A situational analysis of agricultural production and marketing, and natural resources management systems in West Kenya

RESEARCH PROGRAM ON
Integrated Systems for the Humid Tropics

CGIAR

ILRI/*icipe* PROJECT REPORT


icipe
African Insect Science for Food and Health

A situational analysis of agricultural production and marketing, and natural resources management systems in West Kenya

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Contents

Tables

Figures

Acronyms

AEZ	Agro-ecological zone
ASDSP	Agriculture Sector Development Support Program
CIAT	International Centre for Tropical Agriculture
CIP	International Potato Centre
CRA	Commission for Revenue Allocation
CRP	CGIAR Research Program
ECA	East and Central Africa Action Area
FARA	Forum for Agricultural Research in Africa
GIZ	German Cooperation Agency
ICIPE	International Centre of Insect Physiology and Ecology
ICRAF	World Agroforestry Centre
IDO	Intermediate Development Outcome
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IPA	Innovations for Poverty Actions
ISFM	Integrated soil fertility management
IWMI	International Water Management Institute
KALRO	Kenya Agricultural and Livestock Research Organization
KeNHA	Kenya National Highways Authority
KEPHIS	Kenya Plant Health Inspectorate Service
KFS	Kenya Forest Service

KPHC	Kenya Population and Housing Census
KIHBS	Kenya Integrated Household Budget Survey
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KIRDI	Kenya Industrial Research and Development Institute
KWS	Kenya Wildlife Service
LBDA	Lake Basin Development Authority
LVEMP	Lake Victoria Environmental Management Project
NCPB	National Cereals and Produce Board
NGO	Non-governmental organization
NRM	Natural resource management
PALWECO	The Program for Agriculture and Livelihoods in Western Communities
R4D	Research for development
SA	Situational analysis
SHoMaP	Smallholder Horticulture Marketing Program
SRT	Strategic Research Theme
THV	Traditional high value crops
UNICEF	United Nations Children's Fund
VC	Value chain
WFP	World Food Programme
WUR	Wageningen University and Research Centre

Acknowledgement

We acknowledge Humidtropics, a CGIAR Research Program that aims to develop new opportunities for improved livelihoods in a sustainable environment, for funding this work.

Chapter 1: Introduction

The Humidtropics Program

The CGIAR Research Programs (CRPs) aim to align the research of the 15 CGIAR Research Centres and their partners into efficient, coherent, multidisciplinary programs. These exploit the full potential of collaborative research for tackling complex development issues. Seven of the CRPs aim to improve yields and profits of crops, fish, and livestock; they are largely commodity-focused. Three CRPs tackle the challenges of improving sustainability and environmental integrity, adapting to and mitigating climate change. Two overarching CRPs contribute to improving policies and markets and to improving nutrition and diets. One very specific CRP manages and sustains crop seed collections. Finally, three CRPs are unique in that they take a holistic system perspective cutting across different commodities. The Humidtropics system CRP focusses on dryland, aquatic and integrated systems and strives to improve the productivity, profitability, sustainability and resilience of entire farming and landscape systems. The three systems CRPs are intended to be the platforms where the research learning and outputs harvested from the other crop-focused, environmental- or policy-related CRPs are trialed in an integrated manner and their impacts measured on all of the production, marketing and natural resource management (NRM) in drylands, humid tropics and aquatic systems.

Among the three systems CRPs, the Humidtropics CRP led by IITA, seeks to transform the lives of the rural poor in tropical Americas, Asia and Africa. It uses integrated system research and unique partnership platforms for better impact on poverty and ecosystem integrity. Research organizations that are involved in core partnership with Humidtropics are AVRDC, Bioversity, CIAT, CIP, FARA, *icipe,* ICRAF, IITA, ILRI, IWMI, and WUR. As a research program for agricultural development, Humidtropics has four major objectives: reducing rural poverty, increasing food security, improving nutrition and health, and sustainable management of natural resources. Indeed, agricultural growth, through improved productivity, market development and income generation, has been shown to be a particularly effective contributor to reducing poverty, especially in the initial stages of economic development. Furthermore, access to affordable food is a problem for millions of poor in urban and rural communities and requires increasing global supply of key staples and reducing potential price increases and price volatility. In spite of increases in the production of key staples, poor populations spend most of their income on food and suffer from diets that are insufficient in proteins, vitamins and minerals, thereby affecting health and development, particularly among women and children. Finally, agriculture has a substantial impact on natural resources and must therefore be well managed to ensure sustainable ecosystem services, particularly in light of climate change.

To track the progress of the program towards reaching its objectives, the outcomes of Humidtropics are measured along six Intermediate Development Outcomes (IDOs). IDO 1 aims at 'Increased and more equitable income from agriculture for rural poor farm families, with special focus on rural women'. This IDO directly targets poverty reduction through increased incomes for the rural poor. IDO 2 is a complex target linked to nutrition: 'Increased consumption of diverse and quality foods from sustainable food systems by the poor, especially among nutritionally vulnerable women and children'. IDO 3 measures how 'Sustainably intensified pro-poor food systems in the humid and sub-humid tropics deliver improved farm-level productivity to all farming families in equitable ways'. It directly addresses productivity enhancement at the farm level. IDO 4 targets natural resources management (NRM),

which effectively protects or regenerates natural resource integrity at the farm and community levels: 'Improved management of natural resources is essential for sustaining increases in farm-level productivity and the provision of other ecosystem services'. The impact of Humidtropics on the empowerment of women and other marginalized groups is tracked through IDO 5: 'Empowered women and youth with better control over and benefit from integrated production systems'. Finally, IDO 6 is a complex social aspiration that the networks of people involved in Humidtropics and the policies and informal rules that form their working environment manage to foster innovations: 'Increased capacity for integrated systems to innovate and bring social and technical solutions to scale'. All of the IDOs are interrelated, just as the production, marketing and natural resources management systems they are supposed to track are interrelated.

Organized around four geographical 'Action Area Flagships', Humidtropics implements research for development (R4D) by testing innovations that respond to the challenges faced by stakeholders in the target field sites. To identify the current production, marketing and NRM systems the CRP has to work in, the CRP's Strategic Research Theme 1 (SRT1) on Systems Analysis and Global Synthesis proposes a series of research tools to gather robust evidence on the magnitude of the problems to be addressed.

The starting point for that evidence gathering and diagnostic activities required for the Systems Analysis and Global Synthesis is the situational analysis (SA), which paints a comprehensive and broad picture of the current systems that are key to tackling the problems faced in the target field sites.

The SA is followed by detailed characterization studies of production systems in the form of baseline household surveys, leading to household typologies and the description of the production and nutritional challenges faced by the different types of households in the target field sites. Identification of preliminary best-bet entry points for the CRP calculates trade-offs between possible interventions that could help tackle field site challenges. Through value chain assessments and business model identification exercises, SRT1 tools also identify agricultural commodities that make the most business sense to develop and the potential means to accomplish that. Finally, the global synthesis tracks the development of the production, marketing and natural resources management systems in line with the CRP's IDOs. These outputs from SRT1 activities, when discussed within the platforms of likely beneficiaries and research partners, help refine further field research activities for the CRP: pilot testing of technologies and strategies among producers; in-depth analysis of markets and value chains for target commodities and of institutional and policy environments; impact assessments of current and possible policies, of business and natural resources management models.

The SA aims to provide a broad set of information that will provide evidence to inform and tailor the subsequent exercises, and thus is not intended to look into the details of the target systems. Also, because the program by definition works in a consultative manner *through partners* in all aspects of the CRP, the SA also aims to create a joint and common understanding among all partners of the issues at hand, as well as to support the process of establishing strong and sustained linkages with stakeholders at multiple levels.

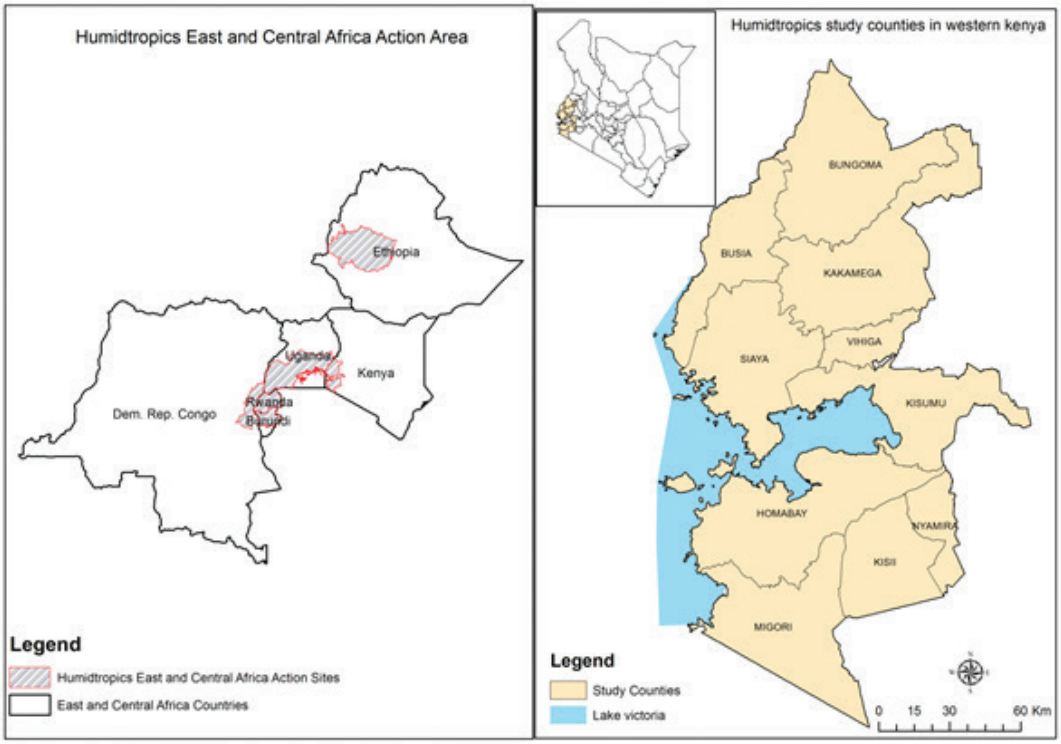
Given this context, the SA has three primary objectives. The first is to characterize broadly all important system aspects that are relevant to the CRP within the target action sites and, through that, generate information to inform all other Program activities to better attain the IDOs, as well as to inform ongoing field site selection. The second objective is to harness the various partner skills and experiences to develop a common and shared understanding of the issues that need to be addressed and potential solutions, particularly between international and national partners, allowing local and global expertise to play complementary roles. The third objective is to initiate and facilitate engagement with stakeholders and partners as part of the R4D platform development that is needed for the long-term success and scalability of the program.

West Kenya action site

The East and Central Africa (ECA) Action Area of the Humidtropics includes the humid and sub-humid tropics of West Kenya, Southern Uganda, the Ethiopian highlands, the Eastern region of the Democratic Republic of Congo,

Burundi and Rwanda (Figure 1). The Area is known to harbour about 78 million people who are mainly smallholder farmers, living on 29 million hectares of land resulting in an average population density of 263 persons per square kilometre. The area is uniquely endowed with great potentials in terms of water, soils, and human resources with a significant young population. Unfortunately, the area faces debilitating poverty levels with about 36% of the people earning less than USD1.25 per day and a substantial proportion of them experiencing a few to several months of food insecurity. Associated with food insecurity are high levels of child malnutrition. Ironically, in the face of food insecurity, a variety of staple crops, including maize, beans, banana, cassava, sweet potato, peanut as well as minor leafy greens and other vegetables are cultivated by farmers. The major cash crops grown in the area include coffee, maize, sugarcane, banana, soybean, Irish potato, cotton and tobacco. Livestock is a major asset for most smallholder farmers in the area though current livestock densities have been seriously affected by civil strife. The agricultural production systems and productivity in the area are in a sorry state of affairs due to a number of constraints that inhibit rural transformation.

Figure 1: Map of Humidtropics sites in West Kenya.



The right side of the Figure 1 shows the overall East and Central Africa Action Area that encompasses areas in Ethiopia, Kenya, Uganda, Rwanda, Burundi and the Democratic Republic of Congo. Within the West Kenyan Action Site, the eight second-level divisions, namely districts, taken as field sites for Humidtropics activities are shown.

Through a multi-stakeholder workshop held in Bukavu on 20 to 22 May 2013 (IITA 2013), Humidtropics has identified the following areas for integrated research and development actions in East and Central Africa:

- Crop-livestock intensification and interactions
- Productivity improvement, processing and market development for priority cash crops
- Integrating legume trees into agricultural and livestock production systems (Agroforestry)
- Sustainable intensification of crop productivity based on integrated soil fertility management (ISFM) principles
- Sustainable intensification of banana-and-coffee-based systems
- Integrated approach to nutritional diversity, sustainable resource use and climate adaptation.

These research initiatives to be implemented through R4D platforms will integrate gender and youth dimensions of smallholder agriculture.

A multi-stakeholder action site launch meeting for West Kenya was held in Kisumu on 10–11 July 2013 and decided to focus these entry points on key issues that were relevant to the counties in the West Kenya action site (WeRATE 2013). A separate exercise undertaken at this meeting led to the selection of four field sites based on the presence of organizations active in agricultural development and R4D partners, likely political support and success rate, and the ongoing presence of agricultural research activities. As a result, the rural field sites located in Kisai, Vihiga and Busia counties had at least one of the following entry points in common:

- Tree-crop-livestock integration, and in particular legume integration;
- Striga reduction;
- Post-harvest activities and linking farmers to markets.

For the field site located close to Kisumu city, the key entry points selected by participants were environmental conservation, linking farmers to markets and developing an enabling institutional environment.

The second section of this report details the methodology used in this analysis. The third section provides an overview of the development situation in West Kenya. The following sections characterize one after the other, the agricultural production systems, markets and institutions, and NRM systems. The final section identifies the overarching problems and issues brought out by the SA. It also provides suggestions for further Humidtropics research interventions to address them and thus attain the strategic development objectives of livelihood improvement, sustainable intensification, gender and youth empowerment and system innovation.

Chapter 2: Methodology

Implementing team

The first step in conducting the situational analysis for West Kenya was the formation of a scientific steering committee (supervisory committee) based on the stakeholder mapping and analysis in which the following institutions were members: Bioversity International, IITA, ILRI, *icip*e, ICRAF, CIAT and key stakeholders within West Kenya, including the Action Site Facilitator WeRATE. ILRI and *icip*e were the lead institutions with *icip*e monitoring the implementation of the activity on a daily basis while ILRI had an overall oversight role as funder of the SA. Two consultants, one on development overviews, markets, and institutions and another on production systems and natural resource management were recruited by the scientific steering committee to carry out the actual implementation of the SA. Individual consultants at the start worked independently and later integrated the two sections of the report together. The progress reports were presented monthly to the Supervisory Committee for the purpose of follow up, monitoring and discussions between consultants and the scientific steering committee in order to make the final product exhaustive and owned by the whole team.

Data used during the exercise were mainly sourced from the review of secondary information and validated through discussions and interviews of key informers in relevant government and non-government organizations (NGOs) both at local and national levels.

Secondary data

West Kenya comprises 10 counties and secondary information covering these 10 counties was reviewed according to the outline provided for the Humidtropics situational analysis (Cadilhon *et al.* 2014). Apart from extracting data on selected indicators, maps representing relevant information were extracted from already existing publications.

Most of the information for the situational analysis was from official secondary information from published peer-reviewed papers, research and development reports, donor reports about various aspects of western Kenya, institutional reports (research and development, including NGOs), academic theses, government (national and county) agricultural and development reports, web-based data sources, national census publications, etc. Most of the secondary information gathered ranged between 2000 and 2013, and 2009 national census publications formed an important source.

Workshops and write-shop

Four workshops were conducted and the first was held in the month of May 2014 in Kisumu. This mainly reviewed consultants' inception reports, assigned responsibilities to other stakeholders and the supervisory team in relation to information search. The second workshop was held in Kakamega in June 2014 to review the progress of individual consultants' sections and the final workshop held in Kisumu in July reviewed the consultants' combined report entirely.

The final two-day write-shop was conducted in December 2014 in Kisumu to finalize the summarized version of the consultants' report submitted earlier in October. During the write-shop, institutions were further tasked with extracting relevant information summarizing the four sections of the report before submitting to ILRI and *icip*e for final compilation.

Key informant interviews

Key informant interviews were conducted at the national, county, and sub-county levels. Experts in the Ministry of Planning, Agriculture, Livestock and Fisheries, Cooperatives, and Health were interviewed to validate secondary information reviewed from secondary sources. Selected NGO officials active in the West Kenya action site and some farmers were also consulted. Most of the key informants were consulted by phone while a few were consulted face to face.

Table 1: List of key informants and individuals consulted, by organization

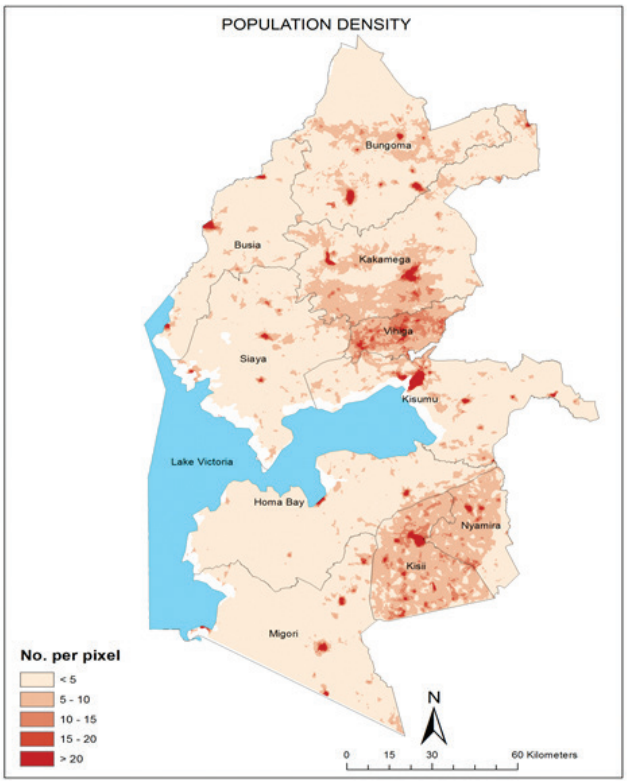
Name	Ministry or Department	County or National
Thomas Ogolla	Ministry of Livestock	Homa Bay
Oduor Mungao	Ministry of Livestock	Nairobi Headquarter
John Oloo	Ministry of Livestock	Kisumu
Frandinda K	Ministry of Livestock	Kakamega
Daniel Odero	Ministry of Agriculture	Nairobi Headquarter
Michael Okumu	Ministry of Agriculture	Nairobi Headquarter
Musa Otieno	Ministry of Agriculture	Busia-Irrigation
Judith Akinyi	Ministry of Planning	Homa Bay
Sonja	PALWECO	Busia
Johnson Imbira	Ministry of Agriculture	Kakamega
Edith Kiche	Ministry Of livestock	Homa Bay
Paul Tana	KALRO	KALRO-Kibos
Jushua Owiro	Ministry Of Agriculture	Kisumu
Mwangi Paul	LVEMP	Kisumu
Eng. Ngugi	LVEMP	Kisumu
Amos Amenya	KOSFIP	Homa Bay
Osumba Job	ACCI	Nairobi
HezeKiahOrwa	Ministry of Agriculture	Nairobi
Orero	CARD	NGO Migori
Olweny	CODA	Nairobi
Olwande	TEGEMEO	Nairobi
Okoko Nasambu	KALRO	Kisii
Henry Ogola	KALRO	Kibos
Muma	KIPPRA	Nairobi
Monica Olala	ASDSP	Nairobi
Koech Samuel	Plan International	Kisumu
Asman Wesonga	IPA	Nairobi
David Ombalo	Ministry of Agriculture	Nairobi
Patrick Magana	Dairy Goats Association and farmer	Kisumu

Chapter 3: Developmental overview

Context

The West Kenya action site is characterized by a diversity of landscapes ranging from the highland regions of Kisii and Nyamira to the South, and Vihiga, Kakamega and Bungoma to the North, to the lowland regions of Kisumu, Siaya, Homabaya and Migori around Lake Victoria. Population density ranges from 300 per km² in Mount Elgon, Suba, Bondo and Migori to over 1000 in Vihiga, Emuhaya, and Kisii districts (MPND and Vision 2030, 2009). Higher population densities especially in parts of West Kenya has put pressure on land resulting into year-round cropping and consequently to low soil fertility, low productivity and increasing food insecurity.

Figure 2: Population map of West Kenya action site.



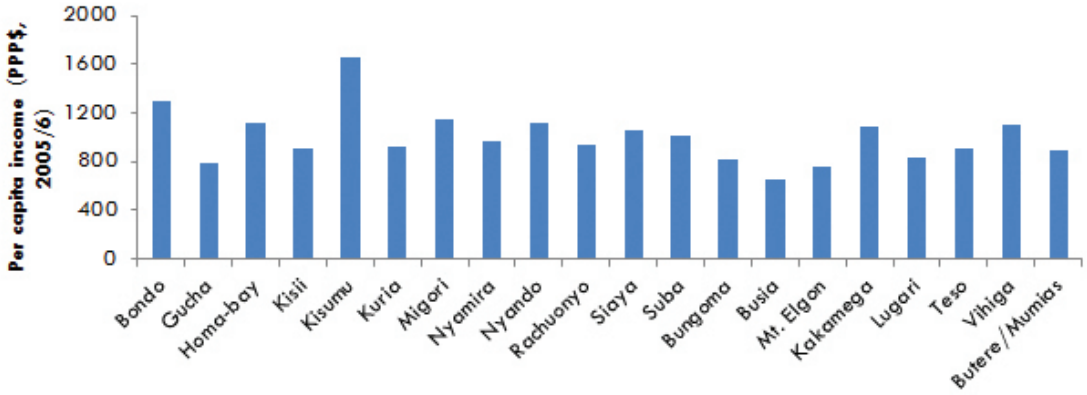
The action site is predominantly rural with households mainly depending on agriculture for their livelihood. Farming is largely small-scale and subsistence oriented except for a few cash crops such as tea in the highlands and sugarcane largely found in the lowlands. The region therefore continues to attract various government programs aimed at enhancing commercial orientation of smallholder households. Poverty remains high, though declining, with nearly half of the population in the two provinces that make up West Kenya living below the poverty line and with limited off-farm employment options.

Income levels, trends and poverty status

Income per-capita and poverty

Per capita income estimates from household expenditure in Nyanza and Western provinces was determined during the Kenya Integrated Household Budget Survey (KIHBS 2005). Nyanza province had higher average income (USD1093) than Western province (USD903), which is comparatively lower than Nairobi (USD4038). Within Nyanza, Gucha district had the lowest per-capita income followed by Kisii and Kuria districts, while Kisumu had the highest per capita income—more than double that of Gucha (Figure 3). In Western province, Busia had the lowest per capita income followed by Mount Elgon, while Vihiga and Kakamega were considerably better-off.

Figure 3: Per-capita income by district in Nyanza and Western provinces in 2006 purchasing power parity dollars (PPP USD)

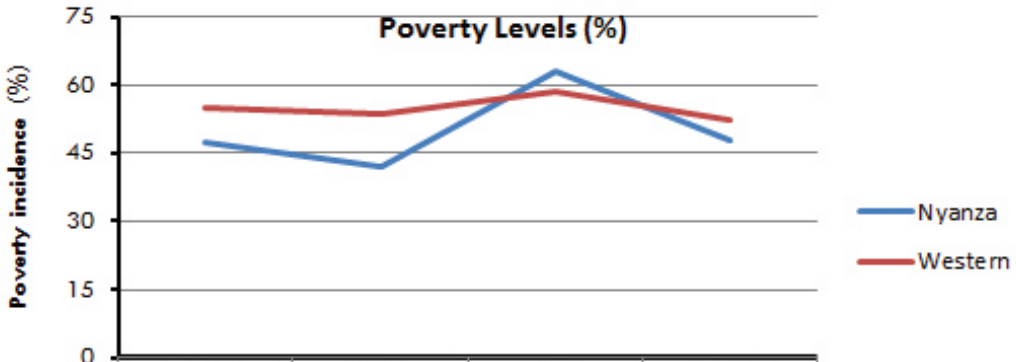


Source: KIHBS 2005/6.

According to the second Kenya National Human Development Report (2001), the national Gini coefficient was 0.571 in 1999. In the same year, Nyanza and Western provinces reported Gini indices of 0.586 and 0.565 respectively. In 2001 national inequality dropped slightly to 0.445, while in the rural Nyanza and Western provinces, it dropped significantly to 0.340 in 2005-6 (MPND 2006).

The poverty level in Western province remained relatively stable between 1992 and 2006 as can be seen from Figure 4. Nyanza on the other hand experienced a sharp rise in poverty between 1992 and 1997 before taking a downward turn in 2006. In that period, the richest rating was accorded to Central Province with a poverty incidence of 31%, followed by Nairobi (44%) and Rift Valley (48%). This trend indicates that those living below the poverty line in West Kenya though reducing, still account for about half of the population of the entire region.

Figure 4: Poverty trends in Nyanza and Western provinces between 1992 and 2006.

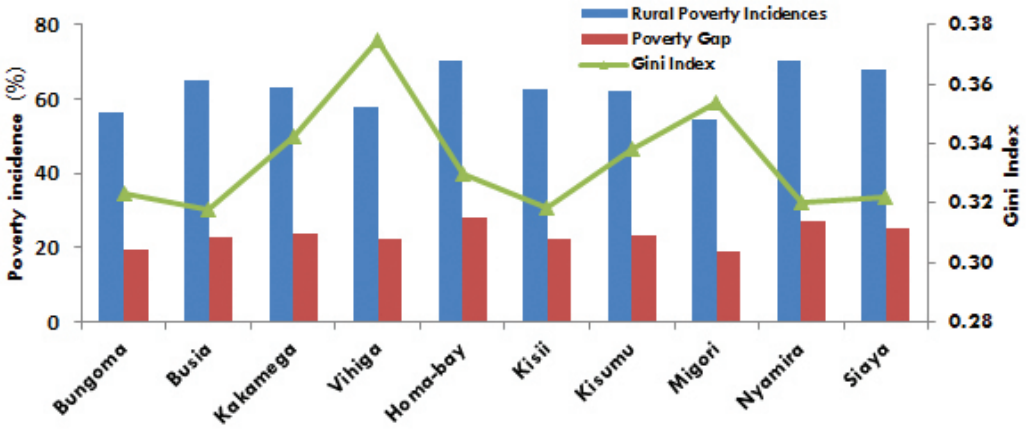


	1992	1994	1997	2005-6
Nyanza	47.4	42.2	63.1	47.6
Western	54.8	53.8	58.7	52.2

Sources: Welfare Monitoring Survey-WMS I II III of 1992, 1994, 1997; KIHBS 2006

Figure 5 shows incidences and severity of poverty as well as inequality levels at county levels. Homa-Bay and Nyamira have the highest poverty levels at 70% while Migori, Bungoma and Vihiga have the lowest poverty incidences. The poverty gap, which measures how much poorer the poor people are relative to the poverty line, followed a similar pattern. All the counties in West Kenya are quite unequal (Gini coefficient of 0.5—the national average) but Busia and Kisii counties had the lowest Gini index at 0.318 and 0.319 respectively, indicating slightly more equal societies. On the other hand, Vihiga (0.375) and Migori (0.354) were among the most unequal counties in West Kenya.

Figure 5: Rural poverty rates and gaps compared by Gini index by counties.

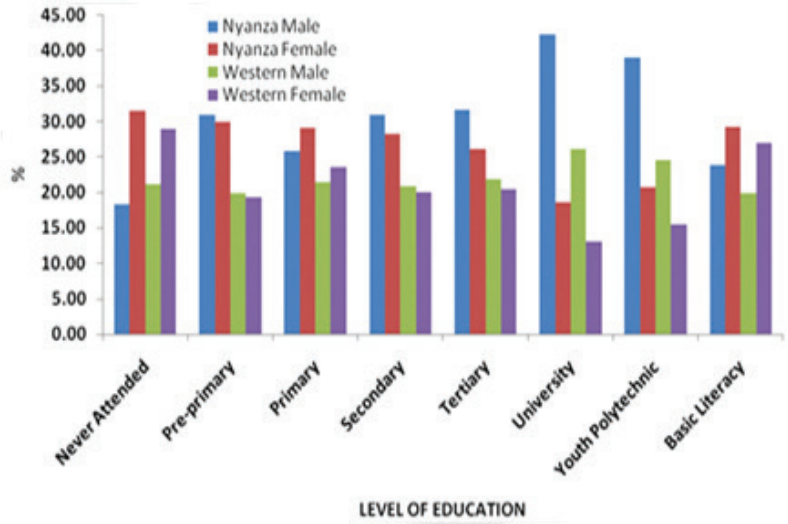


Source: CRA 2013 2011; CBS 2005.

Education

The proportion of women who never attended school in West Kenya (60%) is one and half times higher than that of men in the same category (MPND and Vision 2030, 2009). Male enrolment in pre-primary is slightly higher than female, a scenario which is completely reversed in primary enrolment where female enrolment is about 4% higher than male enrolment (Figure 6). Western province had a slightly smaller differences (2%) compared with Nyanza (4%). In spite of higher enrolment in primary schools, girls record lower transition into secondary schools. This scenario is slightly more pronounced in Nyanza than Western provinces and is also observed for transition into tertiary level colleges and universities.

Figure 6: Highest levels of education by gender for populations aged three years and above.

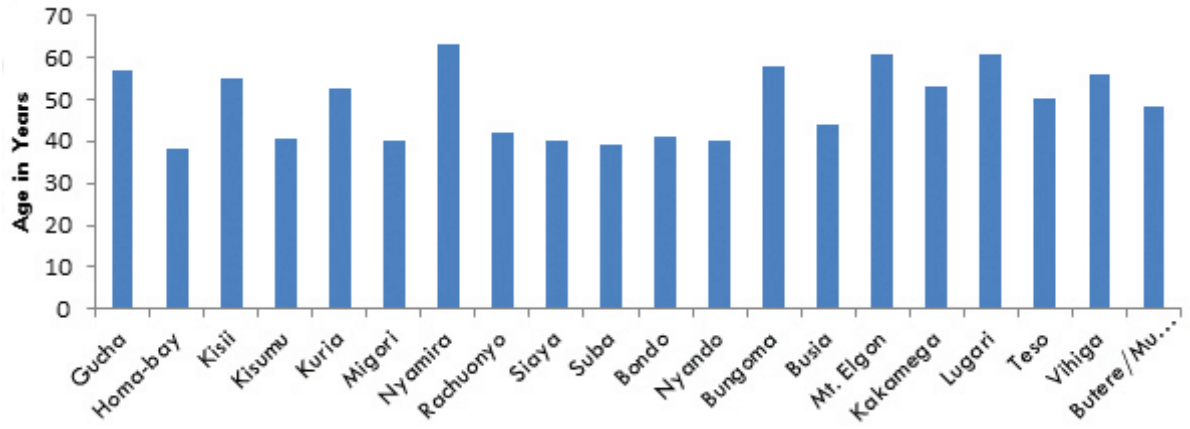


Source: KPHC 2009

Life expectancy, maternal death, and infant and child mortality

The average life expectancy is higher in Western province (52.8 years) compared with Nyanza province at 44.9 years (Figure 7). Within Nyanza, the low life expectancy (about 40 and below) were observed in all districts except Kisii, Nyamira, Kuria and Gucha, while in Western province, Busia had the lowest life expectancy (43.8 years). This is probably due to high incidences of HIV/AIDs-related deaths within districts bordering Lake Victoria region's border town of Busia.

Figure 7: Life expectancy by districts in Nyanza and western Kenya.



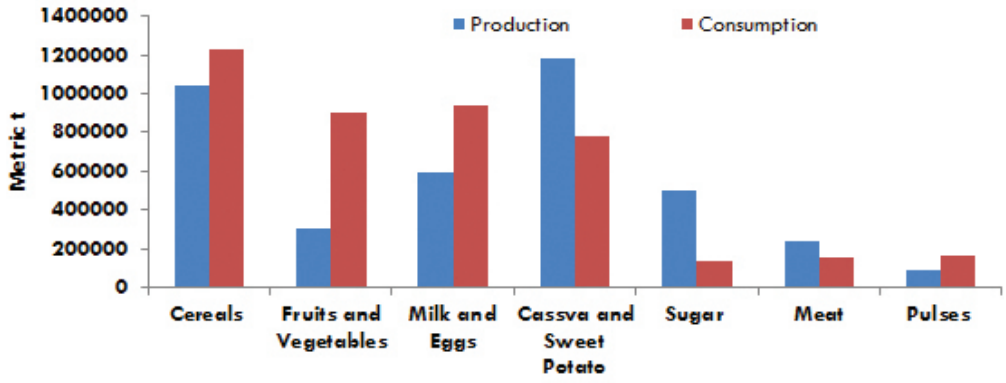
Source: KNHDR 2009

Food and nutrition security

Food security is said to exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

This can be evaluated in terms of the share of consumption that is met by total production of key agricultural commodities and mainly cereals (maize). Similar to other districts in West Kenya, households in Nyando, Homa Bay, Vihiga and Busia districts produced maize far below their household's requirement (FEWSNET/USAID 2005). Nyando produced 33,892 tonnes (t) against demand of 51,465 t, Homa Bay produced 41,420 t against demand of 47,819 t, Vihiga produced 35,077 t against 80,705 t and Busia produced 63,748 t, which was three-quarters of the district requirement. Key commodity balances were also estimated using the 2009 population census and production statistics of 2010. Within the region, production of sugar, and roots and tuber crops was higher than consumption while cereals, fruits and vegetables, milk and eggs, and pulses recorded under-production (Figure 8).

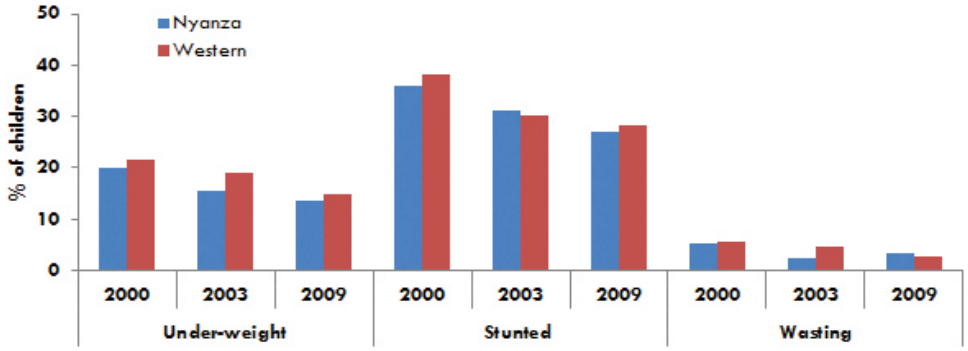
Figure 8: Estimated consumption and production of key food commodities in West Kenya.



Source: Author's own estimation 2010.

Additional to food security, nutritional adequacy is important for all members of households, but critically so for women and children. The nutritional status of children is measured from growth indicators including stunting, wasting and weight for age. Both Nyanza and Western provinces recorded a decline in the proportion of underweight and stunted children. There was also a small proportion of the children population who were wasted. Figure 9 also shows that slightly fewer children in Nyanza were underweight compared with Western province.

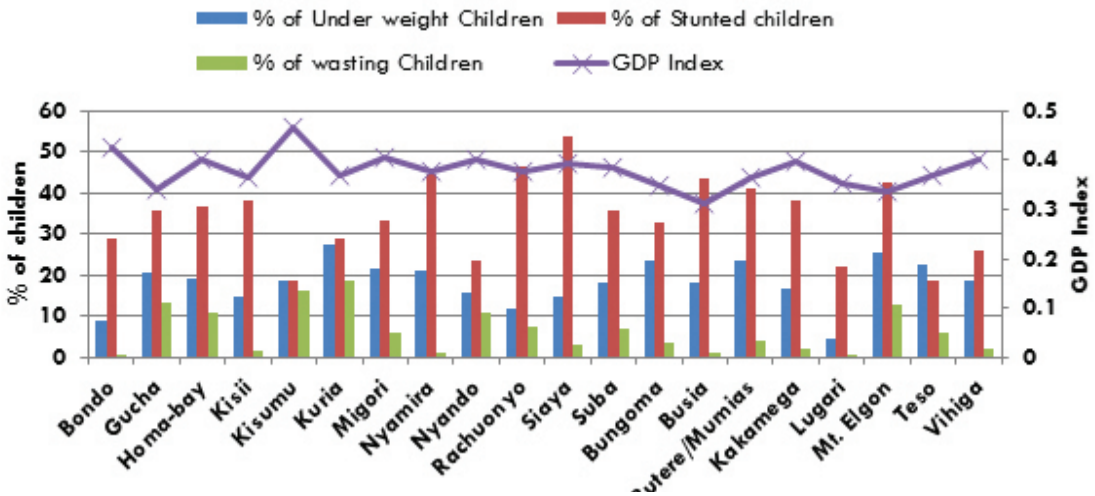
Figure 9: Trends in malnutrition between 2000 and 2009.



Source: KDHS 2008-9

Siaya, Nyamira, Rachuonyo, Busia and Mount Elgon districts had some of the highest proportions of their children population experiencing stunted growth. Figure 10 also shows that Kuria district had the highest proportion of underweight children. There is no obvious relationship between these measures of malnutrition and income levels. Kisumu stands out with the highest GDP index and low proportions of its children experiencing malnutrition.

Figure 10: Proportion of under-weight, stunted and wasted under-five children and GDP Index by districts.



Source: KIHBS 2005-6.

Nutritional status is also closely related to dietary diversity—consumption of various foodstuffs that guarantee provision of all nutritional requirements. Probably due to high incidences of poverty, most households in West Kenya are unable to consume diversified food items (Nyangweso *et al.* 2007). There is overreliance on cereals and vegetable as main staple food for most of the households in West Kenya (Franzo *et al.* 2010). Fruits are also significantly consumed especially bananas in Kisii and parts of Western province, and mangoes in part of Nyanza. Sources of protein including milk, fish, meat and legumes are consumed to a limited extent. Apart from maize, sorghum is another important cereal which was traditionally consumed by many households either pure or mixed together with cassava or maize. Finger millet is also traditionally produced and consumed in Kisii, Kuria, Teso and Mount Elgon. Additionally, roots and tuber crops, mainly cassava and sweet potatoes, are produced and consumed locally and are important crops for communities across the whole of West Kenya. Indigenous vegetables are equally important traditional food crops; however, consumption has shifted more towards production and consumption of exotic vegetables like kales and cabbages.

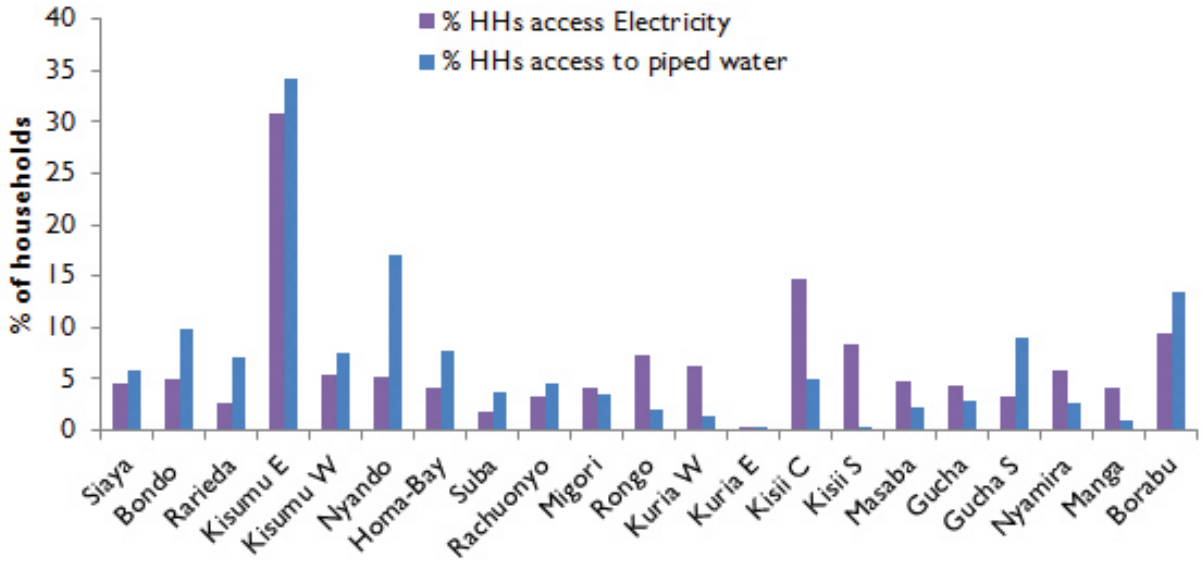
Trends in private investment in agriculture

Private investors in agriculture in West Kenya include dominion groups of farms which have invested in Yala swamp in the past seven years. Local banks such as Equity are giving agricultural credit to smallholder farmers, who are organized in groups and are in contractual arrangements with buyers, such as seed companies (Seed-co Limited, Kenya seeds, East Africa Breweries, etc.). Three new sugar factories have been constructed in the region in the last four years; Ndhiwa and Kibos in Nyanza and Butali in Western province. Kisumu Millers established and expanded a milling company in Kisumu for both human and animal consumption. Other animal feeds companies are located in Bungoma.

Infrastructure—roads, electricity, main ports and border exchange points

Access to electricity: Statistics from the Kenya Population and Housing Census (2009) reveal quite a varied pattern in terms of access to electricity and piped water. See Figure 11 and Figure 12. Kisumu East (>30%), Kisii Central (>14%) and Kakamega Central (>13%) recorded the highest access rates mainly due to high electricity connections in Kisumu City, Kakamega and Kisii towns and the surrounding urban centres in the recent past. Kuria East, Suba, Rarieda, Mount Elgon, Bungoma West and North, Butere, and Kakamega North and South are among the districts with the lowest electricity connections (<3%) in the region. Due to an aggressive rural electrification program, these figures may have changed since the last population census in 2009.

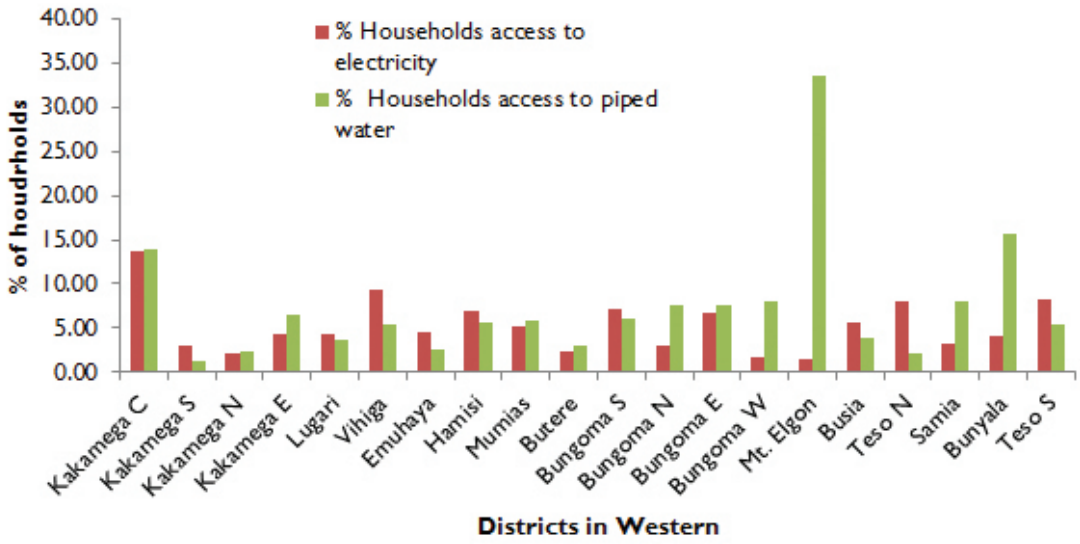
Figure 11: Electricity and piped water coverage by districts in Nyanza.



Source: KPHC, Volume II, 2010

Access to piped water: Figures 11 and 12 also show access to safe water for drinking and to basic sanitation as measured by the proportion of population using improved sanitation facilities. In addition to its association with disease, access to water for drinking may be particularly important for women and children, especially in rural areas, where women and children bear the primary responsibility of fetching water from far flung locations. Across the two provinces, Kisumu East and Mount Elgon are relatively better placed with more than a third of the households accessing piped portable water. Higher coverage in Kisumu East is probably due to its proximity to Kisumu city while the situation in Mount Elgon is possibly because it is a settlement scheme with planned water infrastructure. The majority of other places across West Kenya such as Kuria Suba, Masaba, Gucha, Rongo, Migori, Kisii, Nyamira all in Nyanza had just about 4% of households accessing piped water. The situation is not much better in Kakamega South and North, Butere, Emuhaya, and Teso North in Western province.

Figure 12: Electricity and piped water coverage by districts in Western province.



Source: KNPHC, Volume II, 2010

Average density of roads of different categories

Road network: Road networks open up remote locations and thus stimulate agricultural production and productivity via improved access to agricultural commodity and inputs markets. Table 2 below gives the proportion of good or fair roads and paved roads network as a percentage of total roads length in each county irrespective of road classification as at 2011 and 2012 respectively, and density of roads under Kenya national highway authority.

In West Kenya, Vihiga County has the highest proportion of paved roads at 6.3% compared with Homa Bay County whose proportion is at 0.2%. Nyamira and Vihiga counties also lead in terms of unpaved roads in good/fair conditions.

Table 2: length of classified roads and proportion of unpaved and paved roads by counties

Counties	% of paved road 2012	% of good/fair roads 2011	ABC: 2014 unpaved road (km)	ABC: 2014 paved road (km)	ABC: 2014 Total (km)
Vihiga	6.3	60.0	-	105.44	105.44
Kisumu	4.9	38.0	32.35	243.23	275.58
Nyamira	4.5	64.0	38.82	70.96	109.78
Siaya	0.7	50.5	51.19	233.87	285.06
Kisii	0.7	48.6	25.00	152.25	177.25
Bungoma	0.7	46.0	90.87	157.61	248.48
Busia	0.5	58.0	73.69	119.28	192.97
Migori	0.5	55.0	71.00	98.29	169.29
Kakamega	0.4	54.1	50.04	197.22	247.26
Homa Bay	0.2	42.9	92.71	140.97	233.68

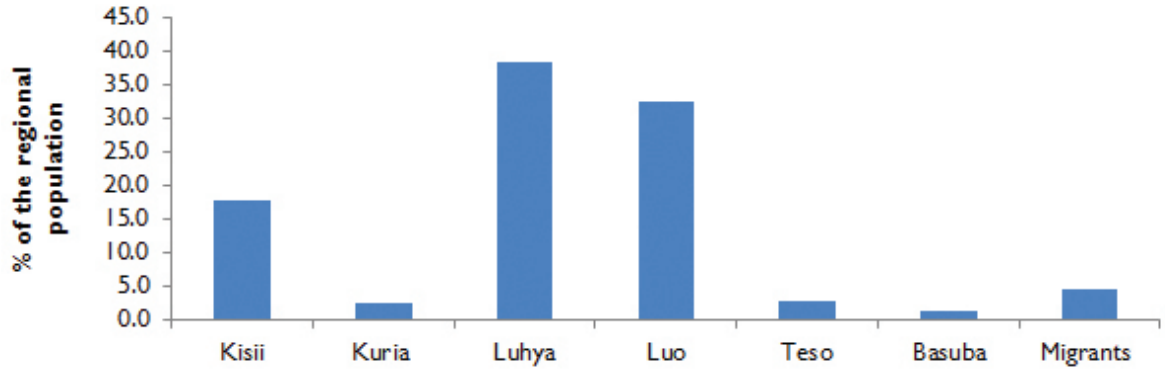
Source: (KeNHA 2014).

Roads in class A, B and C are under the management of Kenya National Highway Authority (KeNHA 2014). Kisumu and Siaya counties had the longest paved roads in these classes, while Nyamira and Migori had the lowest. This does not mean that Kisumu and Siaya counties have the longest overall paved roads since information on other road classes (D and E), which may also be paved but not reported, was excluded. An attempt to link road network (km and proportion of good/fair roads) and poverty incidences amongst the counties did not show any relationship.

Ethnic and cultural diversity and general roles of women and youth

Ethnicity and livelihood practices: West Kenya is composed of six main ethnic communities excluding migrants (Figure 14). Luyha are the majority and make up about 38.5% of the population, followed by Luo (32.6%), Kisii (17.8%), Teso (2.9%), Kuria (2.4%) and Basuba (1.3%). The migrants make up 4.5% of the West Kenya population. Luo and Kisii are mainly found in Nyanza, while Luyha and Teso are found in Western province.

Figure 13: Proportion of main ethnic communities in West Kenya.



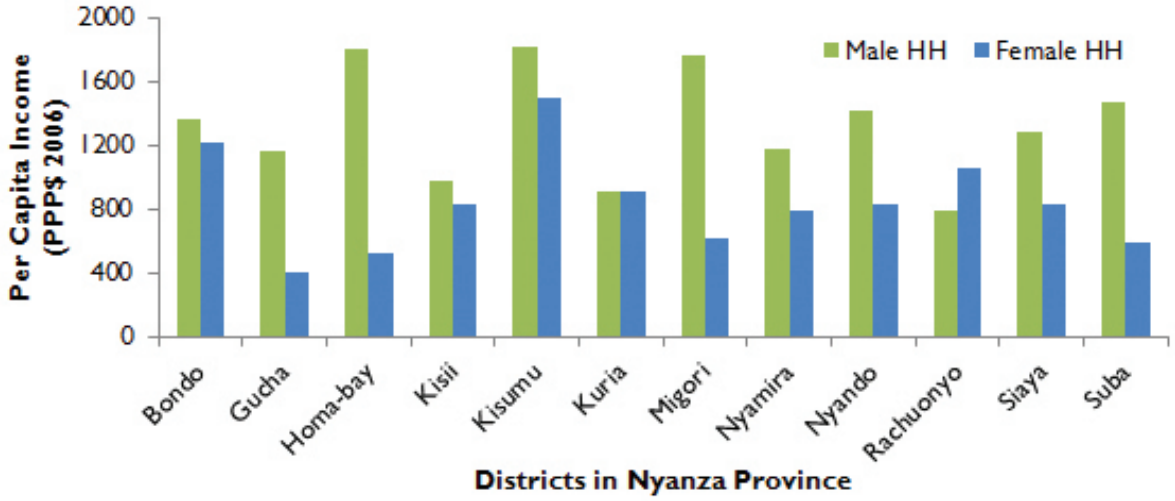
Source: KPHC 2009

The ethnic communities listed above are mainly smallholder mixed farmers, keeping livestock and practicing crop production. The Luo living along the shoreline of Lake Victoria are also engaged in fishing apart from extensive mixed farming. They also diversify in non-farming activities away from the village space. The Kuria community value local cattle and have not embraced improved livestock breeds, especially dairy cows, because they consider large herds to be a source of wealth rather than a source of livestock product such as milk. The main cash crop grown in Kuria is tobacco, while maize is grown both for cash and subsistence. The Kisii community on the other hand practice intensified crop production largely due to serious land pressure. They also keep improved or exotic breeds of dairy cows, mostly under zero grazing system. Due to land scarcity, the Kisii community has also diversified livelihood options into trade and business. Amongst the Luhya, diverse farming system is practiced depending on land availability and agricultural potential. In Vihiga where land pressure is the same as Kisii districts, the Maragoli practice a mixed system of intensified cropping while also keeping improved breeds of livestock. In the more land-abundant areas of Busia, most farmers keep local cattle under extensive grazing. Local poultry is kept by all the ethnic communities in West Kenya, more so in rural areas where nearly all households keep some indigenous chicken.

Role of women and youth in agriculture: Besides their reproductive role, women in Kenya provide about 75% of labour on small holdings, and 96% of rural women work in family farms (GoK1992). This scenario is replicated among communities in West Kenya, with a majority of women in rural areas growing mainly food and some cash crops in family farms. Women also keep livestock since most men are often engaged in off-farm employment and other non-farm livelihood activities. Amongst the Kuria ethnic community for example, women provide labour on tobacco farms for a period of nine months from nursery establishment to harvesting and curing while men are mostly involved in marketing. This scenario is the same for all cash crops grown in the region such as tea amongst the Kisii and sugarcane amongst the Luo and Luhya communities. Generally speaking, male-headed household are better off than female-headed households in the West Kenya action site (Figure 15).

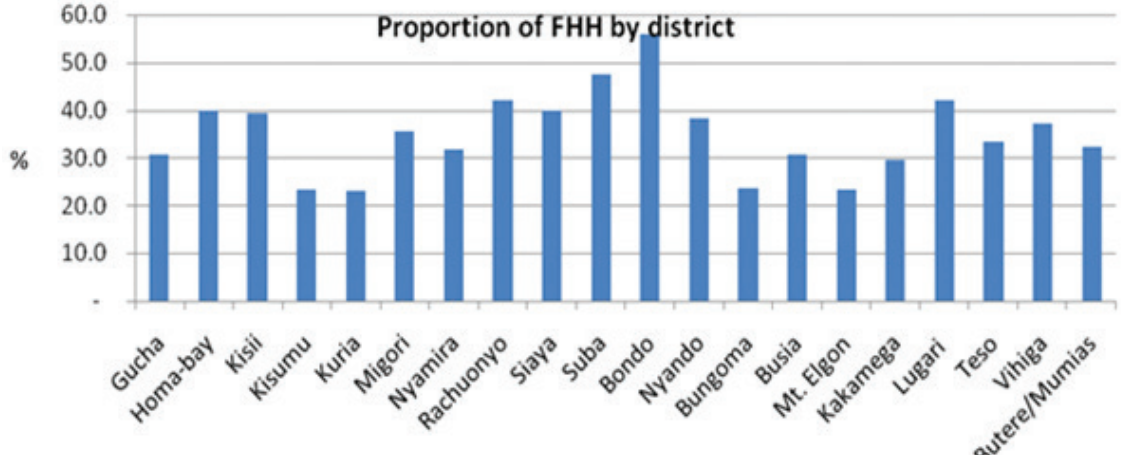
In terms of household headship, three in every ten households in Kenya is female-headed and this proportion is higher in rural areas (30.9% in rural compared to 23% in urban) (KIHBS 2006). Bondo district had the largest share of female-headed households (56%) while Kuria, Kisumu, Bungoma and Mount Elgon had lower proportions (Figure 16). In general, however, the proportion of the female-headed households showed a declining trend between 1999-2007 compared to the previous years (MPND 2006; Manyong *et al.* 2007).

Figure 14: Per capita income by gender of the head of household and districts in 2005-6 purchasing power parity dollars (PPP USD).



Source (KIHBS 2005-6)

Figure 15: Proportion of female-headed households by districts.



Source; KIHBS 2005/6

Summary

The status of income and poverty, food and nutrition security, and infrastructures development confirms underdevelopment of most parts of West Kenya when compared to other parts of the country. Towards addressing this situation, several development agencies and county governments are currently engaged in projects and program targeting the rural poor and vulnerable, including smallholder farmers in the action site. However, these efforts are yet to produce desired results probably due to lack of synergies, coordination and appropriate partnership.

Designing appropriate interventions, exploiting synergies and stakeholder partnerships may improve livelihoods via increased participations of majority smallholder farmers in various promising value chains. This would improve food and nutrition security, increase empowerment and reduce poverty in the long term. However, interventions must build on what the farmers are already practicing in order to realize sustainable outcomes. Moreover, sustainable interventions must take account of the disproportionate role of women in existing livelihood activities.

Chapter 4: Production structure

Introduction

The Western and Nyanza provinces that make up the West Kenya Humidtropics action site form part of the 20% arable land in Kenya. The region is characterized by high agricultural potential coupled with high population density, extensive land fragmentation and degradation (Crowley and Carter 2000).

The main agro-ecological zones (AEZs) range from Upper Midland (UM) to Lower Midland (LM); from 1000 to 2000 m above sea level in altitude. Kisii, Nyamira, Bungoma, Kakamega and Vihiga districts cover Upper Midland (UM1) and Lower Highland (LH1 and LH2) AEZs. Homa Bay, Rachuonyo, Migori, Kuria and Transmara occupy Lower Midland (LM1–LM5) while Kisumu and Nyando cover LM1-LM4. Rainfall varies from the lows of 900 mm in parts of Siaya and Kisumu to highs of 2000 mm in UM and LH AEZs of Kisii, Nyamira, Butere-Mumias and Kakamega among others. Rainfall patterns exhibit bi-modal distribution in most places and a few cases of tri-modal distribution in some parts of Kisii and Nyamira. However, there are a number of places where the short rains can hardly sustain crop production and are as such exposed to risks of seasonality, making them more vulnerable to frequent food insecurity.

Nevertheless, all these zones are suitable for crop production provided farmers use appropriate production methods. Average land size is 1.18 ha and 1.30 ha in Nyanza and Western provinces respectively (Manyong' *et. al.* 2005). Variations exist across districts and counties: 0.95 ha in Bondo and Kisumu; 1.40 ha in Nyando and Siaya; 1.50 ha in Bungoma; 1.38 ha in Busia; 1.60 ha in Teso; 0.77 ha in Vihiga; 1.17 ha in Butere and 1.70 in Kakamega. Mixed crop-livestock farming is predominant across all districts but livestock species and breeds vary depending on prevailing AEZ.

Figure 16: Map of agro-ecological zones.

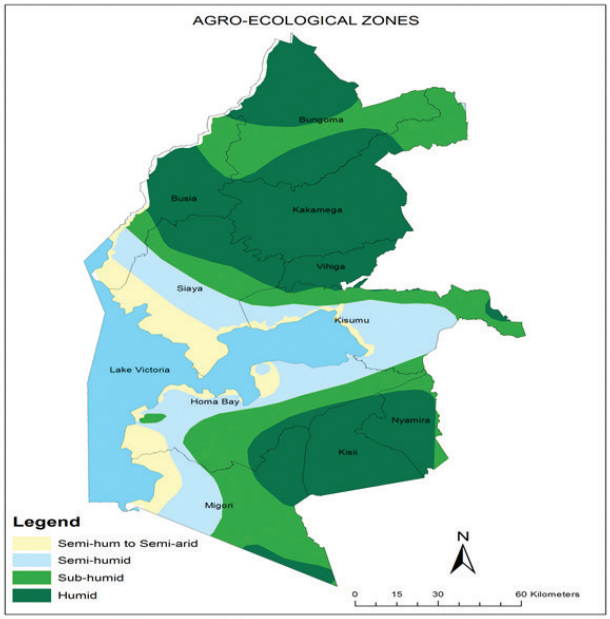


Figure 17: Elevation map.

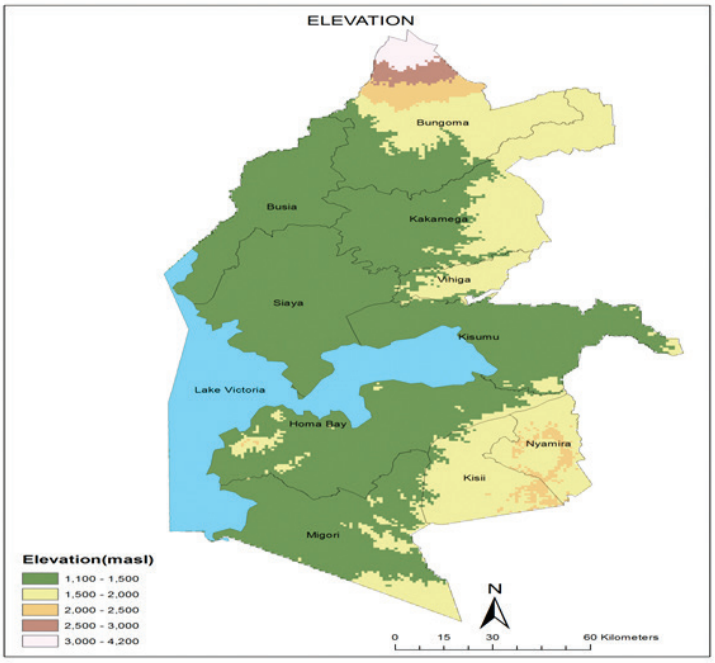
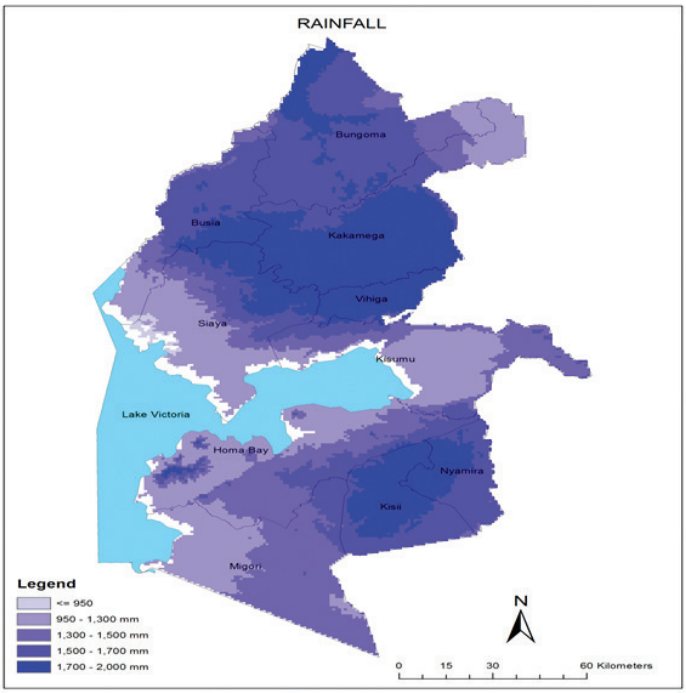


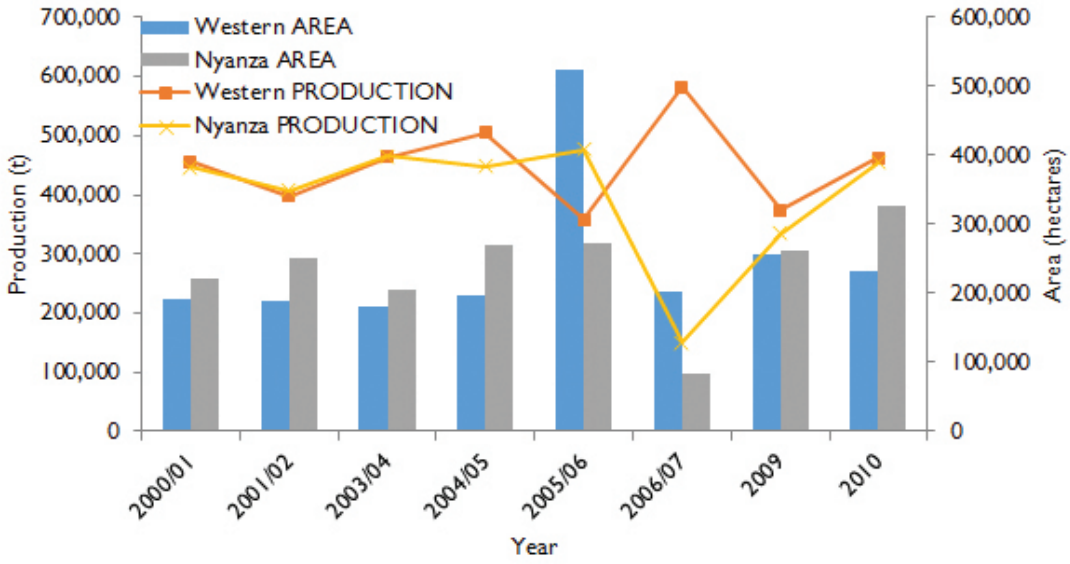
Figure 18: Rainfall maps.



Crop production systems

Production systems across all AEZs of the West Kenya action site are predominantly maize-based. Indeed the maize-based systems account for 43% of total arable land in Western province compared with 48% in Nyanza province (Manyong' *et al*. 2005). Depending on the AEZ, maize is either grown in a single season per year as in UH and LM1 and LM2 or twice a year as in LM3 to LM5. However, area under maize production fluctuates between years as is illustrated in Figure 20 and output also fluctuates depending on area allocation and weather conditions.

Figure 19: Trends in maize production by province between 2001 and 2012.

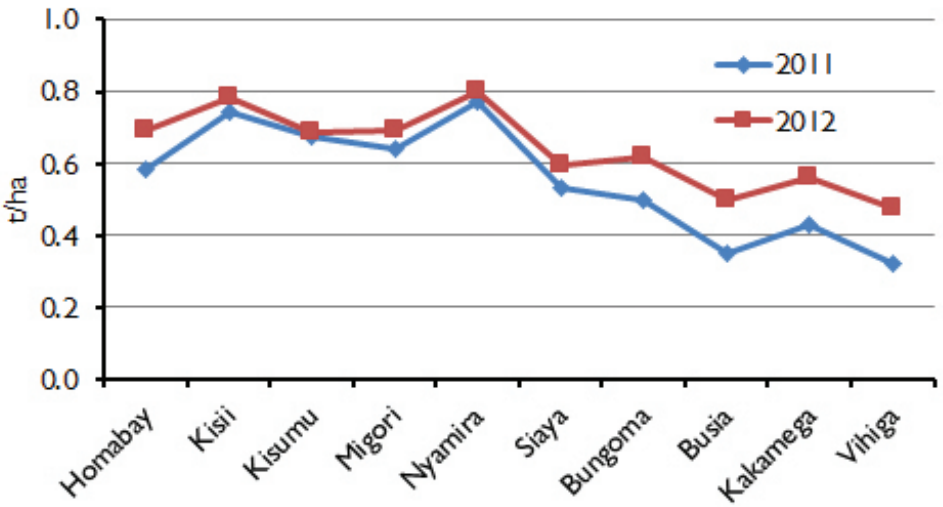


Source: Economic Review of Agriculture of Kenya

Maize productivity ranges between 1.5 t/ha on average in the marginal zones of Kisumu, Homa Bay, and Siaya to 3 t/ha in the higher potential maize zones of Bungoma and Kisii, which is low compared to the yield potential of most improved varieties (between 6 and 7 t/ha). There are also wide fluctuations in yields across the years mainly due to fluctuating weather conditions. Maize is commonly intercropped with legumes across the region with beans being the most popular intercrop grain legume and grown by over 90% of maize producers across the action site. Figure 21 shows yields for beans across different counties in West Kenya action site. While area under production is highest in Bungoma at 61,000 ha and Kakamega at 56,000 ha, Nyamira comes third (52,000 ha) in area allocation and has the highest yields (FMH 2007).

Other intercropped legumes include peanuts in LM3 and LM4 regions of Busia, Siaya and Homa Bay counties and soybean that is gaining prominence due to its nutrition quality and soil fertility replenishment. Western Kenya accounts for more than 90% of the total Kenyan soybean production (Tinsley 2009). Nyanza and western provinces are the most suitable places for soybean accounting for 15% and 13% of the 224,000 ha of land nationally that is suitable for soybean production (Chianu *et al.* 2008). Besides human consumption, soybean is largely utilized in the manufacture of livestock feed. Indeed, only 20% of soybean output is used for human consumption.

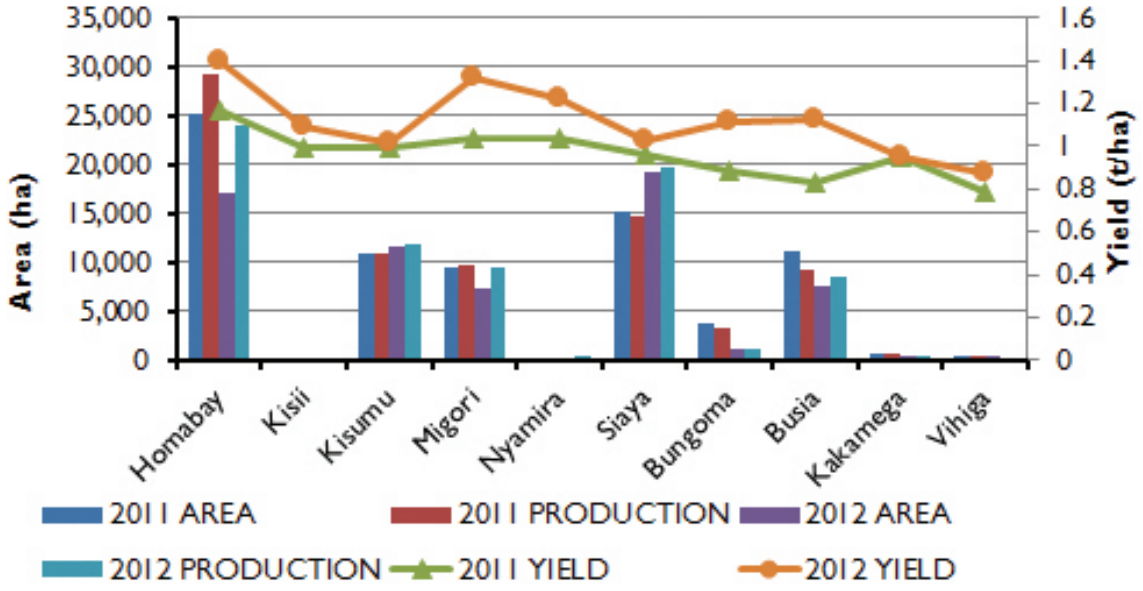
Figure 20: Trends in beans productivity by country between 2011 and 2012 in West Kenya.



Source: ERA 2013

Other staple cereals grown in the region include sorghum, finger millet and cassava. Sorghum is produced in West Kenya both as a food crop and increasingly as a cash crop. West Kenya is a major producer of the commodity; accounting for more than 50% of total national production. Area under sorghum production in the region has steadily increased from 104,000 ha in 2008 to 220,000 ha in 2012 with Nyanza assuming higher production and larger area allocation to sorghum. These increases are attributed to renewed interest in sorghum by Kenya Breweries, which has also seen a more structured marketing system for the commodity. Figure 22 shows a summary of area allocation and yields across selected counties of West Kenya action site.

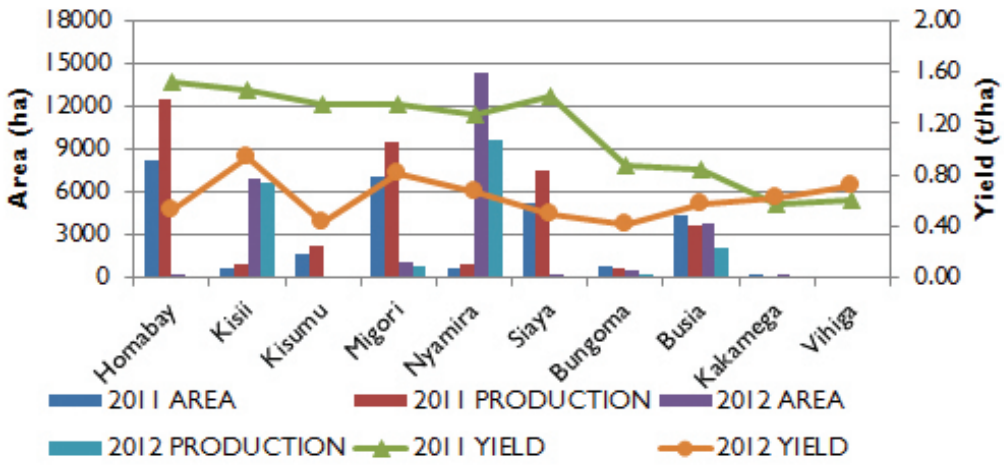
Figure 21: Area allocation and productivity of sorghum by counties in West Kenya.



Source: ERA 2013

Finger millet used to be among the most important food crops in West Kenya but was largely replaced by maize during the twentieth century. The commodity does well in less-favoured areas that are unfavourable condition for maize production because of poor soils, high temperatures, and erratic rainfall. Due to its performance in unfavourable conditions and its good storability, finger millet can play an important food security role despite their lower yield potential (Gill, Turton 2001; Oduori 2005). The crop is mostly produced as pure stand in a single season, while the rest is intercropped with maize or sorghum. Figure 23 shows area allocation and output for finger millet in selected counties of the West Kenya action site. Both area allocation and output tend to be higher in Nyanza compared with Western province.

Figure 22: Trends in total area and productivity of finger millet in West Kenya counties.



Source: ERA 2013

Nationally, cassava is mainly produced in Nyanza and Western provinces; the two provinces accounting for over 50% of total national production. Cassava is mainly produced in Migori, Nyamira, Busia and Siaya where the area under production has been increasing between 2000 and 2006. Migori and Busia account for more than 50% of total production in West Kenya action site producing 245,000 and 175,000 t respectively. Trends in cassava productivity show a lot of variability between 2000 and 2012 and range between 4 and 10 t/ha in most of the cassava growing counties in West Kenya. This is compared to a yield potential of between 40–55 t/ha for most improved varieties. Increasing production through increased adoption of these varieties is an opportunity.

Horticulture production

Horticultural crops produced in West Kenya are mainly vegetables (tomatoes, kales, cabbages, African leafy vegetables, onions) and fruits (mangoes, guava, paw paw, citrus, pineapples, and avocado). Kisii county produced the highest quantity of horticultural crops between 2009 and 2012 followed by Bungoma, Nyamira and Migori respectively (ERA 2012 2013), banana being the key horticultural product from Kisii. In 2012, Bungoma achieved a significant increase in production (580,000 t). Vihiga, Kakamega and Kisumu produced the least in the same period.

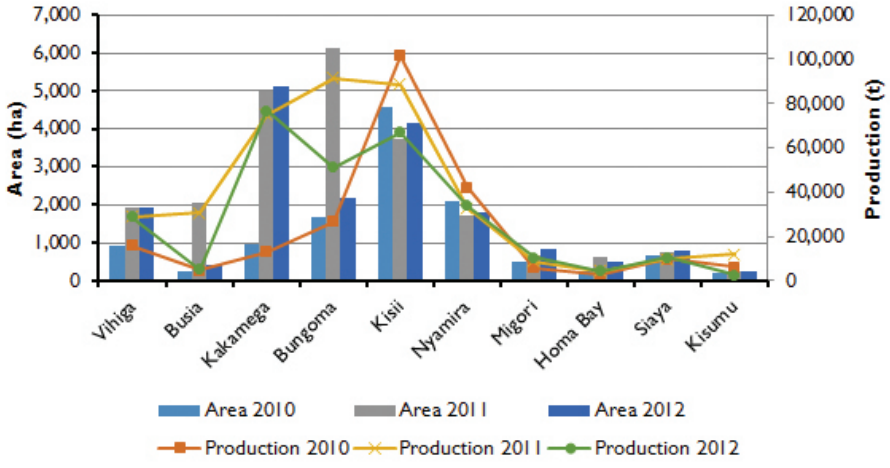
Table 3: Regional production areas for selected horticultural crops

Horticultural crop	Region
Red onions	Highland districts of Bungoma and Kisii
Tomato	Highland districts of Bungoma, Kisii, Kitale and Kakamega
	Lowland districts of Kisumu, Siaya, Homa Bay, Busia, Migori, and Bondo

Source: ERA 2012, 2013

Bananas are mostly produced in Kisii but have shown a decreasing trend in land area allocation from 4,573 to 4,167 ha between 2010 and 2012. This trend is reflected in total production over the same period (Figure 24). Second in area of production is Nyamira, which has also shown decreasing trends in area and total production over the same period. Kakamega, Vihiga and Bungoma have shown increasing trends in area allocation resulting in substantial increases in output.

Figure 23: Banana area and production in western Kenya by county.



Source: ERA 2012, 2013

The region is also known for production of sweet potato, largely regarded as a poor man's crop because of its low input requirements, ease of production and ability to produce under adverse weather and soil conditions. Production statistics indicate that about 730,000 t of storage roots were produced nationally on 75,000 hectares of land (FAO 1998), more than 75% of which is found in the densely populated areas of the western region of the country. Of this, more than 80% is grown in the Lake Victoria basin. However, the crop is grown in all the districts in western Kenya as

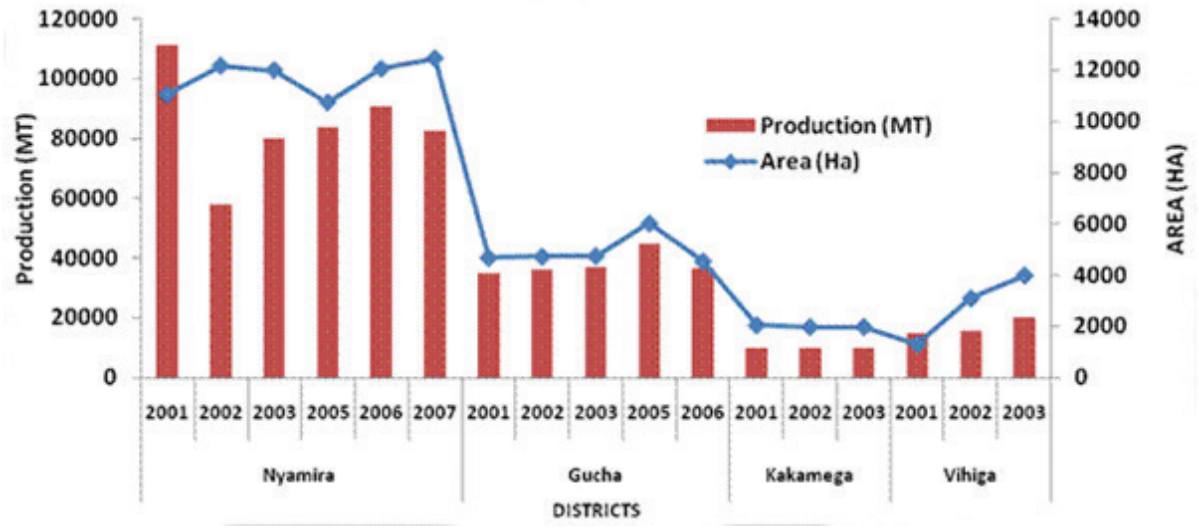
a second crop during the short rainy season. It is mainly produced in fair quantities in lowland districts of the region. Production is both for subsistence and income. The producers rely mainly on fellow farmers or farmer groups for planting materials.

Traditional vegetables are also popular with many tribes across the entire action site. These vegetables out-yield modern crops in drought-prone areas including LM2 to LM5 and are rich in essential nutrients, vitamins and minerals, deficiency in which results in malnutrition. Production of these vegetables occurs within or near homesteads, which are usually fertile from homestead wastes and safe from animal destruction. Land area under traditional vegetables within western Kenya is variable with Kisii having more land under traditional vegetables compared with Luo and Luhya. Spider plant and African night shade were found to be the most popular among the households in each of the three tribes in western Kenya, while pumpkin leaves and cowpeas were found to be only popular with Luo and Luhya.

Perennial crops

The main perennial crops in West Kenya action site are tea and sugarcane. Tea is mainly produced in Nyamira, Kisii, Vihiga and Kakamega counties in the region, with Nyamira having the highest area under production and highest output (Figure 25). Productivity in the two main growing regions in West Kenya has been consistently increasing between 1997 and 2007. This is especially so for Vihiga, which has increased from 2242 to 11,373 kg/ha between 1997 and 2007 (Kabaara *et al.* 2007).

Figure 24: Trends in area under tea and production in selected districts in West Kenya.



Source: FMHB Nyanza and Western 2009

Main growing areas for sugarcane include the Coastal and Western provinces of Kenya and production is largely by out-growers with factories also maintaining nucleus estates. The out-growers represent the backbone of the sugar industry, supplying the factories with approximately 95% of their crop requirements. Mumias zone accounts for 35% of total area followed by Nzoia and West Kenya at 12 and 10% respectively. Between 2008 and 2013 there was a small decline in area under production for two years followed by a steady increase thereafter, probably as a result of the establishment of new sugarcane processing factories (Butali, Kibos, Sukari and Transmara) in the region. Generally, sugarcane production showed an increasing trend between 2001 and 2013 despite fluctuations in 2003 and 2011.

Productivity decreased from 45 to 39 t/ha in Kisumu between 1997 and 2004 while in 2007, when area under production decreased, productivity increased to 68 t/ha, which is probabaly due to improved management because of smaller land size under production. Bungoma experienced greater decline in productivity from 126 to 68 t/ha between 1997 and 2007. In Kakamega, productivity flactuated between 57 to 72 t/ha in the same period.

Livestock production

The main livestock enterprises in West Kenya include cattle keeping (dairy and beef) and goat rearing. The national population and housing census of 2009, which lumped dairy and beef together showed that Nyanza had the highest number of key livestock types except pigs (KNPHC 2009). Within Nyanza, Siaya leads in terms of cattle population and is followed by Homa Bay, Migori, Nyando, Rachuonyo and Rongo districts (MoLD 2010, 2012), while in Western province, cattle population is highest in Bungoma South, followed by Lugari, Bungoma North, Mumias and Busia (MoLD 2010, 2012).

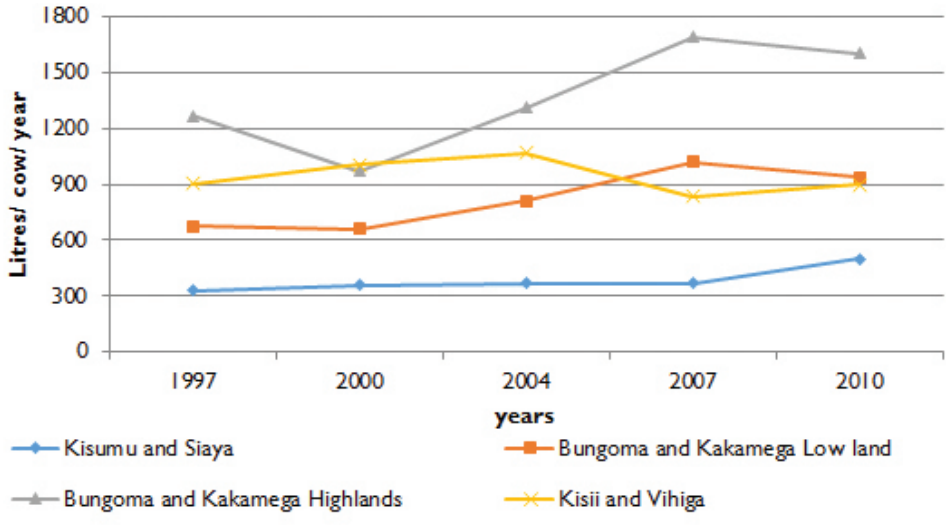
Across the action site, farmers in most counties keep more beef cattle than dairy except in Kisii and Nyamira counties (KNPHC 2009). Beef production is highest in Homa Bay followed by Siaya, Kakamega, Migori and Kisumu. Beef cattle population in Homa Bay, Kisumu, Siaya, Kisii and Bungoma show slight increasing trends compared with the decline in Busia, and Vihiga between 2010 and 2012 (MoLD 2010, 2012).

Dairy production on the other hand is mostly practiced in mixed crop-livestock systems in high potential areas of the action site. Feeding systems include free range, semi zero (21%) and zero grazing (57%). Free range is common in Bungoma while semi zero grazing is practiced in Nyamira. Zero grazing is mostly found in Kisii and Lugari (SDCP Baseline Survey 2009). Herd sizes vary, with 52.6% of farmers having between 3 and 5 dairy animals, and 18.7% keeping more than 5 dairy animals. Crosses of Friesian and Ayrshire breeds are the most popular breeds in the region (SDCP Baseline Survey 2009). Households within western lowlands of Kisumu and Siaya have the lowest mean percentage of improved cows (3%) compared with households in western transitional (Lower Bungom and Kakamega) and highland areas (Kisii and Vihiga), with a mean of 50% improved cows (Kabaara *et al*. 2008).

Daily milk yield per cow varies from 1 to 29 kg, with 67% of farmers producing between 5 and 10 kg/ cow per day. Milk productivity is constrained by inappropriate breeds and poor husbandry practices, partly influenced by limited access to operating capital. Household wealth has been shown to be positively correlated with milk productivity. Poor households achieved low milk productivity probably due to low use of external inputs, as observed amongst the first and second wealth quintile compared with milk productivity amongst households in the fourth and fifth wealth quintiles.

Figure 26 shows trends in milk yields in some selected districts both in Western and Nyanza provinces. Milk yields have shown tendencies of stagnation in Kisumu and Siaya probably due to low genetic potential of breeds kept by the farmers. In comparison, the lower zone of Bungoma and Kakamega recorded productivity increases between 1997 and 2007 (Kabaara *et al*. 2007 and Wambugu *et al*. 2011**)**. The upper parts of Bungoma and Kakamega had the highest milk productivity in the study area and showed a remarkable increase from 1270 to 1700 litres before declining to 1600 litres in 2010. Kisii and Vihiga zones, showed marginal productivity increase from 900 to 1070 litres between 1997 and 2004 before declining suddenly in 2007 and rising gradually to 898 litres in 2010.

Figure 25: Milk productivity trends by agro-ecological zone.



Sources: Kabaara et al. 2007; Wambugu et al. 2011

Goat production is mainly practiced for beef and inceasingly for milk. Goat population is highest in Rachuonyo followed by Nyando, Suba, Migori and Siaya in Nyanza ,while for Western province, Bungoma South had the highest population of goats followed by Bungoma West, Teso North and South. Dairy goat production is a recent livestock system in West Kenya mainly promoted amongst farmers of low resource capacity. Estimates by the extension staff implementing dairy goat project under VI Agroforestry show that Kisumu and Vihiga combined have approximately 15,000 dairy goats while Kakamega has 4000, Bungoma 5000 and Siaya 2000. In Kisumu, Bungoma, Vihiga, Siaya and Kakamega, the main breed is German Alpine with a few Tugenburd while in Kisii and Nyamira the main breed is Alpine. Milk yields from dairy goats are, however, not impressive. According to a study on the economic viability of dairy goats, dairy goat farmers from Coast, Rift Valley and Nyanza realized low milk yields of 1.9–2.1 litres per day, way below the 4 litres per day expected under good management. Farmers in Nyanza realized an average production of 322 litres per lactation compared with 365 litres at the Coast kids.

Trends in indigenous chicken population in West Kenya show a higher degree of variability due to its vulnerability to disease outbreak and frequent off-take for consumption. However, population shows increasing trends in Homa Bay, Kisii, Bungoma and Kakamega. Indigenous chickens are mainly kept for meat with most birds sold at between five and six months (MoALD and Marketing 1993). At this stage, individual birds weigh 1.3–1.8 kg. Chicken are usually left to scavenge for food (insects, food waste, green grass, leafy vegetables and any scattered grains) with little supplements during the day and confined at night. Based on a 2006 Ministry of Livestock annual report, Nyanza has the largest number of indigenous chickens compared with Western province (MoLD 2006).

Fish farming: Lake Victoria is the largest source of fish in western Kenya; producing 144,000 t of fish in 2006 and a declining output of 108,000 t in 2009. The major species are Nile perch and tilapia. Fish production under aquaculture system has grown mainly driven by the economic stimulus program of 2009. In 2010 about 1665 and 1360 households in Western and Nyanza provinces respectively had fish ponds producing approximately 3000 t compared with a total national production of 4700 t from an estimated area of 722 ha. Fish farming has, however, not been taken up on a wider scale in West Kenya, especially by smallholders in the Lake region. The low uptake could be due to proximity of the site to Lake Victoria, a major source of freshwater fish.

Use of agricultural products

Agricultural products are used mainly for home consumption or for income generation. There is very little use of the product for livestock feeding except for crop residues that are commonly fed to cattle especially during the harvesting seasons. Crops grown largely for household consumption include maize, beans, cassava, sorghum, finger millet and a spectrum of vegetables—indigenous and exotic.

Maize is the leading staple mainly grown in the region for household consumption and partly used for processing livestock feeds. Sorghum is utilized for processing or milling for human consumption and livestock feeds (USAID 2010). In rural areas, sorghum is mostly milled at home and used for making porridge and maize meal. Some sorghum is also mixed with cassava and cassava flour to enrich the flour. Sorghum is also milled in big mills and packaged for sale in large-scale outlets. Increasingly, sorghum is also supplied to seed processors while a portion of the produce goes to beer production. According to an economic survey (2007), out of the 160,000 tons of sorghum produced nationally, feeds account for 10%, seeds 1.9%, processing (milling) 23%, food 53.6% and the rest as waste. On the other hand, beans are used by the rural population in the region as a major source of protein, especially for the rural poor while cassava forms an important part of local diets replacing maize in periods of scarcity. Finally, finger millet is known to be rich in important micronutrients like iron, vitamin A and calcium, making it a valuable food for pregnant and nursing women, underage children and for HIV patients and diabetics (Mitaru & Githiri 2007). It is commonly used to prepare porridge.

Tea and sugarcane are grown purely as cash crops contributing substantially to household income in regions where they are grown. The rest of the crops are grown both for subsistence and income generation. These include sweet potato, bananas and increasingly sorghum. Indeed, banana is an important source of income and a food security

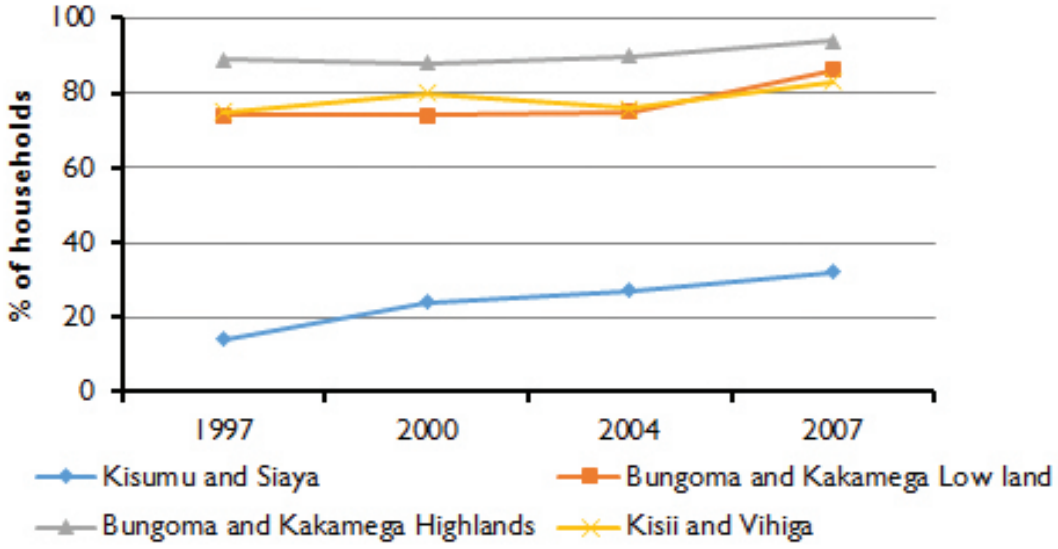
crop among both smallholders and large scale farmers; it constitutes 38 % of the total value of fruits produced in the country. Sweet potato is also an important food security crop grown in Kenya mainly by women (Carey *et al.* 1997) for household consumption and as a source of family cash income. The crop is a major source of income for households in Kakamega and Rachuonyo. Milk from dairy cows and goats also falls in this category of products.

Trends in technology use in agricultural production

Improved crop varieties and livestock breeds: These are predominant in maize production and increasingly in sorghum where new varieties have been introduced in the region by various development agencies and research institutions.

The western lowlands represented by Kisumu and Siaya showed low use of improved maize varieties even though there was a doubling in the proportion of households using these high yielding maize varieties (Figure 27). Other regions showed higher adoption rates.

Figure 26: Trends in proportion of farmers using improved high yielding maize varieties.



Source: Kibaara et al. 2007

There has also been an increase in the number of maize varieties planted by households over the period between 2004 and 2007. In Kisii and Vihiga, the number of maize varieties planted doubled compared with other AEZs where the percentage change in the maize varieties planted was 75%, 59% and 39% in the western lowlands, western transition and western highlands over the same period (Kibaara *et al.* 2007). These trends are indications that maize growing households have many seed varietal alternatives from which to choose, and further explain the high adoption levels of high-yielding varieties.

Other crops that have also witnessed use of improved varieties include soybean, sorghum and bananas (Table 4). Five new varieties of soybean (Hill, Black Hawk, EAI 3600, Nyala and Gazelle) with yield potential of 2 t/ha have been released by the Kenya Agriculture and Livestock Research Organization (KALRO) for commercialization, formerly known as Kenya Agricultural Research Institute (KARI). IITA also introduced for release SB19 and SB8, which are able to fix nitrogen, produce high grain yield and biomass for soil fertility replenishment. Sorghum farmers are also using improved varieties released under the Traditional High Value Crops (THVC) program, relief seeds and GIZ. High output of banana is also attributed to adoption of superior varieties.

With regards to dairy cattle, the proportion of households keeping improved dairy cows was highest in the higher potential zones (upper Bungoma, Kakamega, Kisii and Vihiga). These figures remained low for the lowlands of West Kenya, but increased gradually in lowland Bungoma and Kakamega zones. Livestock breeding faces a challenge

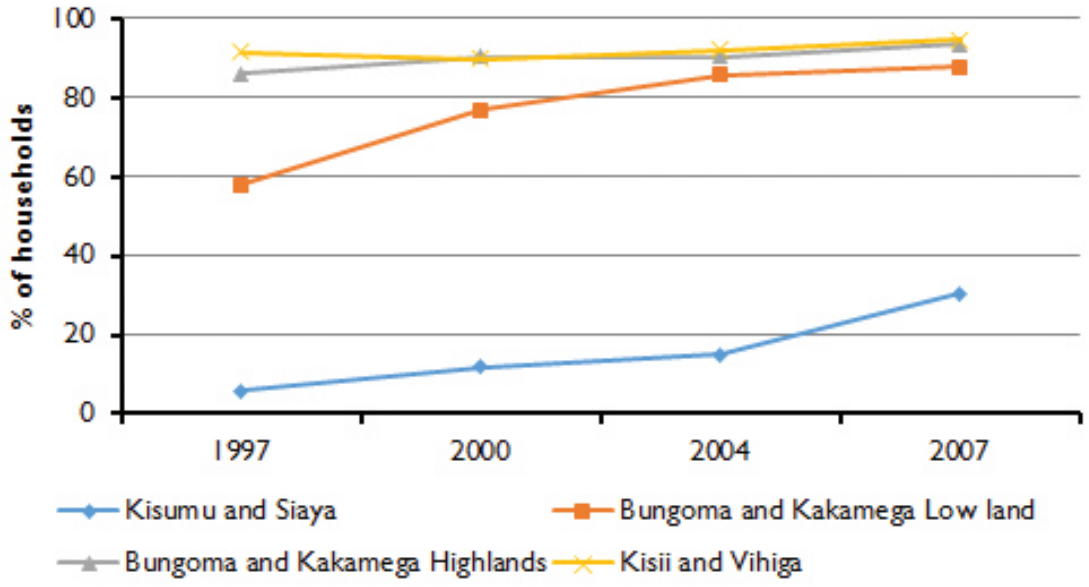
of providing appropriate genetics that match existing farmer enviroment and husbandry practices. Additionally, breeding efforts are compromised by limited infrastructure and last mile delivery options that tend to exclude many smallholders from accessing improved germplasm.

Table 4: Main crop varieties grown in West Kenya

	Variety
Maize	H627, H6213, H626, H6210, H629, H614D, H9401, H628, H6212,
	PHB30G19 WH505, KH600-11D, KH600-14E, KH600-16A KH600-15A
	Duma 41
	H623, H632, H624 H622 KH631Q Duma 42
	H513, H515, H516 PHB3253 WH403 DUMA 43 DK8031 KH500Q
Bean	KSTP 94, Ua Kayongo WS 303, GLP – 2 (Rose coco), GLP – 24 (Canadian Wonder); GLP -1004 (Mwezi Moja), GLP-X92 (Mwitemania), GLP- 585 (Red Haricot (Wairimu); GLP-X1127 (New Mwezi Moja); KAT/B-1, KAT/B-2, KAT/B-9, KAT-X56, KAT-X69, Super Rosecoco; New Rosecoco; Miezi Mbili; Kenya Early; Kenya Sugar; Kenya Umoja; Kenya Wonder; Kabete Super; MLB-40-89 A; MLB-49-89 A; RWR-719
Soybean	Kensoy, Hill, Perry 41, Black Hawk, Red Tanner, Composite,
	Duicker, EAI 3600, Nyala, Gazelle, SCS-1, Sable, Composite
Sorghum	Serena, Seredo, KARI MTAMA1, KARI MTAMA2,
	1576, E1291, Gadam, E6518, Legio, Kaburu, KARI A-SH2
Finger Millet	U-15, Okhale-1, P224, Gulu E, KAT/FM-1, Lanet FM-1
Cassava	I 2200, Tereka, Serere, Adhiambo Lera, CKI, TMS 60142, BAO SS4, Migyera, 192/0427, MM 96/7688, MH 95/0183, MH 96/4466, MM 96/5280, MM 96/9308, MM 96/7151, TME-14,
	MM 96/9362, MM 96/4684, MM 96/1871, MM 96/3868, MM
	96/4884,
Sugarcane	Late maturing varieties, low sucrose content
	CO 421, CO 945, CO 617, N 14, CO 1148, CB 38-22, EAK 70-97, EAK 71-402, EAK 73 335
	Early maturity, high sugar content and cane yields
Sweet potato	KEN 83-737, KEN 82-216, KEN 82-808, KEN 82-247, KEN 82-401, KEN 82-219, KEN 82-62, KEN 82-472, D8484 KSP 20, Kemb 10, Kemb 20, Kemb 23, Muibai, 22/77, 292-H-12, 56682-03, 91-218, Jayalo, K117, SP0047,
	KSP0072, KSP0084, KSP0154, Mtwapa 8, Mugande, Mwavuli,
Banana	SPK 004 (Orange Fleshed), SPK 013 and Wanjugu. Ripening: Muraru, Gross Michel, , Bogoyo, Apple (sweet banana),
	Giant Cavendish, Dwarf Cavendish, Williams, Grand
	Nain, Vallery, Paz, Lacatan, Sabaki, Red banana, Uganda
	Green.
	Dual purpose: Ngombe, Apple, Gradi Shisikame, Mutahato,
	Bokoboko, Mkono wa.
	Cooking: Tembo, Gold finger
Leafy Amaranthus	Amaranthus blitum, Amaranthus dubious and
	Amaranthus cruentus
Black Nightshade	Broad leaved and narrow leafed
Slender leaf (Crotolaria)	C. intermedia (Kotschy) Polhill, the most widespread.
Spider Plant (Dek)	

Fertilizer use: In general, the proportion of households using fertilizer has risen from 64% in 1997 to 76% in 2007, a 20% increase over this ten year period. The largest growth in the proportion of households using fertilizer is observed in the semi-arid regions of Kisumu and Siaya between 1997 and 2007 (Figure 28). In Lower Bungoma and Kakamega region, households using fertilizers in 1997 was only 60% and increased significantly to about 85% of the households in 2007.

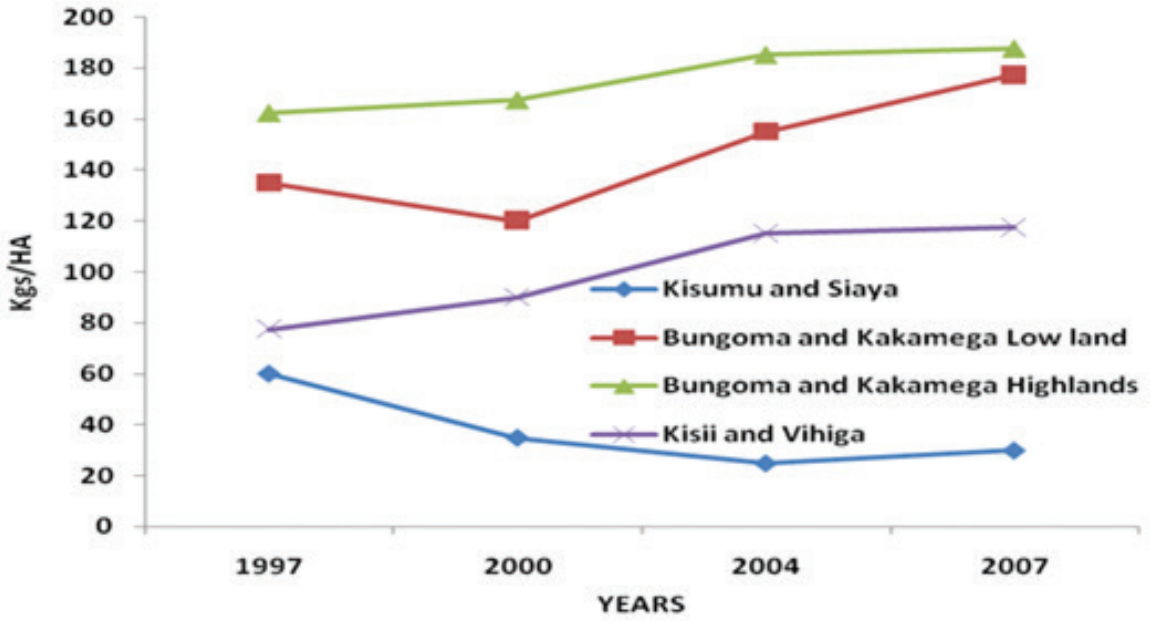
Figure 27: Percentage of households using fertilizer (main and short season) by region and year.



Source: Kibaara et al. 2007

As shown in Figure 29, intensity of fertilizer application (rate of application) on maize has been on the increase in West Kenya, except in Kisumu and Siaya zones where rate of application has declined substantially from 60 kg/ha to 25 kg/ha between 1997 and 2004 (Kibaara *et al.* 2007).

Figure 28: Fertilizer use rate (kg/ha) on maize (users only) main season.



Source: Kibaara et al. 2007

Apart from inorganic fertilizer, organic fertilizer is also an important component of integrated soil fertility management. The proportion of households using organic fertilizers has been on the increase in Kisumu and Siaya from 20% to 35% compared to Kisii and Vihiga where it has declined from 38% to 23% of households over the same period (Kibaara *et al*. 2007). Organic fertilizer use in both Bungoma and Kakamega zones has remained stagnant although the use is higher in lower than upper zones.

Use of agrochemicals: The use of agro-chemicals is quite limited and is only observed in maize and sugarcane crops. Lasso GD is mainly used as a pre-emergence herbicide in maize production while Atrazine is used post-emergence. A range of herbicides including 2-4-D, Kallach and Roundup, among other herbicides, are commonly used for weed control in sugarcane plantations.

Gender roles in key production systems

Decision making regarding farm enterprises is largely dominated by men. Only in 13% and 15% of households in Western and Nyanza provinces respectively do women decide on their own on which crop to plant. Joint decision regarding this only occurred in 38% and 22% of households in Nyanza and Western provinces respectively (Manyong' *et al* 2008). Moreover, women spend approximately 70% of their time on the farm compared to 35% of the time spent by men (Omwoha, J.N. 2007). Women are mostly involved in land preparation by hand, planting, weeding, harvesting and marketing, while men mostly are engaged in land preparation using oxen, pesticide application, and to some extent planting, weeding, and harvesting and marketing. Additionally, women were also shown to be significantly engaged in house duties including fetching water and firewood and cooking. This shows that men have more leisure time compared with women since men cannot substitute women in certain tasks in the house or agricultural activities.

In the mixed farming system in western Kenya, women provide 32% of all labour related to dairy farming (Maarse 1995). They are mostly engaged in forage collection, spreading manure on forage plots, feeding animals, general cleaning, milking, fetching water, heat detection and follow-up, and sale of milk. Men contribute about 23% of the total dairying labour, and participate mainly in planting Napier and fodder trees, buying dairy inputs and spraying animals. Hired workers handle 33.3% of the overall dairy farming activities, contributing most in the following areas: forage collection and cattle feeding, manure application, and buying of dairy inputs, thus complementing women's labour activities. Women's high labour contribution corresponds both to their traditional roles in agriculture and milking of dairy cows. Their responsibility within the mixed cropping system also increases because of shifts in the cropping pattern to accommodate fodder cultivation. In Nyanza province however, women are still not significantly empowered to take care of livestock owned by the family except local poultry (Chavangi 1983). This is because traditionally women do not participate in providing labour in agriculture.

Summary

The West Kenya action site is characterized by a range of AEZs that provide a basis for varied production systems. Annual rainfall ranges between 900 and 2,000 mm depending on the AEZ and predominantly exhibits a bi-modal distribution in a number of districts. However, there are a number of places especially along the lake shore that receive limited rainfall thus exposing their population to risks of food insecurity.

Production systems in the action site are dominated by staple crops especially maize, which is predominantly intercropped with legumes—beans being the predominant legume. Tea and sugarcane are the main cash crops grown in the action site even though there are additional non-perennial crops such as sweet potato and sorghum among others serving both as subsistence and cash crops.

Besides staple crops, the mixed livestock-crop systems are also evident across the entire action site with livestock species and breeds varrying by AEZ. Rearing of dairy cattle is a common income generating activity in Upper Midland and Lower Highland AEZs where crosses of exotic dairy breeds thrive. However, this potential is greatly compromised by systemic breeding challenges and limited delivery options for enhancing farmer access to improved germplasm.

In terms of technology use, the region is characterized by limited uptake and intensity in the use of fertilizer, especially in Kisumu and Siaya, often leading to low productivity and vulnerability to risks of household food insecurity. Maize productivity is further compromised by low uptake of improved maize varieties in the two districts.

Possible interventions

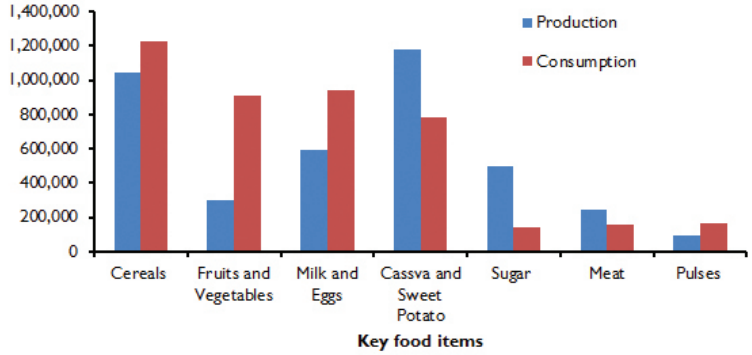
- Gains can be realized from enhanced uptake of fertilizer especially in Kisumu and Siaya where increasing adoption of high-yielding varieties has not been accompanied by increased uptake and intensity in the use of fertilizer.
- There are also potential gains to be realized from increasing commercialization of traditionally orphaned crops such as sorghum and African indigenous vegetables (AIVs).
- The role of dairy production in household income can be enhanced via identification of appropriate genetics and design of appropriate last mile delivery approaches for improved access to improved dairy cattle breeds.

Chapter 5: Market and institutions

Demand outlook

The key agricultural commodities produced in West Kenya include maize, beans and other cereals, such as sorghum, millet and paddy rice. Tea and sugarcane are the main cash crops. Other pulses, such as soybeans, peanuts, green grams, and cow peas, are also produced albeit on a small scale. Root crops, including cassava and sweet potatoes, are also important commodities supplementing maize as food security crops.

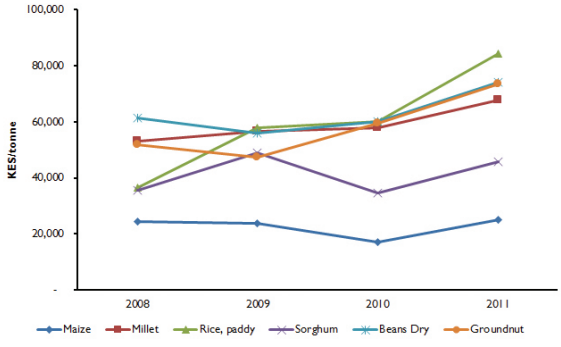
Figure 29: Regional food balances for key food items.



Source: FAOSTAT, KPHC 2009

Figure 30 shows levels of production and consumption for these key commodities produced in western Kenya. These estimates are obtained using the 2009 population census and per capita food supply for 2011. Except for cassava and sweet potatoes, sugar, and meat products, most commodities are characterized by supply gaps indicating substantial potential benefits to be appropriated by producers supplying respective food commodities. Additionally, prices of some orphaned crops, such as sorghum and finger millet, show increasing trends, which could be exploited by farmers producing respective crops. These trends are shown in Figure 31. However, maize prices have stagnated, which is favourable for the majority of net consumers but unsuitable for net producers especially from Bungoma county.

Figure 30: Trends in average producer (farm gate) prices of cereals and pulses.



Source: FAOSTAT 2013

Value chain characteristics of the key commodities in West Kenya

In the following section we describe value chains of key commodities identified as having great potential for poverty alleviation and food security for West Kenya. The value chain maps are presented in the annexes.

Maize: Maize in western Kenya is traded mainly as dry grains with a small proportion reaching the market as green maize. Besides the maize harvest consumed at home, surplus production is marketed through small scale traders and market intermediaries. The major buyers of maize grain are private millers, the main ones in West Kenya being United Millers and Mombasa Millers, both located in Kisumu town. Market intermediaries and traders also bulk maize from farmers and local markets and then supply wholesalers in major markets, who subsequently sell to retailers and millers. Large millers process the grains into flour and by-products which go to retailers and feed manufacturers respectively. *Posho* millers who operate in retail markets are also important players in most of rural and urban areas; they provide the means to produce maize meal relatively inexpensively and are preferred by the urban poor and most rural households, especially in the western parts of the country (USAID 2010).

Sorghum: Sorghum processing and marketing channels are the same as those for maize except the lack of involvement of the National Cereals and Produce Board (NCPB) and a few cases where wholesalers export sorghum. Some sorghum producers are also contracted by seed companies to produce sorghum for seeds. Produced seeds are subsequently distributed to farmers through various channels including seed companies, local stockists, Ministry of agriculture orphaned crop project (THVC) and drought recovery program. From the human consumption perspective there is increasing demand for sorghum as a dietary food for managing diseases such as diabetes. This presents a bright future for the crop, which is often categorized as an orphaned crop.

Finger millet: According to USAID (2010), a large proportion of millet is used for direct consumption (58%), processed into flour (20%) and animal feed (7.3%) and as recycled seed (3.6%). The rest is wasted. The value chain (VC) actors are to a larger extent similar to those of sorghum and maize. After harvesting, smallholder farmers sell millet to middlemen and small traders in local markets (retailers) who then bulk and transport to wholesalers. Wholesalers in turn sell to retailers and grain millers while also exporting some. The large mills produce flour, which is marketed through retailers and other outlets such as supermarkets while the by-products go to the animal feeds industry. Most millet is milled in *posho* mills in rural and urban areas where the flour is blended with other cereals and consumed locally in the form of porridge. Seed companies under regulation of Kenya Plant Health Inspectorate Service (KEPHIS) also contract farmers for seed multiplication.

Rice: In Kenya, rice is used mainly for human consumption (86%) and partly for animal feed and other industrial uses (9%) (USAID 2010). Rice marketing in Kenya was liberalized in 1993 and since then marketing has been undertaken by individual and institutional actors at free market prices determined by supply (local and imported) and demand. Similar to the maize value chain, there are numerous small to medium traders—mostly women—who buy paddy rice from farmers and sell locally. However, some traders also export rice purchased from producers. These traders also purchase milled rice from millers. In West Kenya there are three large mills; western Kenya rice mill (Ahero), Lake Basin Development Authority (LBDA) rice mill (Kisumu), and Dominion Farms. After processing by large millers, rice is packed as grade 1 or grade 2 in packages weighing 50 kg bags (over 75%), or in 2 and 1 kg packets, which are distributed to wholesalers and retailers in the local and regional markets. Large quantities of rice milled from small private mills are sold unpacked and this is what is normally sold by traders in open markets to the majority of consumers from rural and poor urban areas (USAID 2010).

Dry beans: The national demand for beans outstrips local production with the difference imported mainly from the East African region: Uganda, Tanzania, Rwanda and Ethiopia (USAID 2010). The main functions in the beans value chain include production by smallholder farmers; assembling by agents or brokers, and wholesaling and retailing by traders in rural and urban markets. About 40% of total annual production of beans is marketed, with the balance 60% being retained for household consumption (USAID 2010). Consolidation of produce is undertaken by several types

of assemblers: farm gate agents or brokers—either farmers with some little business capital or resident small-scale traders; regional agents or traders who are often non-residents. Resident farm-gate assemblers often visit farms at harvest time and buy beans, often in cash. These assemblers often handle relatively smaller volumes (1–3 bags) and may include some local farmers who have accumulated a little capital. Once they buy, they transport the produce using buses or public minibuses to local urban centres where they often sell to regional traders.

Soybeans: National output of soybean is divided between human consumption and livestock feed production; human consumption accounting for 10–15% of total soybean requirements. The processing of soybean is dominated by national scale industrial processors (98–99%) among which are BIDCO, Promasidor and Proctor & Allan. International organizations like the World Food Programme (WFP) or UNICEF also require soybean. Their demand fluctuates and can constitute up to 10% of the total Kenyan consumption. Products demanded by these organizations include blended flours for domestic consumption and Unimix (a flour blend composed of 80% maize and 20% soybean used for emergency nutrition in refugee camps).

Cassava: The cassava value chain is dominated by on-farm or fresh cassava consumption (boiled and consumed as snacks) and many farmers also dry cassava chips and supply traders in the market who later sell to local and distant urban markets. Although cassava is widely used in feeding pigs, cattle, sheep and poultry all over the world, utilization of cassava in animal feeds is still low in Kenya. The main retail level stakeholder for fresh cassava is the local and urban markets while cassava chips or flour are sold through retail outlets in the country. There is currently no processing of cassava into starch. Imports of cassava starch were valued at USD426,000 between 2004 and 2006 averaging at USD142,000 per year; this is an additional area for value addition (USAID 2010).

Sweet potato: Producers sell sweet potatoes directly to consumers, primary retailers, primary brokers and occasionally to cooperative societies within their locality. They also sell to large traders that buy and transport to secondary markets outside the locality. The large traders sell to secondary retailers in the secondary urban markets. The secondary retailers sell to terminal retailers, who buy in smaller quantities. The terminal retailers break the bags and sell to consumers in smaller units.

Bananas: Bananas are mostly consumed locally with little exports to other districts. Nevertheless, a higher proportion is sold for cash compared with what is consumed by households. A banana value chain assessment revealed that sales mostly occurred at farm-gate with farmers hardly exploring markets on their own (SHoMaP 2011). Mobile traders buy from farmers and sell to wholesalers, retailers and consumers. Wholesalers are major buyers in the distant market and have linkages with the local retailers and markets in the district and surrounding towns such as Kitale, Kisumu, Nairobi and Eldoret. Some have links as far as southern Sudan (SHoMaP 2011). Wholesalers also bulk and sell produce in designated smaller units to retailers.

Horticultural crops: These are mainly vegetables (tomatoes, kales, cabbages, African leafy vegetables, onions) and fruits (mangoes, guava, paw paw, citrus pineapples, and avocado). Mobile traders mostly source products at farm-gate with brokers often playing a link between traders and producers. Brokers may also link traders to other traders at the market stage in the value chain or to wholesalers who bulk products before onward transmission to retailers. They operate locally, regionally and at times even nationally and are particularly more common in the tomato value chain. The defining characteristic of tomato brokers is that they do not incur costs on their own and are rewarded by receiving payment in the form of commissions for work done. Consumers of horticultural products include individual households as well as corporate consumers—public institutions e.g. schools, hospitals, training institutions and private institutions such as cafeteria, restaurants, and hotels, which depend on a regular supplier contracted formally or informally.

Dairy value chain: Milk marketing is mainly informal through hawking and milk bars, among others, and there are a few dairy farmers' co-operative societies still operating in the region. Other milk market outlets available for farmers include private processors such as Kitinda, Nasyanda and Magharibi dairies in Bungoma District and Kaptumo, Kaigat, Kamnon and Lessos co-operative societies in Nandi District. They source milk from farmers for processing and partly for direct sales as fresh milk. KCC is still operational in areas like Nandi where there are two cooling plants in Kapsabet and Lessos.

Aquaculture: A wide variety of markets are linked to the capture fisheries value chain. The four main markets are the export markets for industrially processed fresh and frozen Nile perch filets, domestic markets for fresh tilapia, artisanal processed fish (Nile perch, tilapia, and silver fish) and feed-grade silver fish (*omena*). These freshwater species markets handle 96% of Kenya's annual fish production of around 175,000 t. The fish catch is sold directly on the beach to various traders. Agents working for industrial fish processors buy the Nile perch that meets the processors' criteria (e.g., size, freshness); they also take the processors' ice-laden trucks to the mainland beaches. Lower quality-grade Nile perch, tilapia and *omena* are sold to a number of successive intermediaries along the value chain: collecting traders, regional traders, wholesalers, and retailers. Most of the retailing takes place in urban open-air markets and through street venders. The sale of domestic fish products in modern retail outlets such as supermarkets is also increasing. Grading and the use of ice are minimal in these domestic end-market channels, resulting in high spoilage levels.

Opportunities for improving market access

Significant market opportunities are presented by: supply-consumption gaps and growing demand; export opportunities; emerging seeds market especially for sorghum and finger millet; and increasing demand for livestock feeds providing opportunities for several unexploited commodities.

Supply gaps, especially for cereals, fruits and vegetables, milk and eggs, beans and other pulses as well as for bananas present opportunities for higher prices that could be realized by producers who venture into producing these commodities. Similar gaps also exist for bananas, which despite the huge production potential, are still imported from Uganda mainly because of higher preference for sweet varieties (*bogaya*) from Uganda (Tschirley *et al* 2004). A wide consumption gap also exists for fish. Additional market opportunities are presented by increasing demand for traditionally neglected crops such as sorghum by beer making companies. Soybean is also realizing increasing demand for human consumption locally especially by international organizations (WFP and UNICEF) catering for refugees as well as feed processing. Soybean is also processed into various products by several processing companies such as BIDCO. Export opportunities also exist for tea, fish and fish products, which are produced in West Kenya.

Feed processing based on traditionally neglected crops such as sorghum, millet, cassava and soybeans also present opportunities for producers of these crops. While maize is currently the main energy source for animal feeds (up to 40% of the total ingredients), there exist significant opportunities to substitute this with sorghum, millet and cassava. This would enable maize to be largely dedicated to human consumption and thus forestall possible food security crises occasioned by growing demand for maize as a major ingredient in feed processing. There are also substantial opportunities to substitute whole *Dagaa* (*omena*) and Nile perch with soybean as sources of crude protein. This would relieve the pressure on the fish harvesting from Lake Victoria while offering promising market opportunities for producers of soybean in West Kenya. Additional market opportunities are also presented by seed companies which contract farmers to grow sorghum and finger millet seeds.

Increasing prices for commodities, such as paddy rice, sorghum, finger millet, dry beans and peanuts, present attractive market opportunities for their smallholder producers. This could, however, present challenges for poor net consumers who largely rely on food purchases.

Post-production handling, agro-processing and value addition: Several processing companies have processing plants within West Kenya for processing key commodities that are produced in the region. Commodities with significant processing opportunities include maize, sorghum and finger millet processed by United Millers and Mombasa Millers, both located in Kisumu town. Rice is processed by millers in Ahero, Kisumu and Siaya; soybean is processed by BIDCO, Promasidor and Proctor & Allan. Additional processing opportunities exist to grow industrial sorghum that is currently demanded by the East African Breweries for beer production. Besides opportunities to supply the feeds processing industry, cassava can also be processed into starch to replace imports of cassava starch, which were valued at an annual average of USD142,000 between the year 2004 and 2006.

As for fruits, there are opportunities for processing avocado presented by the small processing plant recently established in Kakamega. This could absorb the fruits produced mainly in Kisii and the larger Western province. There are currently limited activities towards processing or value addition for banana. However, the Kenya Industrial Research and Development Institute (KIRDI) has supported Nyangorora Banana Youth Group in Kisii to set up a processing plant producing crisps, and banana flour to make bread, cakes, biscuits, wine, jam, juice, beer, yoghurt and doughnuts. Additionally, Western Vision Self-Help group makes biscuits, crisps and juice from bananas in Bungoma East district. Finally, existing fish processing opportunities in the region can easily be exploited to absorb increasing production of farmed fish.

Market institutions and opportunities for organized marketing structures: A few value chains have already shown the potential for organized marketing in West Kenya. With increasing demand for industrial sorghum and increasing adoption of contract farming by East African Breweries, there are growing tendencies towards organized groups of sorghum farmers. The contracting agents are mostly NGOs that bulk and transport sorghum to breweries. These contractual arrangements have provided market assurance consequently leading to both expansion of area under sorghum production and improvements in productivity and incomes. Demand for industrial sorghum has also seen an upshot in production of sorghum for seeds, again under contractual arrangement between seed companies such as Kenya Seed, Agro-Seedco and farmers.

There are also nascent farmer organizations handling banana marketing especially in Bungoma East District. There are in total 12 farmer groups that are registered and involved in collective marketing and multiplication of planting material.

Kabondo Sweet Potatoes Marketing Cooperative Society has also recently been registered in Homa Bay to facilitate marketing of sweet potatoes produced by farmers in the region. These value chains provide lessons for improving collective action and improved market access for other commodities produced in the region.

Improved access to inputs: The main traded inputs are improved seeds, fertilizer and pesticides. Maize and sorghum seeds in West Kenya are mainly supplied by Kenya Seed Company, Western Seed Company, Seed-co, Pioneer, Olerai, KALRO seed unit, Monsanto, Freshco, Elgon, and Maseno seed unit. Seeds are marketed through agro-dealers and farm input retailers. Additionally, Ministry of agriculture distributes improved bean seeds to smallholders under the 'orphaned' crop project or drought recovery program. Farmers in West Kenya are also beneficiaries of the subsidized fertilizer currently supplied by the government.

National programs and projects addressing agricultural markets constraints in West Kenya

Smallholder Horticulture Marketing Program (SHoMaP): This is a program funded by the Government of Kenya and the International Fund for Agricultural Development (IFAD) aimed at improving farm productivity and incomes, health and welfare of rural Kenyans by increasing the quality and consumption of fruit and vegetables. The program covers 14 of Kenya's 35 horticultural districts and was designed as a pilot initiative for possible replication throughout the country. In West Kenya, the program is implemented in Kisii, Gucha and Bungoma. It targets poor rural households, particularly the unemployed and underemployed people in areas of Kenya where horticulture is an important source of income. The program focuses only on three horticultural crops which are selected by stakeholders as having the greatest potential as a vehicle for poverty alleviation and source of livelihood. In Bungoma for instance, the program focuses on banana, tomato and onions. The project achieves these through provision of market information infrastructure, construction of fresh produce markets in selected markets and spot road improvement to improve rural access roads.

Smallholder dairy commercialization program: This program fosters market-driven development of Kenya's informal dairy industry, working with poor smallholder dairy producers and traders to strengthen their capacity to respond to market opportunities in nine districts in the Rift Valley, Nyanza and Western provinces. The overall goal of the

program is to increase incomes of poor rural households, smallholder dairy farmers and small-scale milk traders who depend on production and trade of milk and dairy products for their livelihoods. In West Kenya the program is implemented in Nyamira, Kisii, Bungoma and Lugari. It is built on the understanding that the informal sector is the dominant force in milk trading in Kenya; about 75% of traded milk is sold outside the processing sector, both because consumers prefer unprocessed milk and because of inefficiencies in formal trading. The program offers opportunities to address some of the fundamental marketing challenges afflicting smallholder dairy farmers in West Kenya.

Smallholder Horticulture Empowerment and Promotion Unit Project (SHEP UP): SHEP UP is a technical cooperation project between the government of Japan and Kenya's Ministry of Agriculture, and working with farmers groups to equip them with skills to make farming a viable business by growing marketable horticultural crops. Through this initiative, farmers acquire skills on farm record keeping, prudent management of crops, value addition, market survey, crop selection and gender mainstreaming in their activities. A total of 282 farmer groups are participating in the Project in Central, Rift Valley, Nyanza and western Kenya. Bungoma and Kisii were among the target areas in West Kenya for this initiative.

Agriculture Sector Development Support Program (ASDSP): This is a five-year country and sector-wide (agriculture) program funded by Swedish and Kenyan governments together with other donors; it aims to promote county-specific value chains prioritized by the county stakeholders. The program is coordinated by a program management unit in Nairobi with establishment of county units for implementation. ASDSP promotes commercialization of agriculture by developing a specialized value chain component. The program builds upon existing institutions to improve *vertical integration* of actors at all levels of the chain. To enhance *horizontal integration* of actors and to strengthen group governance, local structures for organizing producers are used but such structures (including cooperatives) are re-orientated through specialized training into value chain development. It is expected that strengthening the market orientation of these institutions will enhance their sustainability. ASDSP also promote *improved information flows* in various media among actors across the value chain. The program provides opportunity for collaboration in market access intervention that may be pursued under the Humidtropics program.

Constraints to market access

In spite of the various market opportunities discussed in the previous section, farmers in West Kenya still face a myriad of challenges trying to market their produce. Key challenges include low and often fluctuating prices, poorly coordinated marketing, limited opportunities for agro-processing and post-production handling among others.

Prices: Most commodities produced in West Kenya have been experiencing declining prices over time both internationally and locally. Tea prices for instance have been declining in the world market. Horticultural crops from the region such as dry onions and tomatoes have also recorded wide fluctuation in prices while ripe bananas and sweet potatoes have exhibited price stagnation over the period between 2010 and 2014. Lower prices are partly a consequence of unorganized marketing strategies employed by respective smallholder farmers.

Poorly coordinated and unstructured market: Besides price challenges, a number of commodities produced by farmers in West Kenya are characterized by unstructured market approaches and limited collective action. While there are some farmer groups focusing on specific commodities, the level of operation in terms of volume of produce is small in most cases except where the commodity is contracted by the buyers as in the case of sugarcane, sorghum seed and industrial sorghum. Producers are often scattered across the region, each producing little marketable surplus that can hardly attract serious large scale buyers. Traders therefore assume the role of bulkers, who then sell to large buyers and other key outlets with farmers realizing the lowest of the margins in the entire value chain. Overall, the region has very few active farmers' cooperatives societies and these are concentrated in the main cash commodities such as sugarcane, coffee and fish production. Furthermore, there are tendencies of market concentration with marketing of some products controlled by cartels often working against the interest of farmers. Moreover, marketing is mainly through small-scale traders and middlemen with limited direct linkage by farmers to major buyers such as NCPB and millers. Over-reliance on market intermediaries is largely occasioned by substantial subsistence orientation and lack of

collective marketing among maize producers. This in turn leads to lower farm-gate prices for maize farmers. Similar to crops, dairy farming in the region is also characterized by lack of or limited collective initiatives leading to exploitation of farmers by unscrupulous milk traders.

Agro-processing, post-production handling and value addition: Apart from the main cash crops of tea, sugarcane and coffee, most commodities produced in West Kenya are characterized by limited agro-processing opportunities. Horticultural value chains are particularly affected. Farmers are therefore forced to sell at ridiculously low prices to avoid substantial losses.

Summary

The West Kenya action site has notable market opportunities for several commodities produced locally. These opportunities emanate from: substantial supply gaps for key commodities notably cereals, fruits and vegetables and livestock products; increasing demand for livestock feed and increasing use of traditionally neglected crops in feed processing—sorghum, finger millet etc. and; increasing prices for commodities such as sorghum and finger millet that have realized increasing industrial demand.

Most value chains are, however, characterized by informal trade and limited organized marketing structures except for a few cash crops (tea, sugarcane) and traditionally neglected crops experiencing increasing industrial demand such as sorghum. Moreover, smallholder farmers across the action site are poorly coordinated with often limited collective action. Consequently, individual farmers are left at the mercies of more organized buyers often operating in cartels that work against the interest of farmers. This problem is prevalent across most commodities produced in the action site but is more detrimental to horticultural and dairy value chains. Given the perishable nature of horticultural crops, horticultural value chain also bear the brunt of limited agro-processing and value addition opportunities. Farmers are therefore left with limited opportunities other than selling raw products mostly below production costs.

Possible intervention: Most value chains in the action site would therefore benefit from institutional innovations aimed at collective action and more structured engagement with buyers. Experience from the improved production and marketing of sorghum shows that it is possible to realize significant gains from commodities traditionally produced in the region if only appropriate and pro-poor market linkage mechanisms were pursued.

Chapter 6: Natural resource management

Preamble

Human life depends on healthy ecosystems which supply life-sustaining resources and absorb waste. The natural resource base comprises *agricultural land, forests, wetlands, dryland, aquatic and marine resources.* Globally, current population growth and levels of consumption are placing increasing stress on ecosystems. The challenge is therefore to increase production in order to meet the growing food demand without damaging the natural resource base (Dar and Twomlow 2007). Nevertheless, all indications are that the pressure to meet growing food demand is weighing heavily on the environment. Environmental degradation, loss of biodiversity, deforestation, and the breakdown of social and economic systems are just a few indicators of ecosystems under pressure. The situation is further aggravated by poverty since a majority of poor households depend directly on natural resources for subsistence. The continued reliance of the poor exerts even more pressure on the ecosystems, thus increasing the vulnerability of habitats and biodiversity. Consequently, the poor are both victims and causes of natural resource depletion and environmental degradation. NRM involves taking care of the natural resources with a particular focus on how the management affects the quality of life for both present and future generations. It is about the long-term implications of actions—thinking about the future and not just about now. There often emerges in the development debate a tension between the joint goals of poverty reduction and environmental quality. In some dimensions and in a shorter time horizon there may be trade-offs but, in the longer term, environmental degradation is a threat particularly to the poor who depend heavily on intact ecosystem resources for daily services such as water, firewood, building materials, fibers, and protein as well as capital that can be harvested in times of need.

Throughout the developing world, natural resources are an important input into household production and welfare. Indeed, for many, natural capital stocks account for a sizable fraction of aggregate household income and wealth, even when property rights over them are poorly defined. However, the use of these natural resources in household production can have far reaching, and often negative consequences. While clearing forests may provide essential fuel and other raw materials to households in poor upland villages, it may also threaten local biodiversity, downstream water quality, and climate worldwide.

Kenya is endowed with a wealth of natural and human resources, and yet Kenya is ranked as one of the low income countries in Africa. The Kenyan economy relies heavily on natural resources to support people's livelihoods and to contribute to national income. However, Kenya's huge potential for economic growth is threatened by environmental degradation. NRM is multi-sectoral comprising environment, agriculture, irrigation, forestry, livestock, water supply and energy among others. There is, therefore, a necessity for multi-sectoral cooperation, particularly at the decentralized county government level, which is the focal point for service delivery. Western Kenya has a wealth of natural resources ranging from forests, wetlands, biodiversity, soils, climate and others.

Components of NRM

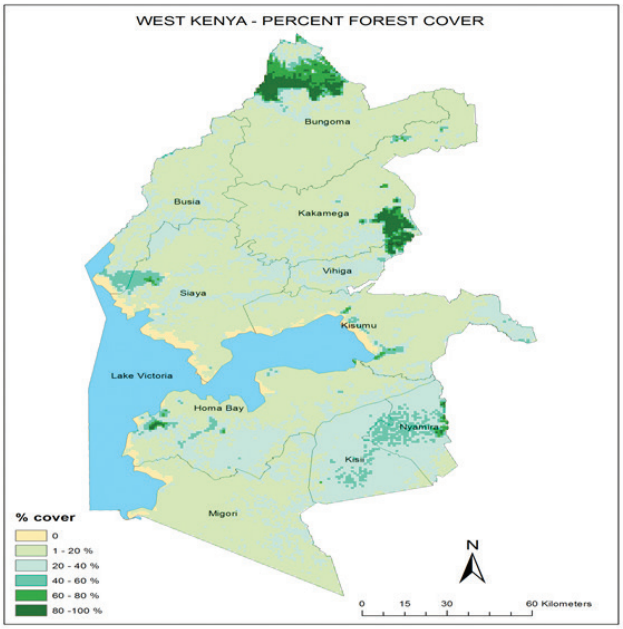
The natural environment is made up of the atmosphere, lithosphere, hydrosphere and the biosphere. Interactions among these components and built environments influence the development of a given place. For instance, direct impacts of agricultural development on the environment arise from farming activities accompanied by over-exploitation of land and water resources (Nagdeve 2002).

Biodiversity (biosphere)

Biodiversity describes the variety and variability among living organisms and the ecological complexes in which they occur (WWF *et al.* 1993). Biodiversity plays a key role in the production of goods and services on which people depend (Perrings 2000). In Africa, millions of people depend directly or indirectly on biological resources for their basic subsistence needs. Moreover, commercial use of natural resources makes an important contribution to many national economies. It includes forests and its associated resources, wildlife and fisheries, among others.

Kenya has great floral and faunal diversity. Natural forests provide essential environmental, economic and socio-cultural benefits in Kenya (Ministry of Environment and Natural Resource 2005) and are important for the conservation of biodiversity, livelihood support and climate change mitigation (ODA 1991). However, despite their crucial functions and fragile nature, these forests have become the epicentres of human conflicts over the past two decades, as a result of land use systems that are destructive to their ecological stability (Blanc *et al.* 2000). Forests in Kenya are under pressure from deforestation, forest fragmentation, forest degradation, over-exploitation and the introduction of exotic species. Lowland forests have been most extensively exploited and were the first forests to be cleared for agriculture. Because the land best suited for the growth of forests is also good agricultural land, the remaining forests in Kenya are highly fragmented. Many species are inhibited from crossing forest gaps and therefore many isolated populations will not be 'rescued' or supplemented by individuals dispersing from forest fragments. Therefore, such species face extinction.

Figure 31: Map of forest cover in West Kenya Humidtropics sites.



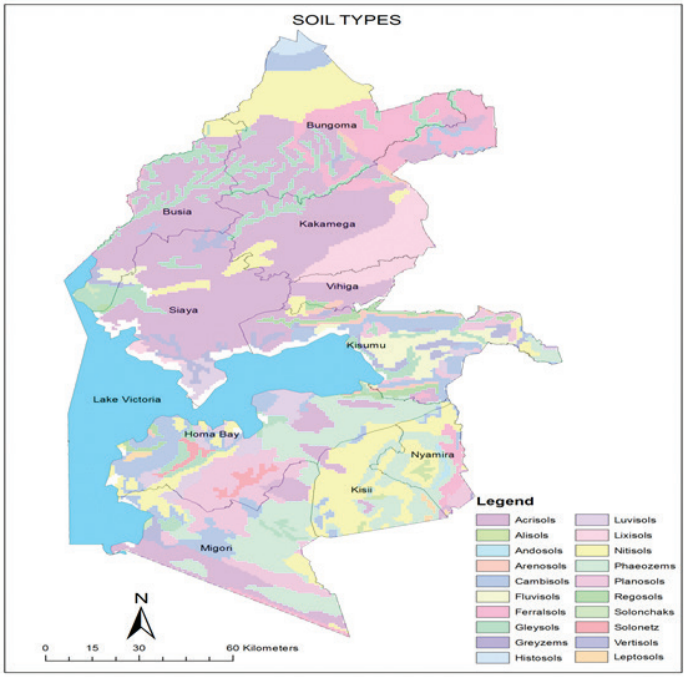
In western Kenya there are mainly two forests: Elgon—classified within the high volcanic block with such dominant species as *Rapanea rhododendroides* and *Hagenia abyssinica;* and Kakamega—which belongs to the western plateau block (Peltorinne 2004). Kakamega forest is the only remaining tropical rainforest fragment in western Kenya and hosts large numbers of endemic animal and plant species. It has indigenous tree species such as Elgon teak, Red stinkwood (*Prunus africanum*) and African satinwood (*Zanthoxylum gilletii*) (Noad 1990). Additionally, it has unique plant species,

e.g *Aningeri altissima*, *Cordia millensii* and *Entandrophragma angolense*. It also has unique animals, e.g L´Hoest´s monkey (*Cercopithecus lhoesti*), which only occurs in Kagamega forest, and two globally threatened bird species: Turner´s eremomela (*Eremomela turneri*) and Chapin´s flycatcher (*Muscicapa lendu*) (Sayer *et al.* 1992). According to Marttila (1998:82), Kakamega Forest is home to as many as 400 butterfly species, and is the only remaining portion of the once great Guineo-Congolean rainforest in Kenya (KIFCON 1994). The forest is the only remaining tropical rainforest in Kenya covering an area of 240 km² and is 1500–1700 metres above sea level. It receives an average of 2000 mm rainfall per year and has a huge diversity of fauna and flora. Kakamega forest has suffered from continued overuse for timber, charcoal, firewood, cash crops and forest plantations. Its survival is threatened by unsustainable utilization by the local community. Mitigating this systematic over-exploitation must therefore take cognizance of the biophysical characteristics of the forest, patterns of resource use and consumption, socio-cultural conditions and the socio-economic roots of poverty. A shift from commercial re-afforestation programs to community involvement in forest resource development would have long-term benefits that are sustainable (Pahkasalo 2004). Social and farm forestry practices have emerged as possible sustainable solutions to environmental degradation because these approaches favour equity, ownership and desired community participation (Newmark 2002).

Soils and agricultural lands (lithosphere) in western Kenya

Western Kenya has volcanic and basement rocks and the soils are majorly red clay. Areas with sedimentary rocks occur in the lowlands at an altitude ranging from 1000 m and have loamy sandy soils. Soils here vary greatly according to the prevailing parent material. In higher regions, soils are dark red clays, which are fertile and well drained. In the Kavirondo Gulf, soils are sandy loam formed from sedimentary rocks. Alluvial deposits of eroded material from uplands are common along flood plains of rivers such as Nyando, Yala, Nzoia, and Kuja. In plains such as the Yala and Kano, peat swampy soils and black cotton soils dominate. Volcanic soils interspersed with fertile peat swampy soils are found in the uplands.

Figure 32: Map showing distribution of soil types in the West Kenya sites.



Soil fertility depletion is the major biophysical root cause of the declining per-capita food availability in smallholder farms in sub-Saharan Africa, with a decline from 150 to 130 kg per person over the past 35 years in production (Nandwa 2003). In densely populated western Kenya it went down to 60 kg for cereals. In this region land resources are continually threatened by the need to raise food for the local population (Noordin *et al.* 2007). Emerging evidence attributes this to insufficient nutrient replacement, primarily through harvested products, leaching, gaseous losses and soil erosion. Yields are about two–five times lower than their potential.

Based on agro-climatic conditions, the highland districts around Lake Victoria in western Kenya should be a food surplus area. In practice, they are heavily dependent on food imports, whilst national poverty surveys consistently show them to be amongst the poorest in the country: about 55% of households in the region are classified as poor (GoK 2003). At the root of this problem are high population densities and hence small land holdings (ranging between 0.5 and 2 ha per household), as well as limited access to markets. Moreover, small landholdings imply continuous cropping often with very little investment in soil fertility replenishment. This has led to severe depletion of soils.

Other principal causes of nutrient losses include crop harvest, leaching, run off and soil erosion (Mango 1996). About 80% of farms are severely deficient in phosphorus and most are deficient in nitrogen whenever phosphorus deficiency is overcome (Ojiem and Odendo 1997; Nyambati *et al*. 2003). Due to low soil fertility in the region, many poor households in both Nyanza and Western provinces are now caught in a 'maize-focused poverty trap', whereby their agricultural priority is to produce sufficient maize for home consumption, yet yields are low (approximately 1 t/ha) and returns are insufficient to support investment in either organic soil fertility enhancement technologies or inorganic fertilizers. Thus, despite having large portions of their land under maize during both cropping seasons, many households are still unable to feed themselves for several months of the year. In addition to the problem of low soil fertility, continuous cropping of maize has also led to an endemic infestation of the striga weed throughout these districts, further depressing maize yields.

Farmers' efforts to restore soil fertility are inadequate since few can afford to use inorganic chemical fertilizers. At the same time, the use of manure is also restricted as farmers have only a limited number of animals. About 40% of farmers use some fertilizer, but at lower rates than recommended and often too late for optimum timing of application (Swinkel et. al. 1997). More than 70% of households are below the poverty line and depend mainly on subsistence farming (Wangila *et al*. 1999). Initiatives to combat nutrient depletion are also limited by dynamics and heterogeneity in African agro-ecosystems in terms of biophysical and socio-economic gradients. This calls for system-specfic or fexible recommendations, rather than monolithic technical solutions such as blanket fertilization recommendation.

Key issues around agricultural land in western Kenya

Land degradation

Land degradation remains a major threat to provision of environmental services and the ability of smallholder farmers to meet the growing demand for food. The attainment of sustainable agricultural production in most African countries is seriously undermined by increasing land degradation problems. Understanding patterns of land degradation is therefore a central starting point for designing any sustainable land management strategies. However, land degradation is a complex process both in time and space making its quantification difficult. There is no adequate monitoring of many of the land degradation issues both at national and local scale in Kenya.

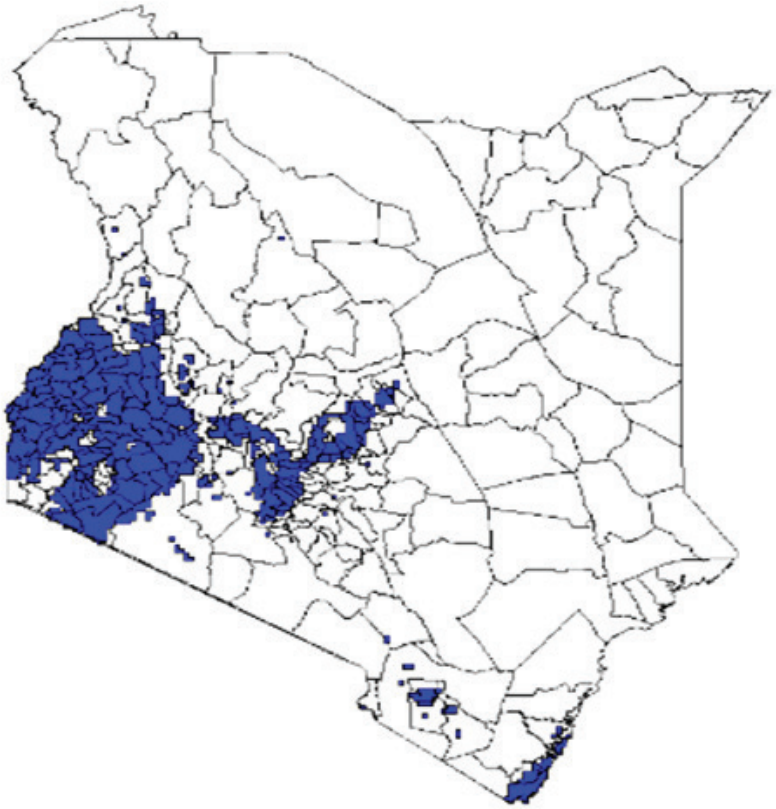
A number of factors contribute to land degradation in western Kenya, including soil erosion, with severe effects on soil functions such as ability to act as a buffer for pollutants, hydrological and nitrogen cycle, and ability to provide habitat and support biodiversity. Indeed water and wind erosion often account for about 46% and 38% of all degradation (GLASOD 1988). Human activities such as cultivation, overgrazing and deforestation, aggravated by increasing human population in the region, have accelerated the process beyond acceptable levels. Excessive erosion is associated with diverse negative on- and off-site impacts, including loss of soil nutrients, leading to a reduction in crop yields, decreasing stream competence and capacity because of sedimentation, and siltation of reservoirs.

Soil acidity

Most soils in western Kenya are acidic in nature resulting in low soil fertility (Kanyanjua *et al*. 2002). This is caused by leaching of basic elements overtime (Ca, Mg and K), continuous cropping, atmospheric pollution and application of N fertilizers containing ammonia. Soil acidity retards plant growth through H^+ and Al^{3+} ionic effects, mineral ion toxicity or by indirectly interfering with mineral availability. Often many soils with pH<5.2 have high exchangeable aluminium

and outright toxicity to most crops (Carver and Ownby 1995). In western Kenya, about 0.9 million hectares of land is acidic with pH<5.5 causing high phosphorus deficiencies (Omenyo *et al.* 2010). As a result, production levels of maize and legumes are markedly low. For example, Sanchez *et al.* (1997) and Nekesa *et al.* (1999) reported crop yields below 1 t/ha from smallholder farms. These yields are very low as compared to the 6–8 t/ha per year that have been reported in research stations or field experiments with adequate management (Okalebo *et* al. 2005). Average subsistence maize, beans and cowpea yields in the region hardly exceed 1 tonne/ha (Okalebo *et al.* 2009).

Figure 33: Map showing areas with acid soils in western Kenya.



Source: Kanyanjua et al. 2002

A survey in Kakamega North and Ugunja Districts in 2009 revealed that about 33% of the farms in Kakamega North were strongly acidic compared with fewer than 1% in Ugunja. About 43% of the farms in Kakamega North were moderately acidic compared with about 54% in Ugunja. Finally, about 4% of the farms in Kakamega North were slightly acidic compared with about 11% of the farms in Ugunja (Figure 34).

Land tenure and related conflicts

Land in Kenya is a key factor of production, making its proper management a requirement for sustainable development. The demand for arable land, grazing, forestry, wildlife, tourism and urban development are greater than the land resources available. These demands become more pressing every year with continued population growth. Addressing key issues in land use management within a development oriented approach poses challenges to all stakeholders and requires integrative solutions across the policy, socio-economic, and environment sectors. Land policy in Kenya has failed to adequately address land use conflicts, a scenario common in western Kenya.

Water resources management in western Kenya

Kenya is classified as a water scarce country with only 647 cubic meters of renewable freshwater per capita and further characterized by high spatial and temporal variability and extremes of droughts and floods (KETS 2013). The Lake Victoria basin in western Kenya has high agricultural potential for both subsistence and plantation farming

(Mugalavai *et al*. 2008). The Kenyan side of the Lake Victoria basin has an area of about 47,164 km^2 and has two catchment areas: Lake Victoria south which is drained by rivers Nyando, Sondu-Miriu, Gucha-Migori and the South Awach, and Lake Victoria north drained by rivers Nzoia, Yala, Sio and the North Awach. The total area of Lake Victoria north catchment is 19,615 km^2. Evaluation of the variation in discharge for a 50-year period found that average discharge in the period 1990–2000 was higher than for the period 1950–1960. This was associated with an increase in over-land transport due to soil cover destruction in the catchments. There is a marked destruction of soil cover in the river catchment that caused a reduction on infiltration resulting in increased run-off and river flows. Other water resources in western Kenya include streams, groundwater resources (such as springs) and rain water.

Agriculture is mainly dependent on quantity, quality and timely availability of water, which comes mostly from rainfall. Other sources include groundwater contribution from shallow water table and amount of soil moisture available at the beginning of the period. Agricultural activities in western Kenya are mainly rain-fed. However, rainfall has been quite uncertain in the recent years; exemplified by high variability of onset and cessation of the rainy season, a scenario linked to climate variability. There is therefore need for rainwater harvesting to bridge the water supply gaps during the dry season.

Weather and climate

The demographic and agro-ecological characteristics of western Kenya are broadly representative of the situation found in other tropical highlands of East Africa (Tittonell *et al* 2005). The altitude ranges from 1000 to 2000 m above sea level and maximum rainfall is 1000 mm per year. Western Kenya receives slightly less rainfall than the humid areas. Nonetheless, current water resources are more than sufficient to meet the demand for crop growth, the main problem is its unpredictable availability, which is very much dependent on weather and climate. All the climatic factors in a broader sense affect the water balance of the agricultural system by way of determining the amount of water received through rainfall versus the amount that is required. On the other hand, the water that is lost through evapotranspiration is also dependent on climatic factors to a great extent. To ensure optimal crop growth, the amount of effective rain should be more than or at least equal to the water loss through crop evapotranspiration from a crop field in a particular period of crop growth. Western Kenya is highly prone to occurrences of climate variability such as floods and droughts.

Practices used to support NRM and the environment

Both the national and county governments recognize that environmental management, poverty reduction and economic growth are closely linked, and have designed policies and institutional frameworks to address the situation. The government's long-term development strategy, Vision 2030, accordingly includes strategies for action in the environmental sector including conservation of natural resources, pollution and waste management, high-risk disaster zone management, environmental planning and governance, and climate change adaptation. Programs and projects to be implemented in the environment, water and sanitation sectors within the period of the first medium-term plan (2008–2012) are identified in sector-specific plans. A number of traditional and improved approaches exist in western Kenya for addressing NRM issues, including soil fertility. Some of these measures are discussed below.

Land fallowing

Land fallowing refers to a process where agricultural land is left uncultivated for a period of time. The fields are left to be occupied by weeds, grasses, and fast-growing woody plants. In traditional tropical farming systems, soil organic matter lost from the topsoil under cultivation was restored during extended fallows (Szott *et al.* 1999). The length of the fallow period would depend on the degree of land degradation and fallow management. However, in recent years, poor land management and increasing pressure on the land rarely allow fallows to restore soil productivity. Vegetated fallows have historically been a core component of many tropical agro-ecosystems and are an effective technique to

restore soil fertility (Sanchez 1999). Improvements in crop yields obtained through the use of fallows are directly linked to the process of biomass recycling, and recovery of soil carbon during the fallow phase can be surprisingly speedy; in some cases recoveries to native soil carbon levels have been observed after only ten years of natural fallow (Mosier 1998). Other benefits to fallowing include increased soil moisture retention due to accumulating organic matter, and increased micronutrient availability as tree and shrub roots penetrate the soil and subsoil.

Fallowing has been found to be particularly important for the cultivation of maize—the principal crop grown in western Kenya—which can rapidly drain soil of its productive capacity when cultivated continuously. Recent evidence suggests that maize-natural fallow systems can result in soil microbial C, N, and P levels 1.3 to 1.5 times higher than continuous maize production (Bünneman *et al.* 2004).

Soil fertilization

Soil fertility characterization studies through limiting nutrient trials have been conducted over many years in the region. Many technologies with diversified use of organic and inorganic materials to restore the fertility of nutrient-depleted soils across western Kenya exist (Woomer *et al.* 2003). Several approaches have been used to manage soil acidity. These include use of soil amendments that counteract the effects of soil acidity or using crops that are tolerant to high level of exchangeable aluminum. Liming is one of the interventions recommended to ameliorate such soils in western Kenya. Lime materials applied as calcium hydroxide $Ca(OH)_2$, calcium oxide (CaO) or calcium carbonate ($CaCO_3$) have been found to effectively neutralize soil acidity by raising the pH of acidic soils, providing Ca^{2+} and decreasing aluminum (Al) toxicity hence stimulating crop growth (Adams 1984; Kanyanjua *et al.* 2002). Rock Phosphate, including Mijingu Rock Phosphate, has also been found to neutralize soil acidity (Kanyanjua *et al.* 2002; Nekesa 2007).

Additionally, management practices like the strategic use of organic and mineral inputs are used (Claasens and Wehner 2002). Organic and inorganic fertilizers can mitigate the losses of P and K, and biological options may also improve the efficiency with which crops use these nutrients. Replenishing soil N, P, and K is essential for sustaining productivity and rehabilitating eroded and nutrient-depleted soils. Soil fertility replenishment results in positive benefits, such as increased vegetative soil cover and increased soil biological activity associated with enhanced crop production (Sanchez *et al.* 1997).

Replenishing soil fertility via practices that are already integrated into production systems is likely to be more effective. These include practices such as intercropping of grain legumes with cereals that is already widespread across West Kenya. Intensifying agro-forestry also presents avenues for quick wins since several households in West Kenya already engage in this practice.

Planting of legumes is very common in western Kenya often as a general cultural practice to manage production risks via crop diversification rather than a conscious effort to improve soil quality, nutrition and incomes. Legumes are beneficial in biological nitrogen fixation. Some of the most common legumes intercropped with key cereal crops include cowpeas, common beans, peanuts, crotalaria, green grams and soybean, with results showing positive returns to investment from these legume-maize and PREP-PAC (an inexpensive product that combines fertilizer, legume seed and rhizobial inoculant techniques) combinations (Ruto *et al.* 2004). There are a number of projects seeking to enhance soil fertility and provide other ecosystem services and livelihood improvements in western Kenya. Notable among these are Tropical legumes II, a joint program of 3 CGIAR centres (IITA, CIAT and ICRISAT), whose emphasis is on increasing productivity and production of legumes (chickpea, peanut, pigeon pea, cowpea, soybean, and common bean) and the income of poor farmers.

Soil and water conservation

Several efforts are being employed to conserve soil and water especially in lower Nyando basin. In a survey conducted in lower Nyando, it was established that soil erosion is being addressed by 97% of the households interviewed with

most common conservation measures being contour lines and strips of grasses and shrubs. The most commonly used species are Aloe vera, sisal, shrubs, Terminalia brownii, Grevillea robusta, Napier grass, and Casuarina spp. A few farmers also have established terraces and check dams.

Agroforestry

Agroforestry involves the smart integration of trees in agricultural landscapes with the aim of improving livelihoods and conserving the natural resource base. Many farmers are practicing agroforestry in western Kenya. The World Agroforestry Centre (ICRAF) has been at the forefront of promoting agroforestry-based technologies in western Kenya since the late 1980s. More than 90% of the homesteads have trees which are protected and more than 90% of farmers are interested in planting more trees; survey results show that more than 75% of farmers interviewed practiced agroforestry. Only 14 farmers out of 177 are not interested in planting more trees, which was mainly due to age (43%) and lack of land and time (29%).

Integrated soil fertility management (ISFM)

Integrated soil fertility management (ISFM) involves making the best use of inherent soil nutrient stocks, locally available soil amendments and inorganic fertilizers to increase productivity while maintaining or enhancing the agricultural resource base (IFDC 2003; TSBF 2003). Various ISFM technologies have been implemented by TSBF-CIAT in western Kenya. Focus has been to fight hunger, reduce poverty and generate economic growth. In turn, this will require coordinated provision of a number of support services (Sanchez *et al.* 1997).

Existing programs or projects addressing NRM and the environment in the region

Securing the forests

The practice of participatory forest management in Kenya has not been fully operationalized and is therefore still ambiguous to many communities. The Forests Act of 2005 dictates that the community, through a community forest association shall enter into an agreement with the Kenya Forest Service (KFS) to assist in safeguarding forest resources through protection and conservation activities (GoK 2007). In exchange, they are expected to receive timber and non-timber forest products as well as revenues from community-based industries, ecotourism and recreation, scientifc and educational activities. In the implementation process, the contribution of communities is limited to protection and monitoring, with minimal decision-making power and limited access to the shared revenue accrued from the forest resources. The communities are therefore burdened with most of the work with little benefits from the forest. The KFS and Kenya Wildlife Service (KWS) are reluctant to devolve authority to the communities. The revenue currently collected from the forests does not benefit the communities while large companies still dominating timber harvesting. Local communities have been given options for engaging in bee-keeping, butterfly farming, and other projects that require funding and technical skills.

Kakamega forest is managed by three distinct organizations, i.e. the forest department, Friends Church Mission and the KWS. In addition, a number of initiatives have emerged aimed at enabling local communities to benefit from the forest while protecting it and conserving the inherent diversity for future generations. Some of these include:

- Kakamega Environmental Education Program (KEEP) (http://www.keep-kakamega.or.ke), which works with local communities on conservation of the rainforest. Projects of KEEP include:
    - The Kakamega Wildlife Conservancy

  - Energy Conservation programme
  - *Mondia whytei* enterprise: *Mondia whytei* is a herbal medicine plant with medicinal values against diverse ailments such as stomach disorders, diabetes, high blood pressure and others. Locally it is known as *Mukombera*.
- KACOFA (Kakamega Community Forest Association) supported by external donors and nongovernmental organizations. Members of the KACOFA are also members of other older local organizations such as the Kakamega Environmental Education Program (KEEP) and the Isukha Heritage. These help ensure there is no unwarranted harvesting of plants and animals from the forest.

N2AFRICA

N2Africa is a large scale, science-based 'research-in-development' project focused on putting nitrogen fixation to work for smallholder farmers growing legume crops in Africa. It seeks to build sustainable, long-term partnerships to enable African smallholder farmers to benefit from symbiotic nitrogen-fixation by grain legumes through effective production technologies, including inoculants and fertilizers. Funded by the Bill & Melinda Gates Foundation, N2Africa began a second phase on 1 January 2014. The project will run for five years from January 2014. It aims to ensure tailored and adapted legume technologies to expand the area of legume production within the farm and to close yield gaps and reduce yield variability in each partner country, build local expertise, provide opportunities for the poor and enhance their food and nutritional security, address gender disparities, establish new linkages with input supply chain and output market actors to ensure a sustainable supply of legume-related agro-inputs, and reach more than 550,000 farmers with a return on investment of USD3.5 for each USD invested.

LegumeCHOICE Project

This project is being implemented in Kisii and Migori counties and is a collaboration between ICRAF, IITA and KALRO. The project aims to improve food and nutrition security, reduce poverty, and enhance the production environment of smallholder farmers and rural populations, in particular women, through facilitation of the smart integration and use of multi-purpose legumes, providing food, protein, feed, fuel, and organic matter in crop-livestock systems.

NRM policies

Robust policies in areas of food security, forest, soil conservation and water resources are fundamental for sustainable growth and development. Kenya has policies on NRM components. There are, however, overlaps and poor implementation of such policies. Some of the policies on NRM include:

- **Water Act**: ACT NO. 8 OF 2002 which provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services
- **Natural Resources Management policy, 2012**: Guides securing, developing, managing and sustainably utilizing natural resources to save and replenish planet earth
- **Environmental Management and Coordination Act 1999:** Was put in place to guide sustainable exploitation and utilization of environmental resources.
- **The draft National Land Policy:** It encourages full participation of citizens, including marginalized groups, to gain better access, use and control of land and land-based resources. It intends to establish a mechanism for sharing the benefits of natural resources by the people of Kenya.
- National Policy on Water Resources Management and Development 1999.
- Kenya's Forest Policy No. 9: The 2005 Forest Act.

- The Agriculture Act, Cap. 318.
- The Wildlife Conservation and Management Act, Cap 376 and the Amendment Act No. 16 of 1989 (KWS) as well as the Wildlife (Conservation and Management) (Amendment) Act of 2010.
- Mining Act (Cap 306, Laws of Kenya).
- **The Integrated National Land Use Guidelines (INLUG):** They outline land issues to be taken into account throughout the country in all land use planning. They take into account the provisions of the new Constitution of Kenya 2010.

Summary

West Kenya is blessed with natural resources in terms of plant and animal biodiversity, rich alluvial and volcanic soils, and a generally favorable climate. However, uncoordinated agricultural activity by many smallholder farmers to bridge frequent food insecurity episodes has led to major land degradation and soil acidification.

With rising demography, increasing demand for arable land is a further threat to natural resources. Climate instability has led to more frequent episodes of the rainy season arriving late or finishing early, which has impacted on mainly rain-fed crop production systems.

Indigenous and innovative NRM techniques have been trialled to sustain the region's natural resources. Furthermore, many projects and development programs have integrated NRM as their key entry point to sustaining the livelihoods of rural communities. Although the policy environment is well developed to regulate NRM in Kenya, it is currently poorly implemented with unhelpful overlaps and conflicts between government services.

Possible intervention: Take the opportunity of devolution to local governments to bring NRM to the policy local agenda and implement concrete activities that can help secure land, soil and water resources for local rural communities. Also harness NRM to provide additional sources of income to agriculture-dependent stakeholders in western Kenya.

Chapter 7: Conclusions

The situational analysis conducted in the West Kenya action site reveals mixed crop-livestock production systems practiced across diverse agro-ecological zones and landscapes. Except for few cash cropping systems in high altitude zones, production systems across many areas in West Kenya are largely staple-dominated with limited use of improved technologies and inputs. Similarly, most farm households in the action site have limited commercial orientation occasioned by low farm productivity, under-developed market structures with limited farmer linkages and poor physical infrastructure especially road connection among other factors. Owing to these limitations, the action site is fraught with vulnerable livelihoods that largely rely on over-exploitation of natural resources, further aggravating individual household vulnerability. Research for development activities under the Humidtropics should therefore aim to empower farming households to sustainably intensify production and access markets for improved livelihoods and healthy lives. Four key areas of interventions have been identified.

Sustainable agricultural intensification

The analysis has revealed low crop productivity that could be enhanced via intensified production systems. However, this has to be pursued with due regard to appropriate and sustainable use of natural resources that form the basis of every production system. The following activities will be at the centre of this initiative:

- Improved and coordinated approaches for dissemination and delivery of knowledge on agricultural intensification
- Exploiting the existing indigenous knowledge and integrating local approaches and systems in NRM
- Mainstreaming NRM in all development programs and into the county government agricultural priorities
- Targeted research for development activities towards promoting integrated production systems such appropriate intercropping that ensures sustainable utilization of natural resources
- Modelling appropriate crop-livestock mix or crop diversity mix that can foster sustainable use of natural resources

Enhanced market development

Access to gainful markets by farm households provides an important pull mechanism for enhancing farm productivity. Yet most commodities are characterized by informal trading and dis-economies of scale that highly discourage structured marketing. The Humidtropics initiative can therefore pursue the following activities as a step to enhancing market development for key commodities produced by farm households across the action site:

- Conduct value chain assessment for key commodities at the action site/county level
- Explore various mechanisms for enhancing farmer market linkages especially via collective action and contract-based commodity transaction

- Pursue mechanisms for tapping into emerging markets for previously neglected commodities such as sorghum (links to brewers and seed companies); sorghum, millet and cassava (feed processing) etc.
- Explore opportunities for value addition for some of the neglected crops such as sweet potatoes
- Pursue development programs aimed at expanding emerging commercial crops such as soy beans.

Gender, youth and nutrition

Besides revealing the relative dependence of livelihoods in the action site on agriculture, the analysis has also shown gender disparities in agriculture and substantial under-nutrition in pockets of the action site. Similarly, the analysis has shown the relative vulnerability of the youth population across the action site. The Humidtropics program can address these limitations via the following activities:

- Identify commodity value chains with greater potential for inclusion of youth and women
- Explore mechanisms for mainstreaming gender in various development programs
- Pursue nutrition education aimed at enhancing utilization of neglected but nutritious commodities such millet
- Encourage coordination and partnership to bear synergy among various projects aimed at addressing poverty, food and nutrition security.

Inclusive policy formulation

Policies are formulated at the national level while implementation has been devolved to the county governments. It is therefore important that implications of these national policies are discussed and internalized before formatting implementation plans. The R4D platform that has been operationalized under the Humidtropics program should form the forum for such discussions. The West Kenya R4D platforms should therefore bring together various stakeholders across the action site and form technical committees that will lead discussions around specific policy issues.

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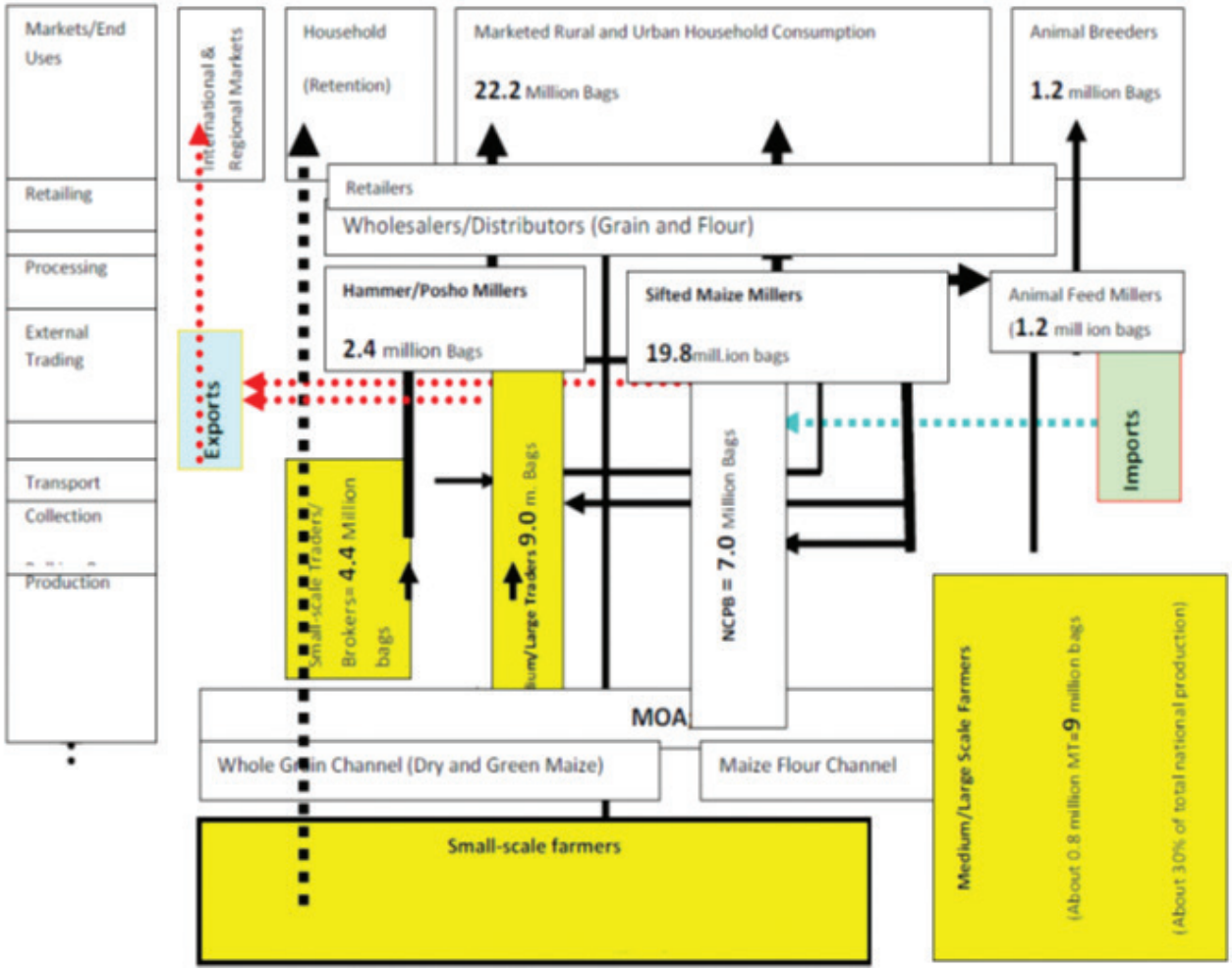
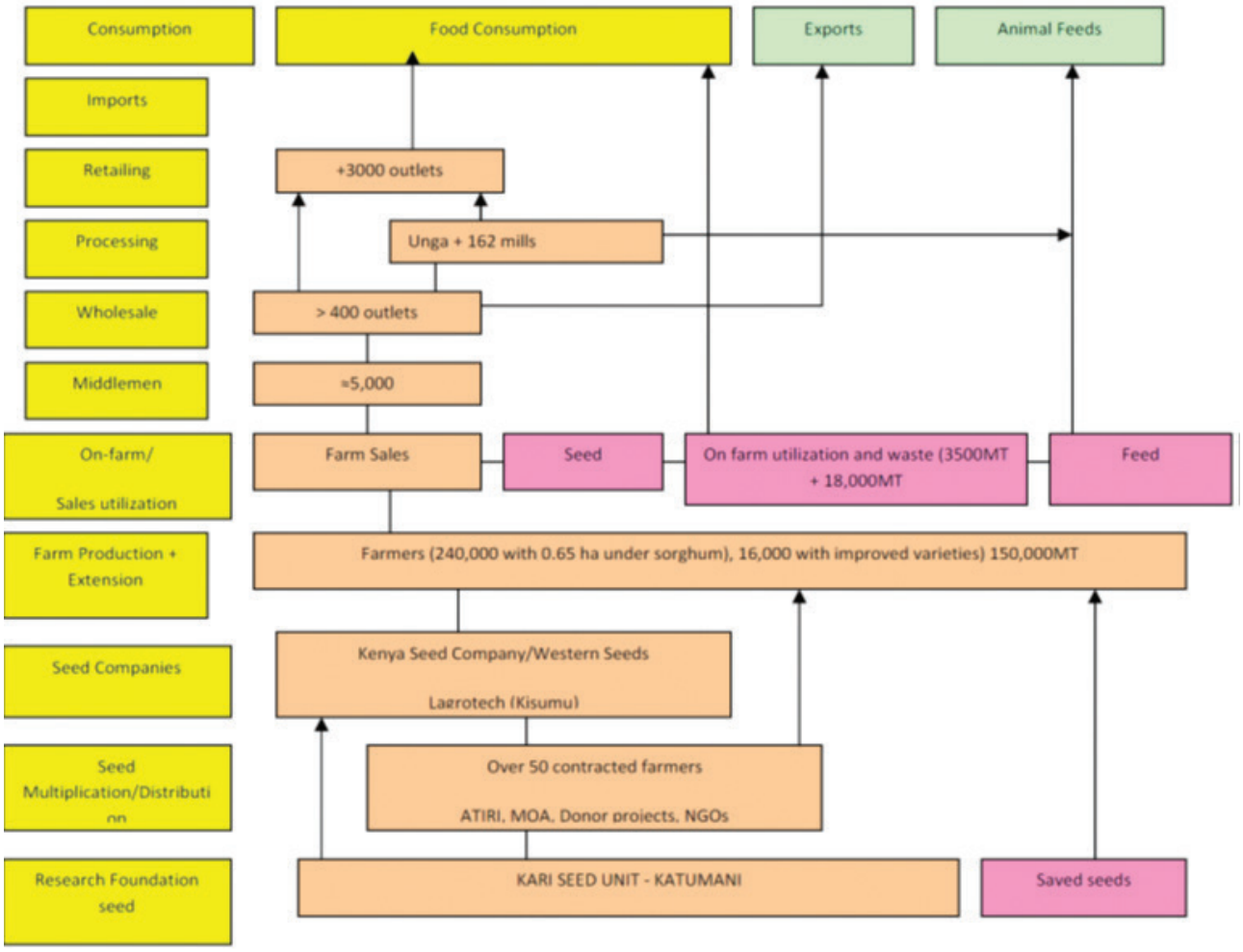
Annexes

Annex 1: Generic value chain map for maize in Kenya



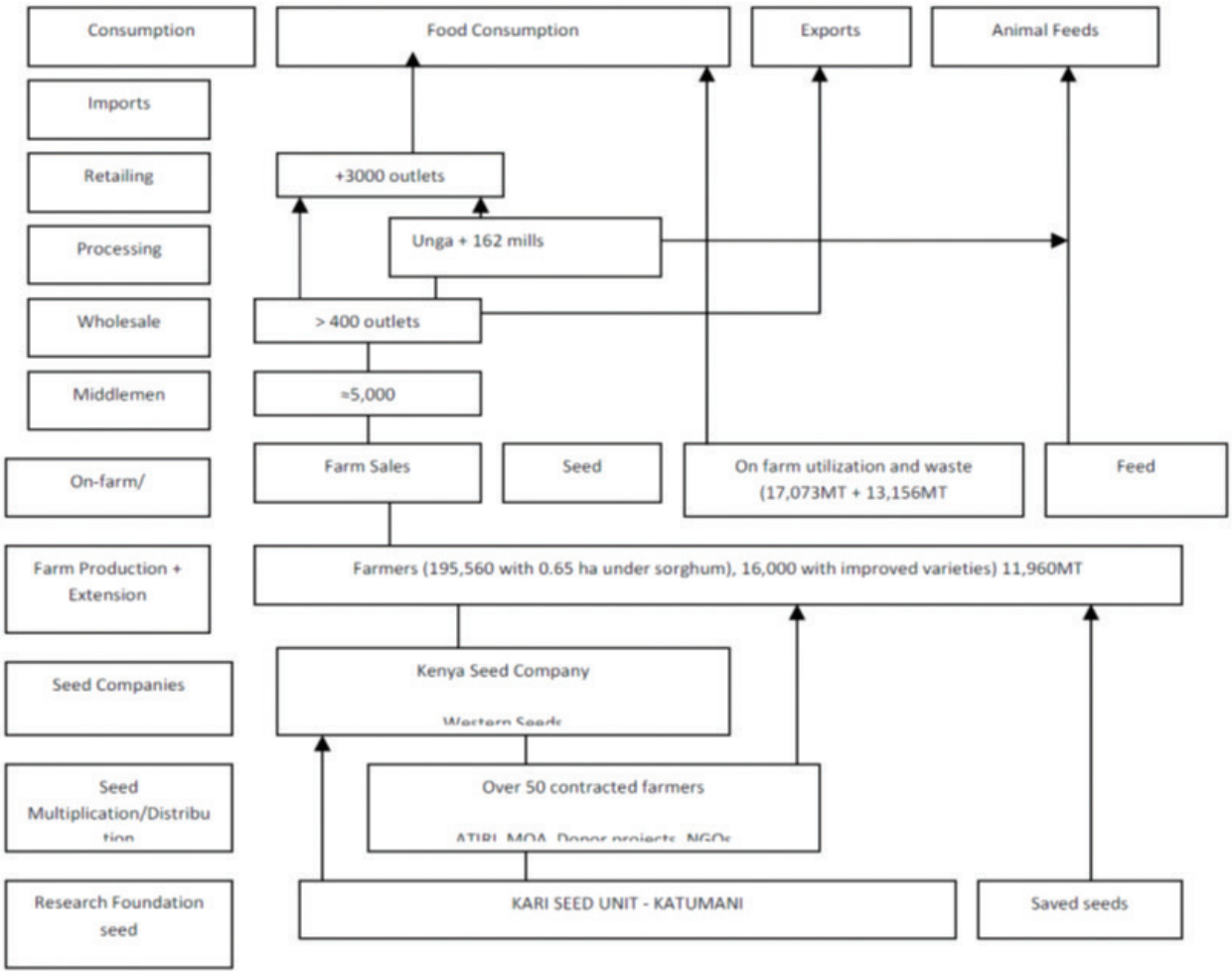
Source: USAID 2010

Annex 2: Generic value chain map for sorghum in Kenya



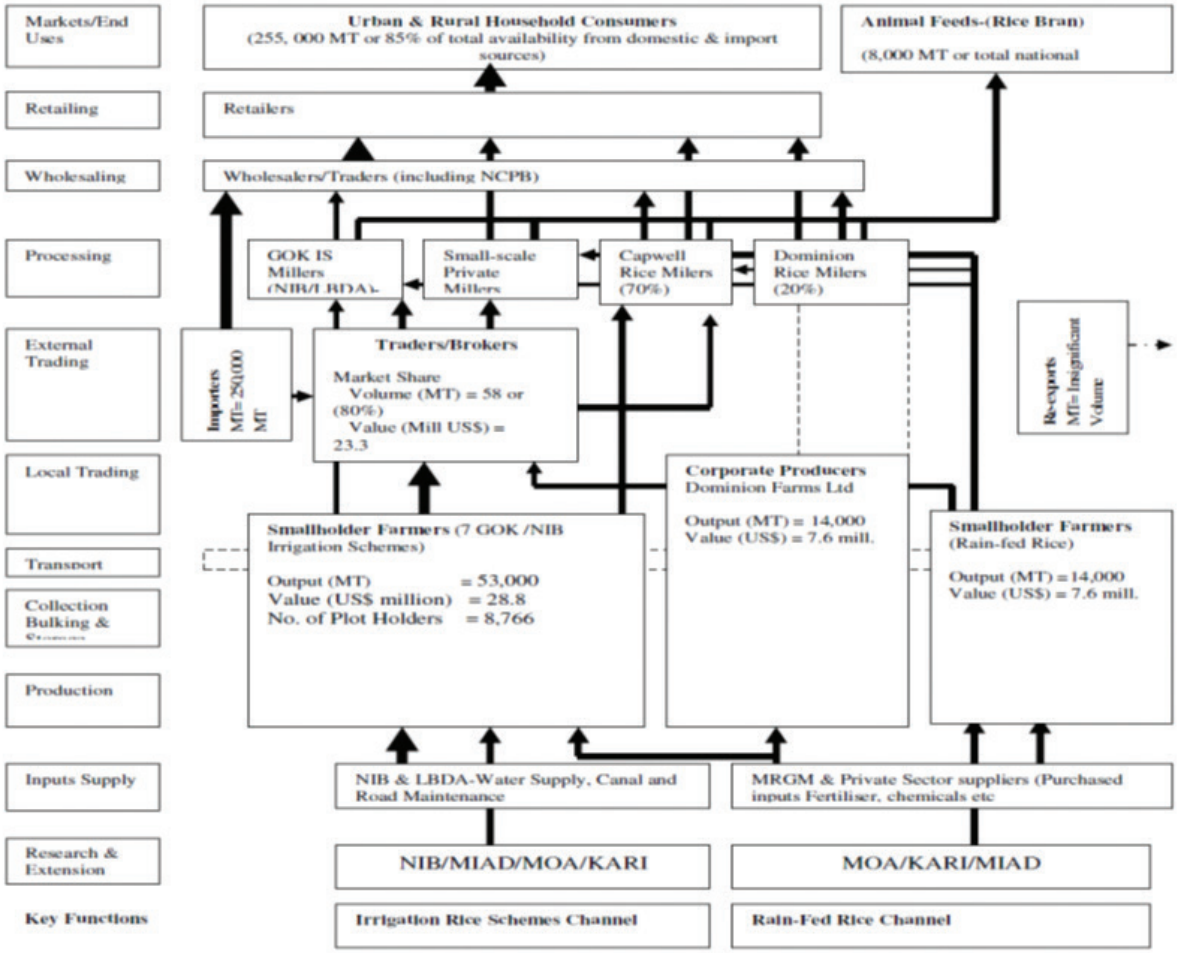
Source: USAID 2010

Annex 3: Generic value chain map for finger millet in Kenya



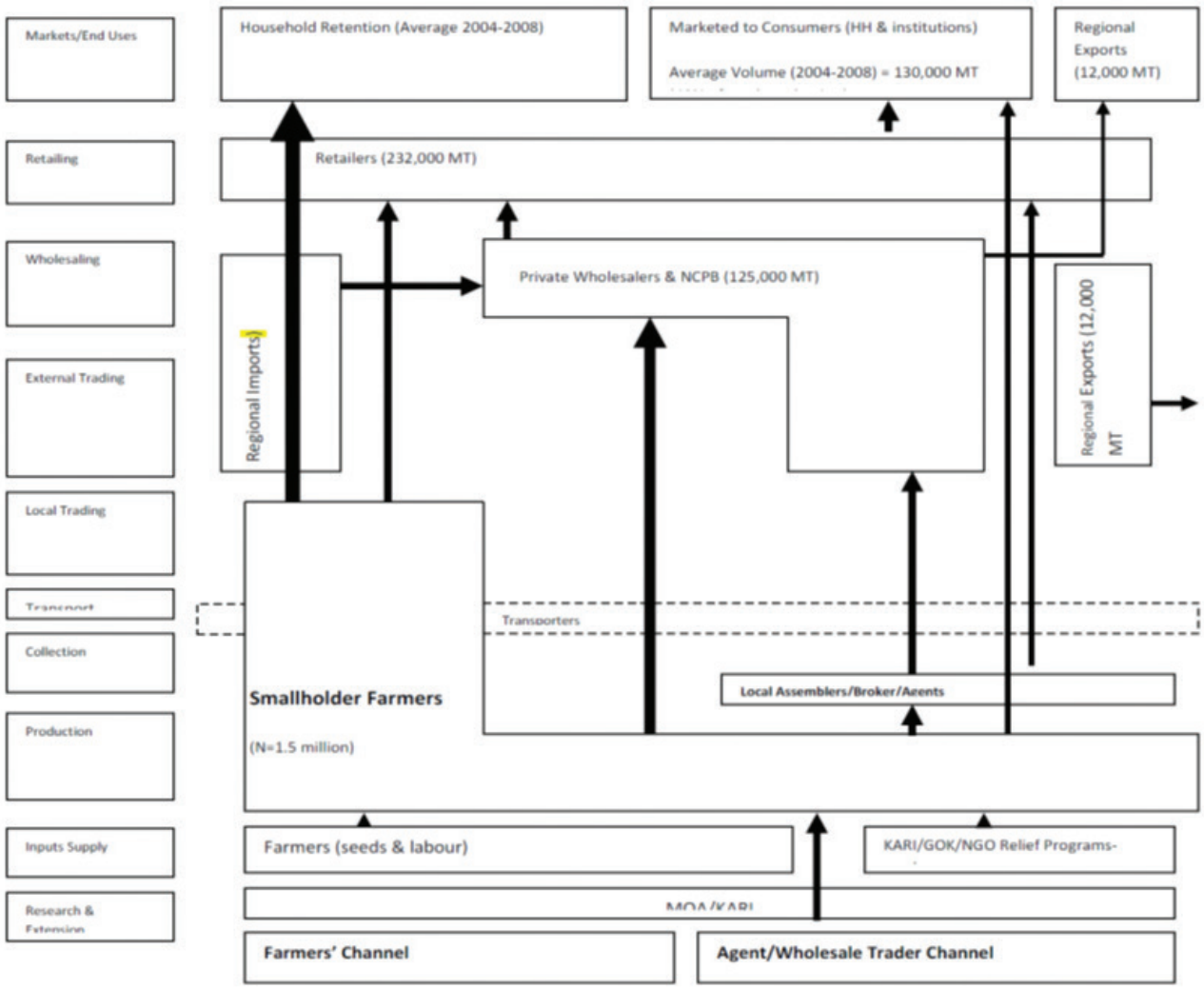
Source: USAID 2010

Annex 4: Generic value chain map for rice in Kenya



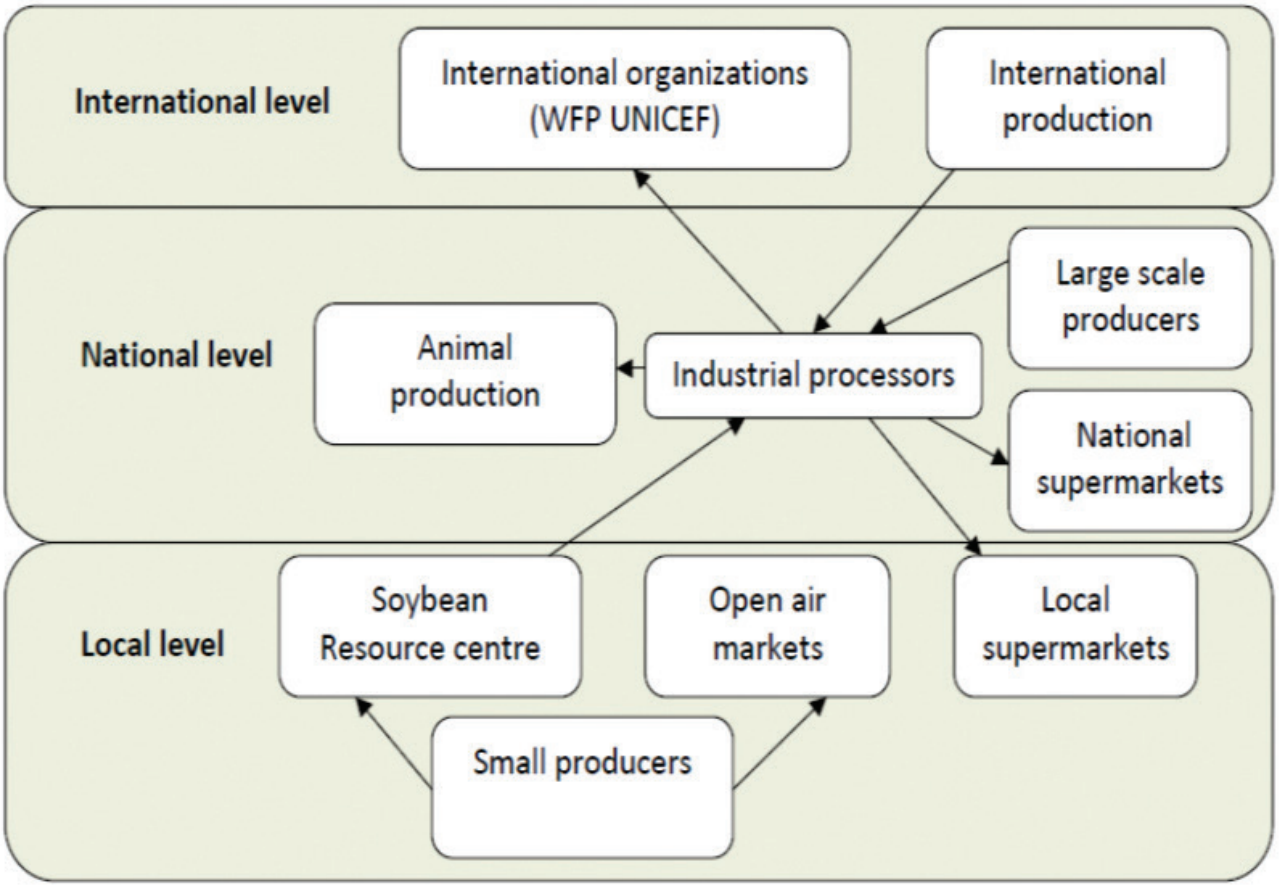
Source: USAID 2010

Annex 5: Generic value chain map for dry beans in Kenya



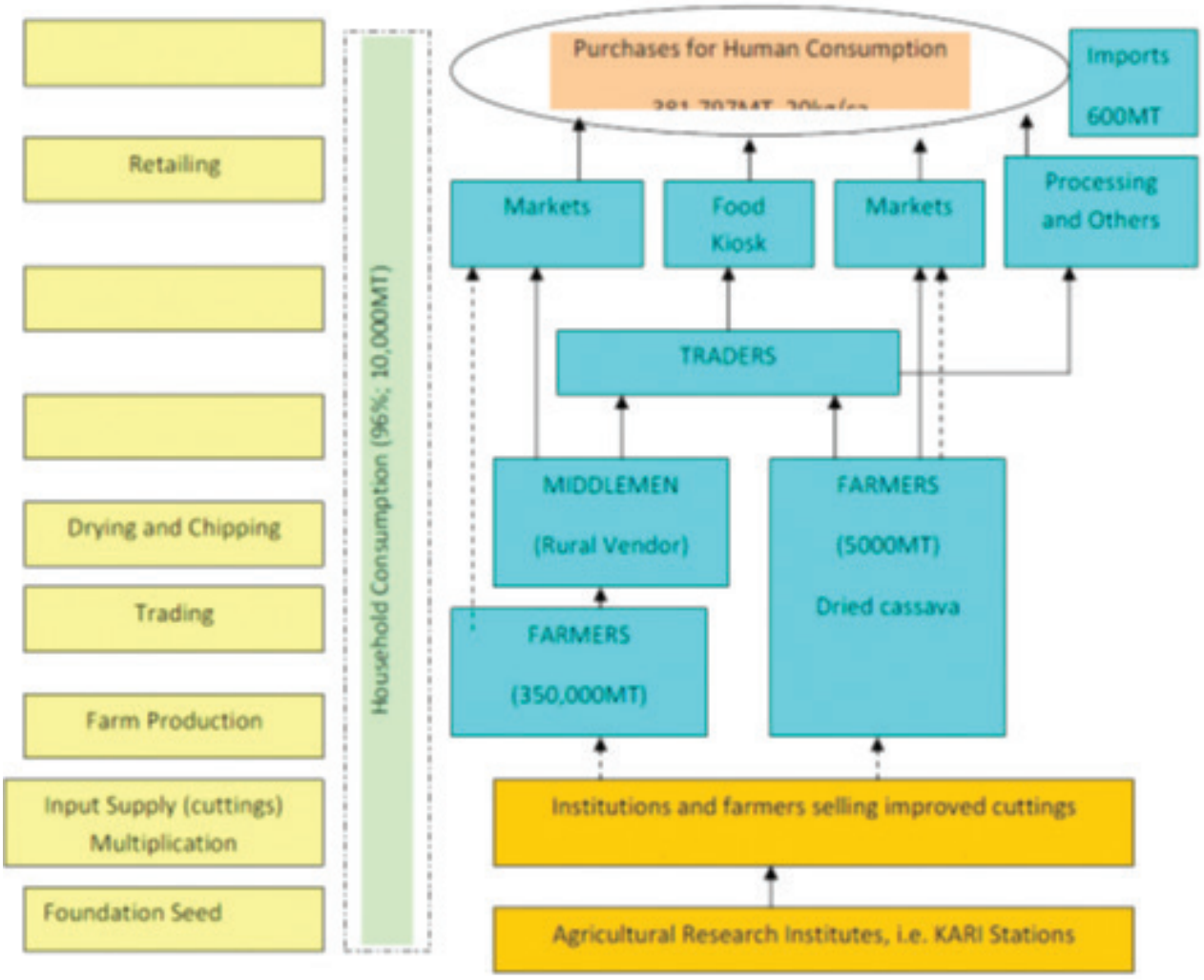
Source: USAID 2010

Annex 6: Value chain map for soybean in western Kenya



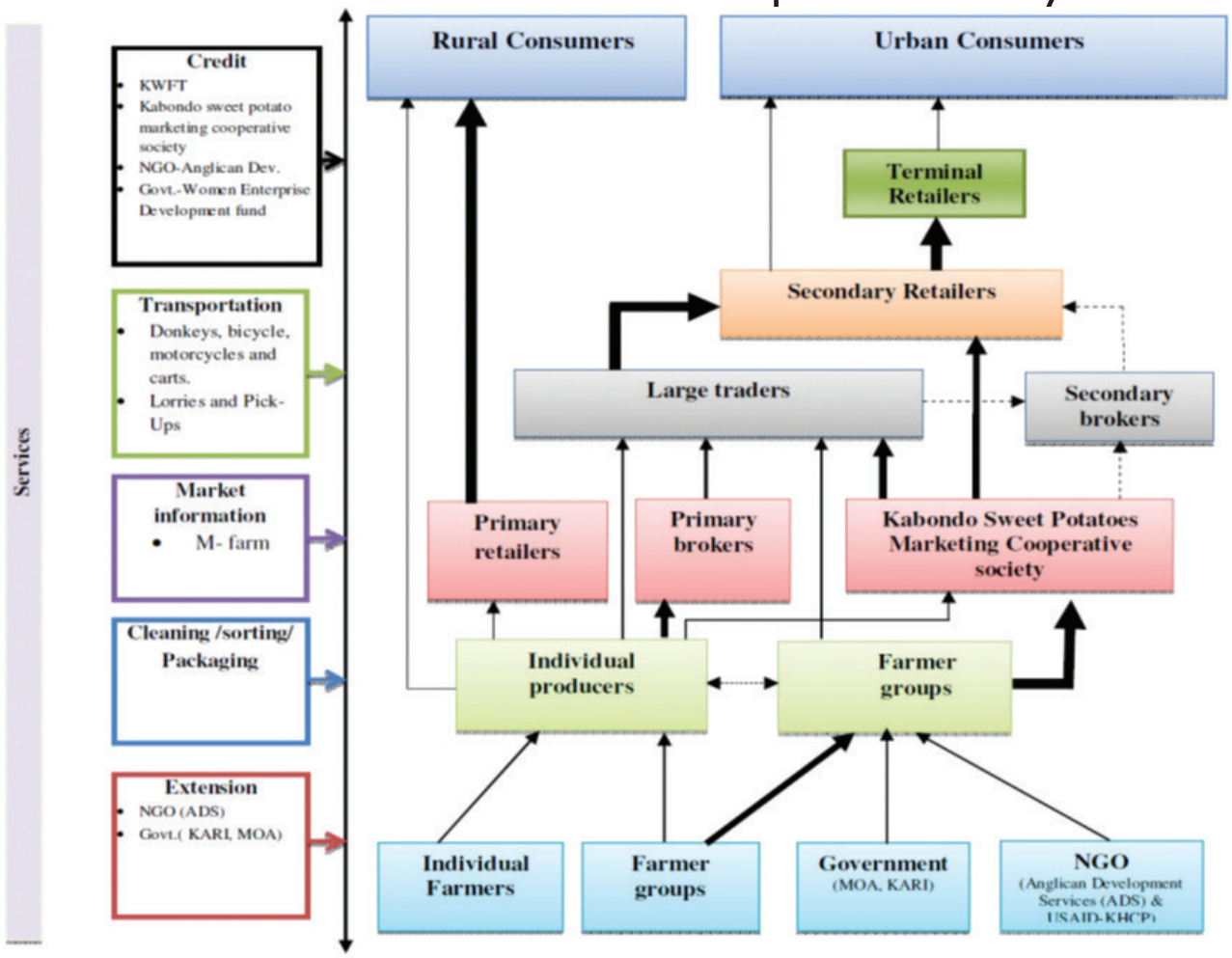
Source: Collombet 2013

Annex 7: Generic value chain map for cassava in Kenya



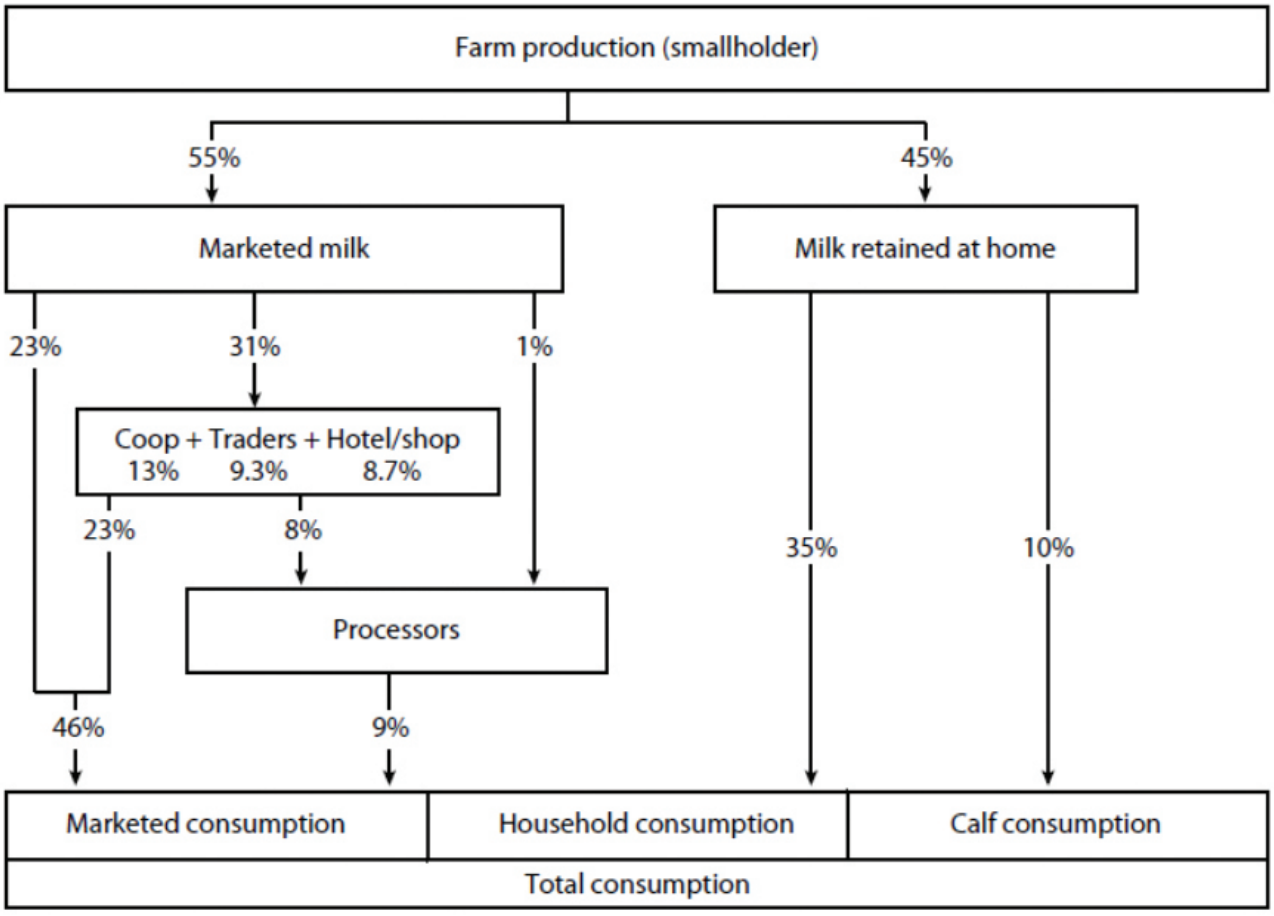
Source: USAID 2010

Annex 8: Generic value chain of sweet potato in Kenya



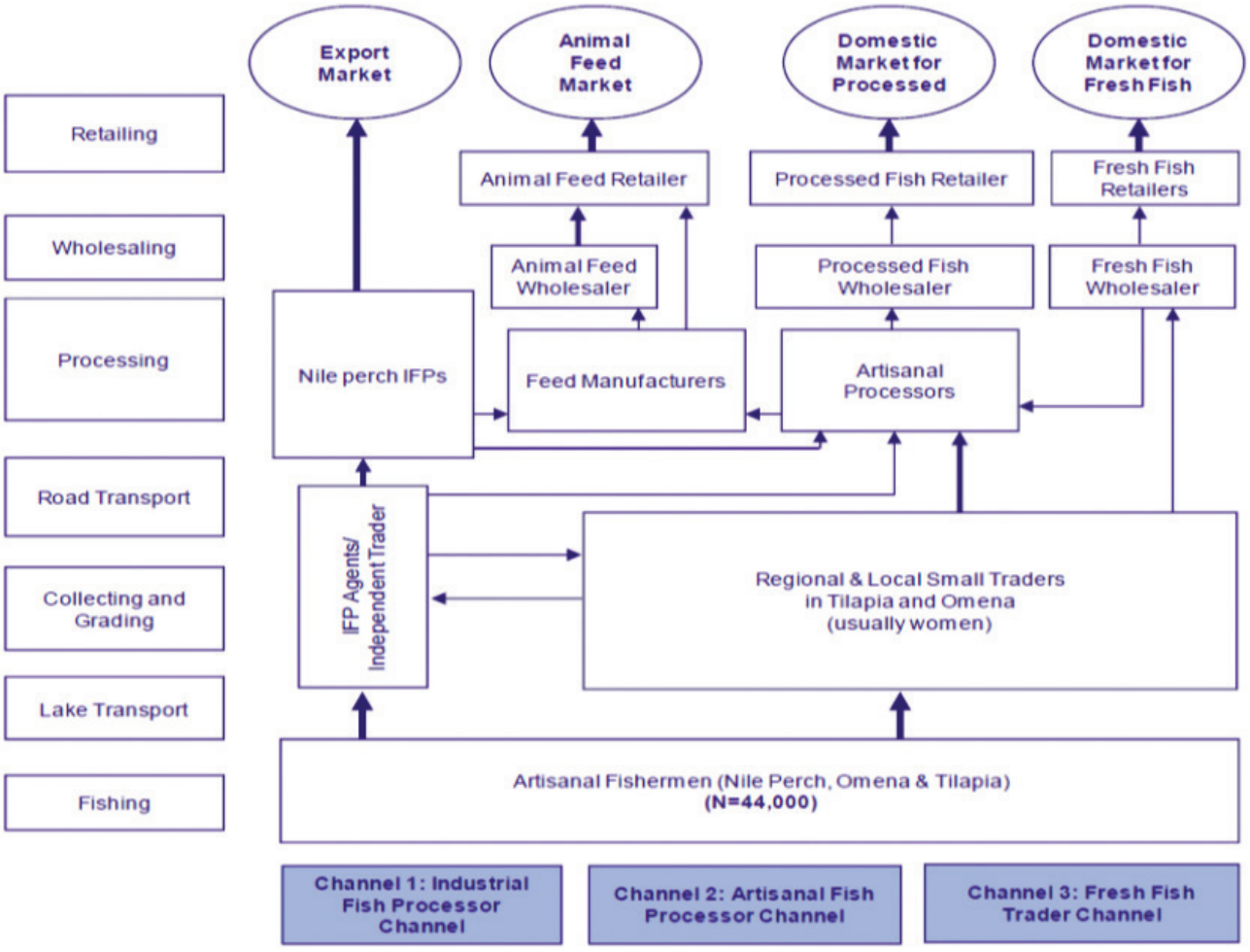
Source: Olwande et al. 2013

Annex 9: Generic dairy value chain in Kenya



Source: Miruiki 2013

Annex 10: Value chain map for Lake Victoria fish



Source: Ardjosoediro and Neven 2008

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