produce enough maize. Moreover, the low value of maize per hectare means that its exchange value for other needed items (e.g., medicines, schooling) is very low. This option has been emphasized primarily by Rift Valley farmers who still retain relatively large farms (this is the prime maize-growing belt of Kenya with many medium-scale farmers).

The third option of diversifying into higher-value agricultural enterprises is a strategy pursued by many farmers in the central highlands of Kenya. It is a strategy that requires good access to markets and the ability to produce a range of higher-value crops at a profit. As shown in the following section, Njuki and Verdeaux (2001) show that central Kenya farmers have adopted many new enterprises over recent decades.

The fourth option of diversifying out of agriculture is one that is pursued to some degree in almost all rural areas of Kenya. Argwings-Kodhek et al. (1999) report that nonfarm income is important in all regions. The nature and level vary across districts, and there is evidence that higher absolute levels of nonfarm income are positively associated with higher absolute levels of farm income. Thus, option 4 may be complementary with options 2 and 3.

All four options may be mutually reinforcing. Which one is likely to drive the other and under what circumstances is an important but generally unexplored area of analysis. Investments in education have clearly helped reduce poverty rates among households later formed by the recipients (Republic of Kenya 1997). There are examples of agriculture-led and non-agriculture-led poverty reduction from both regions. In the past, it could be argued that commercialization of agriculture was a major driving factor in poverty reduction in central Kenya. Now, there are increasing examples of retired or retrenched urban workers investing their savings or pensions in agriculture. Which option is best appears to be partly driven by locational factors (e.g., climate, market access) but also by household-level factors because there remains significant heterogeneity in resources and capabilities among households (see Jayne et al. 2003b for the inequality of landholdings in Kenya). We shall now explore some of the agriculture-based opportunities in more detail, including the extent to which they are accessible to the different regions and different households within each.

New crops or crop mixes. One of the strategies farmers have used to cope with reduced land sizes and changes in livelihoods has been crop diversification. In the central highlands, Njuki and Verdeaux (2001) found that farmers were growing between six and seven crops because of reduction in land size, loss of market for old crops, and opening of new markets for new crops. Area under annual crops can

be altered seasonally, but some of the important cash crops are perennials, and their area changes more slowly. Currently, there is little current investment in coffee because of a decline in coffee prices and mismanagement of the coffee cooperatives. Coffee output has thus fallen dramatically, but the area under coffee much less so. There is relatively high investment in tea in the upper lands and horticultural crops.

A recent study has documented the changing patterns of agricultural enterprises in the central highlands (Njuki and Verdeaux 2001). Table 8.3 presents a summary of the major changes in crop production in Embu, comparing the current situation to that at the time of independence (1963). Tea and potatoes were introduced at the time of independence. A large number of trees were introduced during the 1970s. A few crops, climbing beans, sweet potatoes, and passion fruit have all been introduced since the 1980s. Two of the most important crops, coffee and maize, had been cultivated in both periods, though there were strict marketing limitations facing African coffee producers prior to independence. This diversification into higher-value crops at the same time as average farm size is shrinking serves as a cushion against risky markets and testifies to a recognition by farmers that farming is a business and not just as a way of life.

There is much less known about changes in crop mix in the western highland areas. The response to market opportunities appears to be more uneven than in the

Table 8.3 Changes in crop cultivation before and after independence on the southern slopes of Mt. Kenya

Type of crop	Cultivated before 1963 but not now	Cultivated now but not before 1963	Time of introduction
Legumes	Pigeon peas	Climbing beans	1992–93
	Njabi		
	Cowpeas		
	Green grams		
Grains	Millet	Baby corn	
	Sorghum		
Root crops		Irish potatoes	1963
		Sweet potatoes	2000
Stem and fruit crops		Bananas	1970s
		Mangoes	1960s
		Avocado	1970s
		Tree tomato	1970s
		Passion fruits	1980s
		Pawpaws	1970s
Crops exclusively for sale		Tea	1963
		Macadamia	1970s

Source: Njuki and Verdeaux (2001).

central highlands. This may be because of its poorer access to the Nairobi processor and consumer markets, and therefore farmers face keener competition for the smaller regional market. For instance, informal market surveys have found that much of the vegetables found in Siaya markets come not from nearby farmers but from farmers in Nandi or Uasin Gishu Districts (more commercialized districts located along the western edge of the Rift Valley) (Rommelse 2001b). In areas where farmers are not well linked into market opportunities, there has been little incentive to alter production patterns. Within villages in Vihiga and Siaya, there do not appear to be strong differences in crop mix across households of different size or households at different stages of life cycle. That is, there are no apparent patterns of diversification or specialization emerging.

What drives the process of diversification, and which households can join the process? The chronology of agricultural development in the central highlands suggests that government investment in tea and coffee marketing and processing enabled a large number of households to establish these commercial crops. With these founding commercial enterprises, huge investments in improved dairy animals occurred, and with them additional horticultural crops and heavy input use. In the western highlands, there was no similar successful government investment (though some attempts failed). Yet, similar patterns of diversification into dairy and other commercial enterprises are found in the few areas where tea has been promoted. With recent troubles in the cooperative sector (tea excluded), more recent investments in diversification may have been funded from nonfarm sources. However, studies of farm and nonfarm interactions are lacking for rural Kenya.

Livestock types and inputs. At independence in the Mt. Kenya highlands, most people kept large numbers of livestock, cattle, sheep, goats, and poultry. The cattle were originally zebu and were grazed in paddocks. In the 1980s, there was introduction of crossbred and exotic cattle and a shift from paddock grazing to zero grazing. This was accompanied by a reduction in the number of cattle that farmers kept. The reduction of livestock numbers is best illustrated by the livestock numbers held by different generations of households (Table 8.4). Njuki and Verdeaux (2001) traced the number of cattle through three generations of households. The oldest generation had the highest number of cattle at the time of study and also had the highest number of cattle ever held. Moreover, all generations now have fewer livestock than they once had.

The lower numbers among the current generation have three main reasons. The exotic breeds were high producing and input intensive. In some cases, desired output levels could be achieved with fewer animals, and in other cases, high feed

Table 8.4 Difference in livestock numbers among farmer generations in Embu District

Generation	Number of cows	Largest number of cows ever held	Number of goats	Largest number of goats ever held
Generation 1	1.40	10.19	1.20	21.13
Generation 2	0.61	2.64	0.54	7.88
Generation 3	0.33	1.00	1.33	3.33
F value	5.688	11.184	3.225	1.183
Significance level	0.004	0.0001	0.43	0.315

Source: Njuki and Verdeaux (2001).

costs limited the number of exotic cattle that farmers could keep. The second reason is the reduction in farm size and lack of area for producing feed. Last, increased labor spent on nonfarm activities will tend to reduce agricultural investment across the board. The pattern for goats is somewhat different. Though current herds are smaller than those once held by households, today sizes are similar for different-aged households. Goats are becoming popular among the young in good part because new high-quality dairy goats are being promoted by NGOs using schemes that require little cash. Discussions with farmers also indicate that investment in goats may partly compensate for an inability to establish a dairy cattle system.

Nonetheless, the numbers of improved dairy animals held by smallholder farmers is impressive. It is estimated that there are slightly more than 2.5 million dairy cattle on 600,000 smallholder dairy farms in Kenya, the most in all of Sub-Saharan Africa (Peeler and Omore 1997). Central Province, with 27 percent of the stock, is home to the second largest number of improved dairy animals in Kenya. There are many accompanying investments that follow the improvement of cattle breeds. Some of the recent investments among central Kenya dairy farmers are in feeding regimens. Murithi (1998) found that among dairy farmers, 98 percent had planted napier grass, 18 percent had fodder trees, and 16 percent had planted high-quality pastures.

In western Kenya, as indicated in Table 8.2, one striking difference from the central highlands is the lack of investment in higher-grade cattle and accompanying investments in zero grazing. Very few households have such animals in the sample from Vihiga and Siaya. On the other hand, there is quite a significant investment in napier grass (Table 8.1). Some is used to feed local cows, but some is produced for sale by households without cattle. For instance, 7.4 percent of poor farmers were found to produce napier for the market as compared to only 2.5 percent of the nonpoor. There appears to be a reduction in livestock numbers across generations, similar to the results from the central highlands. The youngest household heads (below the age of 30) had on average 0.87 head of local cattle. Those between

40 and 50 had 1.09 head, and those above 60 had 1.49 head on average. The difference is highly significant, and the number of goats follows the same pattern.

Land investments and inputs. There is evidence to suggest that farmers in the central highlands make significantly more investments in soil management than their counterparts in the western highlands. First, Owuor (1999) found that fertilizer use intensity was highest in the central highlands (106.0 kg/acre). Fertilizer use on the higher-value crops was 194 kg/acre as compared to 58 kg/acre on the lower-value crops, so the mix of crops plays a key role in overall fertilizer rates. However, farmers apply nutrient inputs on most of the crops. Table 8.5 shows that a high proportion (75 to 92 percent) of farmers apply fertilizer on maize, potato, and coffee, and over half of farmers applied manure to all their crops (except for beans, which are normally not fertilized because of their nitrogen-fixing capability). Indeed, farmers placed the purchase of inputs among their top four expenditure categories in over 80 percent of cases in central Kenya, and about 30 percent of farmers felt that input investments ranked first or second (Murithi 1998).

In the western Kenya highlands, the amount of investment in land is much more varied across different sites, with our Vihiga and Siaya sites exhibiting little investment. Only about 20 percent of 1,636 households use fertilizer on a regular basis (Place et al. 2002a), and the amounts used per hectare are calculated to be about one-fifth (28 kg/acre) of those in the central highlands (Owuor 1999). There is somewhat more concentration on higher-value crops (40 kg/acre) as compared to 17 kg/acre for cereals. This low investment level is clearly linked to the relatively low use of industrial crops, horticultural crops, and high-yielding varieties of maize. Only 15 percent of 1,636 households reported the use of hybrids in 1997. Rommelse (2001a) found that the median annual expenditure on farm inputs (crops and livestock together) in western Kenya was about $15. On the other hand, organic nutrient input systems are currently being tested by a large number of households in western Kenya in good part because of a high concentration of NGOs in the

Table 8.5 Nutrient investments on major crops in the central highlands

Crop	Percentage of farmers growing	Percentage of farmers who apply fertilizer	Percentage of farmers who apply manure
Coffee	99	74	89
Macadamia	87	38	60
Bananas	59	11	56
Maize	89	92	57
Beans	82	27	17
Potatoes	69	90	69

Source: Murithi (1998).

region. Over 70 percent use animal manure, and about 40 percent use composting methods in Siaya and Vihiga. New agroforestry techniques for soil fertility management are also being tested by a good number of households (10 to 30 percent) where they have been introduced.

Comparing across the regions, Owuor (1999) reports that average fertilizer amounts per acre for the upper quartile of farmers in western Kenya is below the mean level of the lower half of farmers in central Kenya. These differences in nutrient investments are perceived by farmers to have had long-term effects on the soils as well. A study by Migot-Adholla, Place, and Oluoch-Kosura (1990) found that farmers in the central highlands overwhelmingly perceived their soils to be of higher quality than when they acquired the land (positive changes were reported by around 90 percent of farmers). The exact reverse was found among farmers in the western highlands. Thus, there is strong evidence of vicious poverty–environmental cycles at work in some regions while virtuous cycles exist in others.

Labor. One recent detailed study of labor has been undertaken in the central highlands. Njuki (2001) collected labor data by gender and by major crop during 1998, and some results are summarized in Table 8.6. Two major conclusions are evident:

1. Men and women both invest more labor in cash crops than in food crops.

2. Women invest more labor than do men in both food crops and cash crops.

The only activity where men contribute more labor than women is livestock raising. But even in this case, women's labor contribution nearly equals that of men. These results demonstrate the clear priority that households place on cash crops over food crops. Moreover, the idea that men are interested in commercial crops and women are interested in subsistence crops is dispelled by the fact that the ratio of female to male labor is similar for both types of crops. Because women often manage farms, either on a temporary basis when the husband is away, or because of death or divorce of a husband, the fact that women are active in the higher-value crops is very positive.

Driving Factors Underpinning Agricultural Investment

Macro and Meso Factors

In this section we highlight the major factors that could explain the remarkable differences in agricultural development between the western and central highlands.

Table 8.6 Allocation of labor by major crop in Kirinyaga and Embu Disticts

Activity/enterprise	Percentage of all labor allocated to the activity/enterprise (column percentage)	Women's labor as a percentage of total labor for each activity/enterprise (row percentage)
Food crops	13.8	70.2
Maize	4.4	68.8
Cash crops	49.9	67.6
Coffee	30.3	61.0
Tea	19.6	77.8
Livestock	10.6	47.6
Other resource management	3.8	96.5
Domestic	21.9	92.1

Source: Njuki (2001).

The key factors are highly linked to government policy and public investment. As a proximate factor, commercialization seems to be the most important. Throughout the previous discussion, the influence of markets and higher-value enterprises in central Kenya has been paramount. How did this occur? One obvious reason for relatively higher commercialization in central versus western Kenya is its proximity to Nairobi, where virtually all major agricultural processing firms are located. Also of great importance was government investment in tea and coffee factories in central Kenya. Because these had ready international markets, there was a steady inflow of income into the rural areas. Moreover, the tea and coffee associations provided credit to farmers, which helped to maintain high productivity levels. As global competition in these commodities has heightened, liberalization and the reduction of transaction costs may prove to be important in the future. Liberalization was certainly the most important policy change for the dairy industry. The role of culture is not clear, but there is more dynamism of individuals and groups in the central Kenya highlands (Place et al. 2002b). Whether this is inherent in culture or built from earlier successes is not clear. Last, it may also be useful to highlight the factors that are not important because of their similarity in both sites: rainfall, extension, and land tenure. In the following paragraphs we provide some illustrated examples of these factors.

There is a strong relationship between commercial orientation and agricultural development. Owuor (1999) shows that throughout all regions of Kenya there is a strong link among the proportion of crops marketed, the crop mix, and the value of crop production. For example, in central Kenya, the upper quartile of households according to value of crop production sells on average 63 percent of crops. On the other hand, the lower half of households sell only 38 percent of crops. The

favorable crop mix has pronounced effects (direct and indirect through incentives for investment in other areas) on crop income. Households apply much greater concentrations of fertilizer and other nutrients on their higher-value crops. The end result is that households with higher-value crops earn significantly more than do households with lower-value crops.

Expansion of market opportunities in Kenya has been strong throughout the dairy sector. With the relinquishing of control of purchasing and processing by a monopoly parastatal in the early 1990s, there was a mushrooming of private firms in the dairy sector. These firms innovated a range of new products and brands of cheese, yogurt, butter, and ice cream. Added to this was the already strong demand for milk by nearby rural consumers (consumers of fresh milk and milk-based tea). At lower levels of the chain, a variety of buyers for milk emerged, including the large dairy producers cum processors. By 1998, Murithi (1998) found that smallholders were utilizing a range of outlets for their milk, including local trading centers, their farms, neighbors, the government parastatal, and dairy cooperatives.

Complementing the influence of markets for outputs has been the availability of credit for farmers in the central highlands. This is one success of the government-supported cooperative sectors in coffee and tea. Murithi (1998) found that 76.8 percent of households in Embu had received credit through their membership in coffee cooperative societies. A further 23.2 percent received credit from the Agricultural Finance Corporation. These outlets are largely unavailable to smallholders in the western highlands, and there are no other major sources that might fill this gap.

Household Factors

In this section we highlight the roles that household factors have in farmer investment patterns. In central Kenya, there are certainly differences in agricultural practices among households. However, these differences are not so apparent in the types of enterprises adopted, as evidenced in Table 8.5, but rather in the management of and investment in these enterprises. Unfortunately, the factors that explain differences in such investments are not well studied in the region. Therefore, this section draws on detailed microstudies from western Kenya.

Household wealth is positively associated with the presence of many of the investments discussed above. Using a wealth indicator driven by criteria identified by villagers, we classified households in Vihiga and Siaya into groups of "very poor," "poor," or "nonpoor." The nonpoor households have:

- larger farms (2.5 acres compared to 1.4 acres for the very poor),
- more cattle (1.7 compared to 0.6 for the very poor),

- a higher proportion cultivating high-value crops (67.1 percent compared to 51.9 percent of the very poor growing kale; 13.2 percent compared to 8.1 percent of the very poor growing tomatoes),

- a higher proportion growing hybrid maize (25.2 percent compared to 6.8 percent for the very poor), and

- a higher proportion using fertilizer (33.6 percent compared to 8.3 percent for the very poor).

In terms of overall expenditure on agricultural inputs, one study found that the nonpoor spent approximately $100 per year, whereas the very poor spent only $5 (Rommelse 2001a). However, Place et al. (2002a) found that poor households do invest in labor or land-using practices such as manuring, composting, and agroforestry techniques for soil improvement at rates similar to those of the nonpoor. For instance, the very poor had improved fallows on about 11 percent of their maize area as compared to 10 percent for the nonpoor.

In terms of the influence of gender of household head, the following relationships were found in western Kenya:

- Women grow slightly fewer crops than men (5.7 compared to 6.2 for men).

- Women are less likely to grow high-value crops than men (31.0 percent grow napier compared to 48.0 percent for men; 11.4 percent grow hybrid maize compared to 16.9 percent for men; 6.4 percent grow tomatoes compared to 14.4 percent for men).

- Women have similar land sizes as men.

- Women have similar numbers of local cows, goats, and poultry as men.

- Women are slightly less likely to use chemical fertilizer than men (17.4 percent compared to 22.6 percent for men).

Descriptive analyses found that farm size and education also feature in differences across households. The causal relationships are not determinate, but farm size in these areas is relatively fixed, with inheritance passing ownership of more than 90 percent of all land area. Farm size is positively correlated with cattle ownership, use of hybrid maize, and use of chemical fertilizer. But it is not linked to whether

cash crops are grown. Farm size is also positively associated with education level, and education appears to be similarly critical in use of chemical fertilizer (e.g., fertilizer is used by 33 percent of those with secondary education and 11 percent of those with no education), use of hybrid maize, and the number of local cows owned. Education is also strongly linked to obtaining important off-farm income, and it is likely that the complementarities among education, agricultural assets, and off-farm income are key to household investment in western Kenya, if not throughout rural Kenya.

Effects of Investment and Land Management Choices on Income and Poverty

The purpose of this section is to assess the extent to which the abovementioned differences in agricultural investment translate into significant differences in income and poverty reduction. The first piece of evidence reported is a comparison of gross margins for different agricultural enterprises in central Kenya. Njuki (2001) measured outputs, inputs, and labor for 40 farmers during the 1998 growing season, and an analysis is presented in Table 8.7. In terms of gross margins (excluding own labor), it is clear that in the late 1990s coffee and tea were far superior to food crops such as maize, potato, and beans. Gross margins per hectare were between two and eight times those for the food crops. Returns from livestock farming were also relatively high. So shifts in relative enterprise mix can have a large influence on agricultural revenue. As demonstrated above, many households recognize these profitable opportunities and devote a high proportion of labor to them. However, households do not specialize in the highest expected return activities for several reasons. The key reason is economic risk both of finding markets for outputs and of obtaining a favorable price. Imperfect factor markets, especially for credit, hamper farmers' ability to access the necessary resources for the high input–high output farming systems.

The implications of this microanalysis are confirmed in a national study by Owuor (1999). In that study, a comparison is made between percentage area under cereals, industrial crops (coffee, tea, sugar), and horticultural crops and the percent of crop revenue that each contributes. Table 8.8 shows the results not only for the central and western highlands but for several other agricultural zones in Kenya. In most zones, the contribution of industrial and horticultural revenue to total crop revenue greatly exceeds the share of land under these crops. This is very evident in the central highlands, where the share of land area under industrial and horticultural crops is 46.2 percent, but their share of revenue is a staggering 71.1 percent. Thus, the central highlands have not only diversified into higher-value crops but have selected very profitable ones. On the contrary, though there is some diversification

Table 8.7 Seasonal gross margin for farm enterprises in central Kenya

Indicator	Coffee	Tea	Maize	Beans	Potato	Livestock
Output value (per farm)	258	272	32	31	35	135
Output value (per hectare)	947	1,035	65	52	137	—
Input costs (per farm)	22	48	14	4	10	43
Input costs (per hectare)	81	181	28	7	39	—
Hired labor costs (per farm)	12	25	6	13	—	
Hired labor costs (per hectare)	46	97	12	21	—	—
Gross margin (per farm)	223	199	13	14	25	92
Gross margin (per hectare)	819	757	25	24	98	

Source: Njuki (2001).

in the western highlands (28.0 percent of land under noncereal crops), these particular industrial and horticultural crops (e.g., sugar cane, cabbage) are not providing an incremental gain in revenue. The figure for average labor productivity summarizes this well. The productivity level in the central highlands is 3.5 times that in the western highlands, reflecting differences in crop mix, technical efficiency in crop production, and relative prices of inputs and outputs.

Do these differences in agricultural productivity translate into differences in household incomes? Argwings-Kodhek et al. (1999) show clearly that crop and livestock income play vital roles in total rural household income. It appears that farm and nonfarm income sources are complementary, providing investment funds for each other or at least secure bases that enable farmers to take risks in other ventures. In the central highlands, average total household income was estimated at $2,819. Of this, 39 percent or $1,099 came from crops, 24 percent from livestock, and 37 percent from nonfarm sources. Households in the western highlands earned 32 percent of income from crops, 29 percent from livestock, and 39 percent from nonfarm sources, which do not differ significantly from the pattern in the central highlands. However, total income for western highland households averaged only $1,014 (36 percent of the figure for the central highlands). Adjusting for farm size differences, central highland farmers earn 2.5 times the amount of crop income per person as western highland farmers. Similarly, livestock and nonfarm income are multiples of those earned by western highland households. In addition, average earnings for agricultural wage labor and nearly all other nonfarm occupations are higher in the central highlands than in the western highlands (Argwings-Kodhek et al. 1999). It seems that the high agricultural incomes from the central highlands play a significant role in stimulating the wider local economy.

So in aggregate, the investment in new enterprises and in intensifying crop, livestock, and tree production systems have led to significantly greater incomes for

Table 8.8 Contribution of different crop types to revenue generation

Crop	High-potential maize	Central highlands	Western transitional	Western highlands	Western lowlands
Share of land (percent)					
Cereals	93.1	53.7	51.0	72.0	84.1
Industrial	3.6	26.9	43.4	16.6	14.3
Horticulture	3.3	19.3	5.5	11.4	1.6
Share of revenue (percent)					
Cereals	84.7	28.9	36.8	71.4	58.9
Industrial	7.2	45.7	51.0	24.1	34.7
Horticulture	8.1	25.4	12.2	4.2	6.4
Land productivity (ksh/acre)	188	289	146	110	90
Labor productivity (ksh/adult)	257	262	142	74	60

Source: Owuor (1999).

central Kenyan farmers compared to their counterparts in other regions. In western Kenya, enterprise diversification has not yet been as extensive or profitable as in central Kenya. Consequently, intensification of production is lagging too, and low agricultural incomes are the norm. These general results mask important intra-regional differences between households, however. Jayne et al. (2003b) find that despite regional disparities, there exists substantial variation in household incomes within regions, districts, and villages. In line with the meso- and microanalyses in previous chapters, this shows that although getting the market economy right is an important antipoverty intervention, it by no means guarantees that all households can be uplifted. Special attention is still required for those households unable to seize opportunities in the agricultural or nonagricultural sectors.

Summary and Ways Forward

This synthesis began by demonstrating the significant gap in poverty levels between the relatively poor western highlands and the relatively better off central highlands of Kenya. It further tried to show the extent to which historical and current agricultural practices have influenced this divergence. Finally, policies and investments that have underpinned positive changes in the agricultural sector have been noted. A brief summary of this is shown in Table 8.9. In this section, we summarize those analyses and offer suggestions as to how agriculture could become more productive in the poverty hot spots.

In the Kenyan highlands, market development of higher-value agricultural enterprises is a strategy that has paid off for a large number of smallholder farmers. To reinforce the point that in the relatively market-oriented highlands of Kenya,

Table 8.9 Summary of comparative analysis

Indicator	Central Kenya	Western Kenya
Poverty rates	Low	High
Agricultural incomes	High	Low
Nature of agricultural enterprises	Diverse, commercial enterprises including perennials and high-grade dairy	Diverse, staple crops, local livestock breeds
Level of investment	Moderately high fertilizer use	Very little
Availability of credit	Mainly through cooperatives	No significant sources
Soil fertility management	Good, fertility improving	Poor, fertility declining
Public investment in agriculture	Tea, coffee, and dairy sectors with generally favorable results	Cotton and sugar mainly with mixed success
Private sector investment in agriculture	Dairy marketing, contract farming	Contract farming tried but not successful

food security is mainly about income generation (and not producing one's own food), Table 8.10 provides some data on sources of food consumed from western Kenya. The first striking fact is that households demand and consume a wide range of food products, and it is infeasible for households to produce all of these at sufficient levels. Second, it is easily seen that households are relying on market purchases, at least at times during the year, for most of the items, including maize. Rommelse (2001a) found that about 70 percent of household expenditures in the western highlands were for food. It is therefore clear that household food security would benefit significantly from enhanced income sources, whether from agricultural or nonagricultural sources.

Clearly, there are many examples of successful intensification from the central highlands. For this region, a key foundation has been either coffee or tea, both export crops with a ready buyer and supplier of inputs on credit. With these pillars in place, other commercial-oriented enterprises such as dairy, macadamia, pyrethrum, vegetables, and fruit trees were easy to accommodate.

This type of development pathway has escaped the majority of the western highlands. One factor has been the lack of parallel development of infrastructure for processing coffee and tea and to service high-quality animals. Proximity to Nairobi cannot be discounted as a factor. The end result is that much of western Kenya has focused on the development strategy of diversifying into off-farm activities. For the poor, this often means seeking jobs as agricultural laborers or relocating to Nairobi to work in the low-paying informal sector. These nonfarm strategies have yet to pay off for the majority of rural households.

Most households have invested considerable funds and foregone labor in the education of their children. Not only is this done on moral grounds, but it is expected to provide economic and social rewards to parents. In prior decades,

Table 8.10 Percentage of food consumption from own-farm production in Siaya and Vihiga

	Percentage of consumption from own production (range two visits)	
Food item	**Luhya**	**Luo**
Maize	19–46	59–66
Kales	38–56	71–75
Banana, cooking	83–87	88–96
Sweet potato	65–68	84
Beans	53–66	61–86
Cowpea leaves	83–96	76–92
Milk	24–31	24–27
Mango	44–78	87
Beef	0	0
Avocado	65–79	64–81
Banana, ripe	51–56	76–85
Cabbage	0–2	3–7
Chicken	51–78	97–98
Pawpaw	66–78	89–94
Egg	64–65	85–97
Rice	0	0
Cassava	0–33	53–75
Millet	20–38	8
Irish potato	0	1–11
Pumpkin leaves	51–55	68–88
Groundnut	28–36	21–40
Sorghum	41–59	20–66
Tomato	11	11

Source: Rommelse (2001a).

educating children to high levels was a poverty-alleviation strategy with a relatively high probability of success, even if after a long payback period. But now, education is only a necessary but not sufficient condition for a successful livelihood because job growth is poor if at all positive, and there are increasing numbers of educated job seekers. Furthermore, the costs of education at secondary levels and beyond are enormous. Thus, even this strategy requires the generation of funds for school fees. Where can funds for this or other large investments come from?

In central Kenya, it is clear that many households are able to generate significant sums of cash with which to meet such investments. It is thus more critical to explore possible ways to generate investment capital in the western highlands. We

cannot explore all the potential nonfarm opportunities in this chapter, so we offer a few immediate prospects within agriculture. In the Siaya-Vihiga food production area, the 10 most commonly sold items are: (1) vegetables, (2) chickens, (3) fruits, (4) poles and timber, (5) milk, (6) maize, (7) fuelwood, (8) beans, (9) eggs, and (10) cattle and goats (Rommelse 2001a). Of these, some are feasible for households with little cash. These would include short-term enterprises such as certain types of vegetables (e.g., kales, but not tomatoes) and chickens (starting on a small scale). Longer-term investments in trees for fruits, poles and timber, and fuelwood are also feasible in terms of requiring little cash (but require land and the ability to bear lengthy payback periods). But even these small investments may be difficult for the poorest households. There are several "first steps" that households could take to generate small sums of cash without having to invest cash. These include better husbandry practices with existing crops including an expansion in the use of organic nutrients. Thes major question is whether these incremental gains can be used to fuel further investment in agriculture because the competition for cash from different consumption needs is acute. Many integrated interventions would be required for rapid and widespread improvements in agricultural productivity to take place in poverty hot spots. In a place like western Kenya, with good potential for commercial production but small farms, increasing credit opportunities will be essential.

Appendix: Description of Key Studies Synthesized

Author	Topics covered	Geographic area covered
Murithi (1998)	Farming system description, especially dairy	Central Kenya 100 hhs
Mugo (1999)	Female and male decisionmaking and tree planting	Central and western Kenya 200 hhs
Wangila, de Wolf, and Rommelse (1999)	Description of farming practices	Western Kenya 1600 hhs
Owuor (1999)	Farm enterprises, inputs use, and productivity	All of Kenya 1500 hhs
Argwings-Kodhek et al. (1999)	Farming systems and income	All of Kenya 1500 hhs
Njuki (2001)	Female and male labor allocation, enterprise profitability	Central Kenya 200 hhs
Njuki and Verdeaux (2001)	Historical change in farming systems	Central Kenya Focus groups
Rommelse (2001a)	Farm investment, consumption and expenditure	Western Kenya 120 hhs
Place et al. (2002)	Soil management	Western Kenya 1600 hhs

Note: All studies reflect data collected in the period 1995–2000.

Notes

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1. The Kenya Agricultural Marketing and Policy Analysis Project of Tegemeo Institute, Kenya Agricultural Research Institute, and Michigan State University.

2. There is one tea factory in the north of the district, and the immediate surrounding area is more prosperous than elsewhere. Our data do not include these households.

3. Two corollaries to this are (1) the influence of seniority among Luo men living together on a single compound and (2) cases where land given to sons has not been officially confirmed as permanent by the father.

4. Young males in the Siaya and Vihiga are often maligned by local leaders as being lazy if not delinquent (Wangila 2000).

5. For coffee, this may have changed during the downturn in coffee prices in the early 2000s.

6. Including the high-rainfall areas of Kakamega, Vihiga, and Siaya. Exceptions are former resettlement areas (e.g., in Kakamega) and the drier areas to the west (Busia, Bungoma).

7. This may underestimate the true diversity because yams, tobacco, millet, onions, cow peas, groundnuts, finger millet, coffee, sisal, sesame, and soybeans are also grown in the area.

8. A woody species grown as a bush whose main product is a stimulant that is sold in Somalia and the Middle East.

9. The high potential maize zone spanning the edges of the Rift Valley is an exception whereby cereals account for 93 percent of cultivated area on more medium- or large-scale farms (Owuor 1999).