Demand Analysis Report- Republic of Kenya

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KENYA

Treat the earth well. It was not given to you by your parents…it is loaned to you by your children…

- A Kenyan proverb

I. OVERVIEW OF KENYA

1.1 Location

Kenya described as "the cradle of humanity"lies on the equator on the eastern coast of Africa. It is bordered by Ethiopia to the north, Somalia to the east, Tanzania to the south, Uganda to the west, and Sudan to the northwest, with the Indian Ocean running down the southeast border. Kenya covers an area of 582,646 km^2 measuring about 890 km east to west and 1,030 km from north to south. The country enjoys a tropical climate. It is hot and humid at the coast, temperate inland and very dry in the north and northeast parts of the country.

Figure 1 Location of Kenya

1.2 **Climate**

The country has a warm and humid climate along its Indian Ocean coastline, with wildlife-rich savannah grasslands inland towards the capital. Nairobi, the capital, has a cool climate that gets colder approaching Mount Kenya, which has three permanently snow-capped peaks. Further inland there is a warm and humid climate around Lake Victoria, and temperate forested and hilly areas in the western region. The northeastern regions along the border with Somalia and Ethiopia are arid and semi-arid areas with near-desert landscapes. Lake Victoria, the world's second largest fresh-water lake and the world's largest tropical lake, is situated to the southwest and is shared with Uganda and Tanzania *(MoA, Kenya 2016).*

1.3 Tourism

Kenya's services sector, which contributes about 61 percent of GDP, is dominated by tourism. The tourism sector has exhibited steady growth in most years since independence and by the late 1980s had become the country's principal source of foreign exchange. Tourists, the largest number from Germany and the United Kingdom, are attracted mainly to the coastal beaches and the game reserves, notably, the expansive East and West Tsavo National Park (20,808 square kilometers (8,034 sq mi)) in the southeast *(MOA, Kenya 2016).*

1.4 Population

Kenya has an estimated population of 46.1 million, which increases by one million a year.Kenya's population has tripled over the past 30 years and over 20 per cent of the population live in urban areas, with the UN predicting this will double by 2045. Almost half of the population lives in poverty and 30 per cent are malnourished, but the highest poverty levels are in the arid pastoralist districts in the north where 80-95 per cent of people live below the poverty line. Here, insecurity is a growing threat, as is conflict between neighbouring and cross-border communities over increasingly limited water and pasture resources.

Table 1. Kenya's Rural Population

	Share [%][1]			
	2000	**2005**	**2010**	**2015**
Rural population [% of total population]	80.11	78.32	76.43	74.36
Labour force in agriculture [% of total labour force]	75.43	73.10	70.61	67.95
Females [% of labour force in agriculture]	49.40	48.99	48.72	48.43

1.5 Economy

[1]Source: FAOSTAT, FAO of the UN, accessed on January 24, 2014. http://faostat.fao.org/site/550/default.aspx#ancor

The World Bank has classified Kenya as a Lower middle-income country. Kenya has one of the most developed economies in Africa, with relatively well-developed agricultural sectors and substantial agricultural foreign exchange earnings. However, key underlying challenges remain, including corruption, conflict, poverty, a rising population and climate change.

With the support of the World Bank Group (WBG), International Monetary Fund (IMF) and other development partners, Kenya has made significant structural and economic reforms that have contributed to sustained economic growth in the past decade. Development challenges include poverty and inequality, and vulnerable of the economy to internal and external shocks. (World Bank, 2016)

Kenya's growth is projected to rise to 5.9% in 2016 and 6.1 % in 2017. According to the October- 2015 Kenya Economic Update, Kenya is poised to be among the fastest growing economies in Eastern Africa. Besides, the 2016 Country Economic Memorandum says that Kenya's growth prospects will depend a lot on Innovation, Oil, and Urbanization on the long term.

With the recent creation of the East African Cooperation that became East African Community,Goods can easily cross the borders without Customs documentation hence not accounted in trade. Nevertheless, the value of the goods traded in such manner is of a small proportion that cannot distort the recorded trade.

Kenya has a set of ambitious targets in its bid to become a middle-income country by 2030.

1.6 Kenya – a development overview

Home to some of the world's most mesmerizing natural wonders and people, Kenya is considered a wealth of bio- and cultural diversity.

Historically, Kenya enjoyed relative peace compared to other African nations. Arabs settled the area in the 10^{th} century for trade and were violently taken over by the Portuguese in the 16th century. By the late 1800s Britain took the colonial lead, settling into the region and establishing railways into the interior under weak resistance from the native tribes. British rule lasted until 1963 and included the deaths of tens of thousands of Kenyans who resisted white settlement.

In 1994, 47 percent of Kenyans fell below the poverty line—$17 per month in rural areas and $36 per month in urban areas. According to the Human Development Index (HDI), Kenya

has experienced steady declines since 1980, with only the goal of universal primary care showing positive growth. Extreme poverty, which is defined as those living under $1 per day, includes almost 30 percent of Kenya's current population.

In the Corruption Perceptions Index (CPI) of 2014 prepared by Transparency International, Kenya is ranked 145th out of 175 assessed countries with a score of 25 out of a possible 100.

Development in Kenya has largely been concentrated in the west-east corridor straddling the northern corridor linking the port city of Mombasa to the western part of Kenya. About two-thirds of the country, covering northern and eastern parts, and to some extent the southern parts, remain underdeveloped, largely occupied by nomadic pastoralists.

1.7 Summary Statistics

Table 2. Basic Information of Kenya[2]	
Region	Eastern Africa
Surface area (sq km)	591958
Population (est., 000)	45546
Pop. density (per sq km)	78.5
Capital city	Nairobi
Capital city pop. (000)	3768
Currency	Kenya Shilling (KES)
UN membership date	16 December 1963

Table 3. Economic indicators of Kenya[3]		
GDP: Gross domestic product (million current US$)	2013	54443
GNI: Gross national income per capita (current US$)	2013	1218.1
Gross fixed capital formation (% of GDP)	2013	20.7
Exchange rates (national currency per US$)	2013	86.31
Agricultural production index (2004-2006=100)	2013	123
Food production index (2004-2006=100)	2013	123
Unemployment (% of labour force)	2013	9.2
Employment in industrial sector (% of employed)	2013	...
Employment in agricultural sector (% of employed)	2013	...
Labour force participation, adult female pop. (%)	2013	62.2
Labour force participation, adult male pop. (%)	2013	72.4
Mobile-cellular subscriptions (per 100 inhabitants)	2013	70.6
Mobile-cellular subscriptions (per 100 inhabitants)	2010	61.0
Individuals using the Internet (%)	2013	39.0

[2,3 & 4]From Kenya National Bureau of Statistics, 2015 (Source: UN Data, 2016)

Exports (million US$)	2013	5537.0
Major trading partners (% of exports)	2013	Uganda (11.9), United Kingdom (7.9), United Rep. Tanzania (7.7)
Major trading partners (% of imports)	2013	India (18.3), China (12.9), United Arab Emirates (8.3)

Table 4. Social indicators of Kenya[4]		
Population growth rate (average annual %)	2010-2015	2.7
Urban population growth rate (average annual %)	2010-2015	4.3
Rural population growth rate (average annual %)	2010-2015	2.1
Urban population (%)	2014	25.2
Population aged 0-14 years (%)	2014	42.0
Population aged 60+ years (females and males, % of total)	2014	4.7/4.1
Sex ratio (males per 100 females)	2014	99.6
Life expectancy at birth (females and males, years)	2010-2015	63.5/59.7
Infant mortality rate (per 1 000 live births)	2010-2015	51.6
Education: Government expenditure (% of GDP)	2007-2013	6.6
Education: Primary-secondary gross enrolment ratio (f/m per 100)	2007-2013	92.1/94.1
Education: Female third-level students (%	2007-2013	41.2

of total)		
Seats held by women in national parliaments (%)	2015	19.7

Table 5. Environment[5]		
Threatened species	2014	428
Forested area (% of land area)	2012	6.1
Proportion of terrestrial and marine areas protected (%)	2014	10.6
Population using improved drinking water sources (%)	2012	62.0
Population using improved sanitation facilities (%)	2012	30.0
CO_2emission estimates (000 metric tons and metric tons per capita)	2011	13568/0.3
Energy supply per capita (Gigajoules)	2012	12.0

- **Land use**: arable land: 8%; permanent crops: 1%; other: 91% (2005)
- **Major industries**: small-scale consumer goods, agricultural products, horticulture, oil refining; cement, commercial ship repair, tourism
- **Agricultural products**: tea, coffee, maize, wheat, sugarcane, fruit, vegetables; dairy products, beef, pork, poultry, eggs
- **Natural resources**: limestone, soda ash, salt, gemstones, fluorspar, zinc, diatomite, gypsum, wildlife, hydropower
- **Export commodities**: tea, horticultural products, coffee, petroleum products, fish, cement
- **Export partners**: UK 11.31%, Netherlands 9.81%, Uganda 9.07%, Tanzania 8.83%, US 5.93%, Pakistan 5.63% (2009)[6]

[5]From Kenya National Bureau of Statistics, 2015 (Source: UN Data, 2016)

1.8 Challenges and Potential

The challenges for the country include its growing population of which about 30 % is malnourished, corruption and threats from neighbouring African nations over sharing of water and pasture resources. Regional disparities too face a serious challenge as about two-thirds of the country remains underdeveloped. However, the agricultural sector and the substantial foreign exchange earnings hold promise. Tapping this potential could help Kenya realize the dream of becoming a middle-income country by 2030.

II. KENYA'S AGRICULTURAL SECTOR

> "…too often historical change in Kenya and elsewhere in Africa has been conceptualized as the *transformation of a peasant society.* It would be more accurately conceptualized as the *creation of a peasant society from a pastoral one.*
>
> -Kitching, 1980

2.1 Overview of Agriculture sector

The evolution of modem agriculture in Kenya began in the colonial period duringwhich cash crops such as tea, coffee, and maize were introduced for commercial purposes.Agriculture is a cornerstone of Kenya's economy employing over three quarters of the population (IFOAM 2003)directly contributing 26 per cent of the GDP annually, and another 25 per cent indirectly. The sector accounts for 65 per cent of Kenya's total exports and provides more than 70 per cent of informal employment in the rural areas. Therefore, the agricultural sector is not only the driver of Kenya's economy but also the means of livelihood for the majority of Kenyan people *(ERA Kenya, 2015).*Over 80% of the Kenyan population live in the rural areas and derive their livelihoods, directly or indirectly from agriculture. Although subsistence farming still represents half of agricultural output, the sector includes many large-scale commercial farms, plantations and specialist horticultural units.

- [6]Source – New Agriculturist,2010. Accessed at http://www.new-ag.info/en/country/profile.php?a=1787

In large-scale farming districts of Kenya namely, Nakuru, Uasin Gishu, Trans-Nzoia, Kericho, Nandi and Laikipia, the average size of farms is around 700 hectares. Overall, 25 per cent of the farms range between 20 and 50 hectares.

2.2 Agricultural production systems

2.2.1Rainfed Agriculture

Kenya's agriculture is mainly rain-fed and is entirely dependent on the bimodal rainfall in most of the country. There are two cropping seasons except in the very high-altitude areas. The performance of rain-fed agriculture varies due to the diverse agro-climatic zones. In the humid, high-altitude areas productivity as well as predictability of a good crop is high. However, the population density in these areas has increased and land has been subdivided into such small sizes that it is becoming uneconomical for farm enterprises. To mitigate this problem, land sub division should be restricted and farm enterprises intensified.

In the medium altitude and moderate-rainfall areas, arable rainfed farming is moderately suitable. However, there is a relatively high risk of crop failure due to increased frequency of dry spells and an uneven rainfall distribution. Increasing productivity in these areas will require better selection of crops, adoption of improved technologies, and better crop husbandry.

A large proportion of the country, accounting for more than 80 per cent, is semi-arid and arid with an annual rainfall average of 400 mm *(ERA Kenya, 2015)*. Droughts are frequent and crops fail in one out of every three seasons. Most of the area is rangeland suitable for ranching and pastoralism. Farm enterprises comprise mixed crops and livestock. While there is ample land, farmers tend to grow crops that are not suitable for this rainfall regime or for the soils. These areas require better planning, careful selection of farm enterprises and greater investment in infrastructure.

2.2.2 Irrigated Agriculture

Kenya is classified as one of the water-deficient countries in the world. Water resources are unevenly distributed in space and time: about 56 per cent of all the country's water resources are in the Lake Victoria basin *(MOA, Kenya 2016)*. Even in the basins, with the exception of the highlands, water availability is scarce. Consequently, the country's irrigation-based farming is still limited.

Irrigation agriculture in Kenya is carried out mainly in irrigation schemes and in large-scale irrigation of crops such as rice and coffee. Individual farmers have developed their own systems of irrigation especially for export crops such as coffee and horticulture. Large commercial farms account for 40 per cent of irrigated land, smallholder farmers 42 per cent, and Government-managed schemes 18 per cent.

With a national average rainfall of 400 mm, the country should harvest and store adequate water for agriculture and other uses. Groundwater resources that can be exploited for agriculture need to be assessed and quantified.

More land can be reclaimed for crop cultivation by developing irrigation infrastructure in the ASALs (Arid and Semi-Arid Lands). It is estimated that intensified irrigation can increase agricultural productivity fourfold and, depending on the crops, incomes can be multiplied 10 times.

2.3 Agricultural Commodities

2.3.1 Crop Production

Crop production is in two categories based on the use of the harvested produce: food crops and cash / industrial crops.

2.3.1.1 Food Crops

Food crops are classified into cereals (maize, wheat, sorghum, rice, millet); pulses (beans, pigeon pea, cowpea, chickpea, green grams); and roots and tubers (sweet potato, Irish potato, cassava, arrowroot and yam). The main food crops are maize, rice, wheat, sorghum, potato, cassava, vegetables and beans. However, the production of other food crops, particularly legumes and root crops, declined due to a combination of factors such as the effects of heavy rains, pests and diseases, and lack of quality planting material.

Production costs for most of these crops are still high due to high costs of inputs especially fertilizer, poor and long marketing chains, low level of mechanization and high transport costs. Increases in global fuel prices have also contributed. Production of the main food crops—maize, wheat and rice—has generally been below the country's consumption requirements *(MOA, Kenya 2016).*

2.3.1.2 Industrial Crops

The main industrial crops are tea, coffee, sugar cane, cotton, sunflower, pyrethrum (Chrysanthemum) , barley, tobacco, sisal, coconut and bixa (introduced by the Japanese and the Kenyan government in the 1970s), all of which contribute 55 per cent of agricultural exports.

2.4. Summary statistics

Table 6. Kenya: Evolution of land use[7]

	Area [Millions of ha]				Annual growth rate [%]		
	1997	2002	2007	2012	1997-2002	2002-2007	2007-2012
Total area	56.91	56.91	6.91	6.91	0	0	0
Arable land	4.81	5.09	.30	.60	1.14	0.81	1.11
Permanent crops	0.48	0.43	.47	.53	2.18	1.79	2.43
Forest cover	3.62	3.56	.50	.44	-0.33	-0.34	-0.35

Table 7. Production of major commodities - 2012[8]

	Commodity	*Quantity [t]*
1	Sugar cane	5822633
2	Milk, whole fresh cow	3732960
3	Maize	3600000
4	Potatoes	2915067
5	Mangoes, mangosteens, guavas	2781706
6	Bananas	1394412
7	Milk, whole fresh camel	933616
8	Cassava	893122
9	Sweet potatoes	859549

[7] Source: FAOSTAT, FAO of the UN, Accessed on August 12, 2014.
http://faostat.fao.org/site/377/default.aspx#ancor
[8] Source: FAOSTAT, FAO of the UN, Accessed on February 4, 2015.
http://faostat.fao.org/site/567/default.aspx#ancor

10	Cabbages and other Brassicas	684000

2.5 SWOT analysis

During 2012, the Montpellier panel had come up with a SWOT analysis of African Agriculture, which is given hereunder[9].

TABLE.8. SWOT ANALYSIS OF AFRICAN AGRICULTURE

Strengths:	**Weaknesses:**
• The diversity of African agricultural agro ecosystems furnishes resilience although this heterogeneity also requires sophisticated and nuanced management • Smallholder agriculture can be highly efficient, producing five or more tons of grain per hectare with appropriate inputs and management • Farm-level production costs in Africa are often relatively low • There is a strong tradition of village-level farmer associations providing a basis for growth and innovation • Acceleration in GDP growth in SSA has been, in part, driven by faster agricultural growth • Foreign direct investment (FDI) in the continent increased from US$2.4 billion in 1985 to US$55 billion in 2010 although	• A lack of coherent, cross-ministerial policies and leadership on agriculture • Poor incentives for small business investment • Access to input and output markets is often weak • Average cereal yields are only one ton per hectare • The predominant rainfed agriculture is vulnerable to unreliable and unpredictable rainfall • Total agricultural R&D spending in Africa grew at only 1.9% between 2000 and 2008, although there is wide variability between countries • African soils are heavily degraded and depleted of nutrients • Tenure over more than 90% of land remains outside the formal legal system in Africa and is therefore at risk of dispossession.

[9]The Montpellier Panel. 2012. Growth with Resilience: Opportunities in African Agriculture. London:Agriculture for Impact.

	• Agricultural mechanization
Opportunities: • There is a large agricultural workforce: 65% of Africa's population lives and works in rural areas • The workforce will be predominantly young: by 2040, one in five of the world's young people will live in Africa • Large opportunities to improve yields through increasing fertilizer application rates and irrigating more land • Fertilizers are applied at average rates of about 11kg/ ha of arable land (compared to 154kg ha in India and 468kg/ha in China). There is a huge potential to use local African sources of rock phosphate fertilizer at affordable costs • Only around 4% of cultivated land in SSA is irrigated. Potentially over 20 million hectares of land under irrigation • Already in motion are agricultural growth corridor projects in areas with high agricultural potential that will stimulate investment and develop regional value chains • Mobile and internet connectivity is growing rapidly: mobile phone subscribers have risen from less than two million in 1998 to over 400 million in 2009 and internet users in SSA between 2005 and 2010 grew by almost 430%	**Threats:** • 80% of all African farms (33 million farms) are less than two hectares in size, which can increase transaction costs • The success of investments in agriculture depends on the engagement of women who make up 50% of the agricultural labour force and have relatively poor access to resources and services • SSA has many pests, diseases and weeds such as Striga, Black Sigatoka, Banana wilt, Cassava mosaic virus, Maize leaf streak, Maruca beetles, stem borers, downy mildew and locusts that are capable of destroying harvests • SSA farmers face the lowest agricultural incentives in the world • Three quarters of African countries are net importers of agricultural products and African trade tariffs are on average 50% higher than comparable tariffs in Latin America and Asia • Climate change is likely to reduce

2.6Revival of the Agricultural sector

The agriculture sector,after a slump, began to revive in 2000, with an average growth rate of 2.4 per cent. This was driven by the governments' efforts, especially after 2003, to recognize agriculture as a priority sector, key to economic growth in the context of the Economic Recovery Strategy for Employment and Wealth Creation (ERS) and the Strategy for Revitalizing Agriculture (SRA). The government gradually started to invest more in the sector and to increase budgetary allocation to an average of 4.5 per cent of the total national budget (GoK, 2009). The sector reached a high growth rate of 6.1 per cent in 2007 (GoK, 2009).

In 2010, growth in the agriculture sector rebounded. Vibrant internal demand for major staples, livestock products and horticultural goods, and growth in key export sub-sectors such as coffee, tea, pyrethrum, horticulture, and cut flowers, were important factors that contributed to this recovery (GoK, 2010). In 2012, agricultural output grew by 3.8 per cent, more than twice its growth in 2011 thanks largely to better weather conditions. The government is undertaking important legal and institutional reforms in the sector, in addition to increasing allocation of resources towards irrigation, and improved access to inputs, especially fertilizer and seeds (KIPPRA[10], 2013).

2.7 Acts and Strategies

Three major reforms, all enacted in 2012, for revival of the agricultural sector in Kenya are:

- The *Land Act*, which mandates the National Land Commission to recommend policies on land, acquire land for public purposes, regulate land use in the public interest and allocate land for investment
- The *Agriculture, Livestock, Fisheries and Food Authority Act*, which establishes an authority to oversee the operation of the agricultural sector – including licensing, law enforcement and registration of farmers – and to promote and regulate the production, processing, marketing and transportation of agricultural products, advise the government on agricultural policy and build the capacity of county governments in relation to agriculture

[10]Kenya Institute for Public Policy Research and Analysis - an autonomous public institute that was established in May 1997 to provide quality public policy advice to the Government of Kenya and other stakeholders by conducting objective research and through capacity building in order to contribute to the achievement of national development goals.

- The *Crops Act*, which formulates policies for the development of scheduled crops, facilitates marketing and distribution of crops, conducts training for farmers, and establishes and enforces crop standards.

In order to put Kenya back on a strong economic growth path, the Government of Kenya embarked on the formulation of a wide range of policies aimed at economic reconstruction and the rehabilitation of collapsed infrastructure and institutions. In 2003, the ERS was launched as a blueprint for economic development with an overall goal of creating more jobs and wealth to move the country from poverty to prosperity. The ERS gives high prominence and priority to agriculture and recognizes it as the backbone of the economy. Its rapid growth is necessary to generate wealth and employment. In addition, the strategy recognizes that revival of agricultural institutions and investment in agricultural research and extension are essential for sustainable economic growth (GoK, 2009).

As a response to the ERS, the Government of Kenya, as mentioned above, launched the SRA in 2004. The SRA states that the Vision of the Government is "to transform Kenya's agriculture into a profitable, commercially oriented and internationally and regionally competitive economic activity that provides high quality gainful employment to Kenyans" (GoK, 2009).

In June 2008, the Government launched the Kenya Vision 2030 as the new long-term development blueprint for the country (GoK, 2009). The Vision of this blueprint is "a globally competitive and prosperous country with a high quality of life by 2030." It aims to change Kenya into "a newly industrializing, middle-income country providing a high quality of life to all its citizens in a clean and secure environment." The Vision is underpinned by three pillars: the economic pillar aiming to achieve a sustained economic growth rate of 10 per cent per annum in 2030; the social pillar seeking to create cohesive and equitable social development in a clean and secure environment, and the political pillar aspiring to realize an accountable democratic system. The table below outlines the country's main targets that it hopes to achieve by 2020.

Table 9. Kenya's targets for growth, food security and poverty reduction by 2020[11]

[11] *Source:* Agricultural Sector Development Strategy *(GoK, 2009)*

Indicator	Target
GDP growth rate (%)	10
Agricultural growth rate (%)	7
Poverty rate (%)	25
Reduction in food insecurity (%)	30
Annual increase in agriculture contribution to GDP (billions of KSh)	80
Divestiture in state corporations dealing with production, processing and marketing	All
Reform and streamlining of agricultural services	All

The Agricultural Sector Development Strategy outlines the following interventions to facilitate rapid growth in the sector:

- Review and harmonize legal, regulatory and institutional frameworks;
- Restructure and privatize non-core functions of parastatals and sector ministries;
- Improve delivery of research, extension and advisory services;
- Improve access to quality inputs (fertilizer, hybrid seeds, equipment) and financial

Services; and

- Improve access to both domestic and external markets.

2.8 Agricultural Projects and Key Policy Issues

The projects being implemented by the State Department of Agriculture and co-ordinated through the Agricultural Projects Co-ordination Unit (APCU) are:

- Agricultural Sector Development Support Programme (ASDSP) [To increase equitable income, employment and improve food security of male and female target groups through improvedproduction and productivity in the rural smallholder farm and off farm sectors]
- Kenya Agricultural Productivity Project and Agribusiness Project (KAPAP) [To increase agricultural productivity and incomes of participating smallholder farmers]

- Kenya Agricultural Productivity and Sustainable Land Management Project (KAPSLM)[To facilitate agricultural producers and other natural resource users to adopt environmentally-soundland management practices without reducing their incomes]
- Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands (KACCAL) [To enhance theresilience of communities and the sustainability of rural livelihoods threatened by climate change in the ASALs]
- National Accelerated Agricultural Inputs Access Project (NAAIAP)[To improve inputs (seedand fertilizers) access and affordability for targeted 1.8 million resource poor farmers]
- Eastern Africa Agricultural Productivity Project (EAAPP) [To increase agriculturalproductivity and competitiveness of agriculture sector, increase farm incomes, reduce poverty and improve food security in Eastern Africa]
- Drought Resilience and Sustainable Livelihoods Project (DRSLP) [To enhance droughtresilience and improve sustainable livelihoods of communities in ASALs of Kenya.]
- Rice-based Marketing Agriculture Promotion Project (RICEMAPP) [To establish, disseminate and promote adoption of the Market-oriented Approach in Mwea Irrigation Scheme and other Schemes]
- Traditional High Value Crops Programme (THVC) [To increase productivity by facilitating access to affordable quality inputs and services for food and nutrition security, diversification. To reduce the gap between consumption and production]
- Urban and Periurban Agriculture Project (UPAP)[To increase employment and income generating opportunities for youth and women through urban agriculture, livestock and fisheriesBusinesses]
- Kenya Cereal Enhancement Project and Kenya Climate Resilient Agricultural LivelihoodsProject-KCEP –CRAL [To contribute to the reduction of rural poverty and food insecurity ofsmallholder farmers in the ASALs by support to tap into the economic potential of targeted value chains]

Agricultural policy in Kenya revolves around the main goals of increasing productivity and income growth, especially for smallholders; enhanced food security and equity, emphasis on irrigation to introduce stability in agricultural output, commercialization and intensification of

production especially among small scale farmers; appropriate and participatory policy formulation and environmental sustainability *(ERA Kenya, 2015)*. The key areas of policy concern, therefore, include:

- Increasing agricultural productivity and incomes, especially for smallholder farmers.
- Emphasis on irrigation to reduce over-reliance on rain-fed agriculture in the face of limited high potential agricultural land.
- Encouraging diversification into non-traditional agricultural commodities and value addition to reduce vulnerability.
- Enhancing the food security and a reduction in the number of those suffering from hunger and hence the achievement of goals.
- Encouraging private-sector-led development of the sector.
- Ensuring environmental sustainability.

2.9 Challenges and potential

Challenges abound in this sector. With a mean annual rainfall of 400 mm, Kenya is classified as one of the water-deficient countries in the world. This sector is crippled with constraints such as predominance of rain-fed agriculture, implications of climate change, low productivity levels, poor mechanization and use of outdated production technologies. However, various strategies adopted by the Government with a series of acts, for its revival,hold promise. Irrigating more lands with proper water management measures, improving the nutrient management and using scientific technologies in this sector could help the sector grow fast.

III. ALLIED SECTORS – HORTICULTURE, ANIMAL HUSBANDRY AND FISHERIES

It's the little things citizens do…. That's what will make the difference. My little thing is planting trees..

-Wangari Muta Maathai, Kenyan Environmentalist & Nobel Peace Prize Winner

3.1 Horticulture

The horticultural industry plays an important role in the national economy. Products in this industry include cut flowers, vegetables, fruits, nuts, herbs and spices.

Horticultural production for export is a major cash cropping practice in Kenya and is ranked third in terms of foreign exchange earnings after tourism and tea (HCDA, 2009). It contributes 30 percent of agricultural GDP and continues to grow at between 15 and 20 percent per year (GoK, 2012). Kenya has been the most successful exporter of horticultural products in the sub-Saharan Africa. The horticulture sector is estimated to employ over 50,000-60,000 people directly and 500,000 people indirectly through affiliated services to the industry for example farm inputs, transport, packaging and banking.

The history of the export of fresh horticultural produce from Kenya dates back to the period before independence whenKenya, then a British colony, was required to contribute to the running of the budget for East Africa. Afterindependence, the industry continued to flourish with exports starting to go to Europe and thus opening up the potential for Kenya in the export market (Maplecroft, 2010).

Kenyan horticulture has seen unprecedented growth since the early 80s . The volume of exported fresh horticultural produce increased from 213.8 thousand tonnes in 2013 to 220.2 thousand tonnes in 2014. This was despite introduction of duty by the European Union (EU) during the second half of 2014, but which was later dropped. The rise in the volume of horticultural exports was mainly caused by an increase in exports of cut flowers from 105.6 thousand tonnes to 114.8 thousand tonnes during the period under review. Similarly, fruit exports, registered an increase of 12.9 per cent from 31.1 thousand tonnes in 2013 to 35.1 thousand tonnes in 2014. Despite the impressive performance in 2014, vegetable exports were impacted negatively by introduction of tax by the EU and therefore registered a decline in quantity from 77.2 thousand tonnes in 2013 to 70.3 thousand tonnes in 2014. This led to earnings from vegetable exports declining significantly from KSh 22.9 billion in 2013 to KSh 18.8 billion in 2014. Delays in signing an Economic Partnership Agreement (EPA) affected performance during the period under review. However, total earnings from the export of fresh horticultural produce rose marginally from KSh 83.7 billion in 2013 to KSh 84.1 billion in 2014. (ERA, 2015)

Table 10. Horticultural commodities[12]

Commodity	Production (tonnes) 2013	Area (ha) 2013	Yield (Hg/ha) 2013
Bananas	1398154.00	60153.00	232433.00
Plantains	31000.00	2600.00	119231.00
Oranges	100281.00	7574.00	132402.00
Tangerines, mandarins, clementines, satsumas	17000.00	950.00	178947.00
Lemons and limes	16378.00	1133.00	144554.00
Grapefruit (inc. pomelos)	2800.00	200.00	140000.00
Fruit, citrus nes	115000.00	13200.00	87121.00
Apples	1000.00	70.00	142857.00
Pears	6226.00	418.00	148947.00
Apricots	70.00	15.00	46667.00
Peaches and nectarines	1200.00	115.00	104348.00
Plums and sloes	1800.00	190.00	94737.00
Strawberries	230.00	30.00	76667.00
Berries nes	600.00	210.00	28571.00
Mangoes, mangosteens, guavas	582907.00	47154.00	123618.00
Avocados	191505.00	11000.00	174095.00
Pineapples	128944.00	6666.00	193435.00
Dates	1100.00	450.00	24444.00
Papayas	120000.00	8000.00	150000.00
Fruit, tropical fresh nes	36200.00	3700.00	97838.00
Fruit, fresh nes	105000.00	9500.00	110526.00

[12]Source – FAOSTAT – 2015 Retrievable from http://faostat3.fao.org/download/Q/QC/E

The ongoing Horticulture projects in the country are (ERA, 2015):

- Small-scale Horticulture Development Project (SHDP) [contribute to poverty reduction and enhance food security],
- Smallholder Horticulture Empowerment & Promotion Unit Project (SHEP- UP) [To improve the livelihood of smallholder horticulture farmers],
- Smallholder Horticulture Empowerment Promotion Project for Local and Up scaling (SHEP PLUS) [To increase number of horticulture smallholders applying the SHEP Approach and improve their livelihood] and
- Smallholder Horticulture Marketing Programme (SHoMAP) [To increase domestic horticulture productivity and improve the produce and input marketing system]

3.2 Livestock Production

Almost 80% of African agricultural land is grazing land. African farmers depend on livestock for income, food and animal products (Nin et al., 2007), and are known to keep cattle as an insurance policy for when droughts ruin annual crops (Fafchamps et al., 1998). Kenyan livestock sector is dominated by small producers. The livestock population is concentrated in the arid and semi-arid lands (ASALs) which cover about 75 % of the total land surface.

Livestock plays an important economic and socio-cultural role among many Kenyan communities. The livestock subsector contributes to the food and cash needs of the farmers, and provides employment to about 10 million people, contributes 7 per cent to the GDP and 17 per cent to the Agri.GDP, and provides 50 per cent of the agricultural labour. Both crop farmers and pastoralists keep livestock for food and income generation *(ERA Kenya, 2015).*

The livestock industry has a high degree of vertical links with upstream and down-stream industries. It is a significant user of products from feeds, drugs, vaccines and equipment manufacturing industries and is a major provider of raw materials for agro-processing industries. Therefore, any shock in the industry will affect the supply chain.

The key livestock subsectors are beef, dairy, sheep, goats, camel, poultry, piggery and emerging livestock (Table 11).

Table 11. Livestock and Poultry (2014)[13]

Item	Number
Pigs	430844.00
Goats	25430058.00
Horses	2050.00
Camels	2937262.00
Sheep and Goats	42850265.00
Cattle and Buffaloes	17811845.00
Cattle	17811845.00
Sheep	17420207.00
Rabbits and hares (1000 head)	875.00
Chickens (1000 head)	42413.00
Poultry Birds (1000 head)	42413.00

3.2.1 Beef Industry

The main beef species are East African Zebu, Boran, Sahiwal and cross-breeds. Although most beef is produced from rangelands, dairy cattle culls contribute substantially to the national supply. However, beef production is affected by climate variability and animal diseases *(MOA, Kenya 2016).*

3.2.2 Sheep and goats

Sheep and goats play a key role in pastoral households' food security and incomes owing to their short-generation intervals, high adaptability and versatile feeding habits *(MOA, Kenya 2016).*

[13]Source: FAOSTAT data. Food and Agricultural Organization, Rome. Retrievable from http://faostat3.fao.org/download/Q/QC/E

3.2.3 Poultry

Kenya has an estimated 28 million birds out of which 76 per cent consist of free-ranging indigenous chicken, while 22 per cent are commercial layers and broilers. Other poultry species like duck, turkey, pigeon, ostrich, guinea fowl and quail make up 2.2 per cent and are becoming increasingly important *(MOA, Kenya 2016).*

3.2.4 Pigs

Pig rearing in the country has become a relatively well-established industry in African markets. It has withstood periodic fluctuations common in the pig industry, moving from large-scale to smallholder farming *(MOA, Kenya 2016)*.

3.2.5Dairy Industry

Dairy cattle are mainly kept in medium- to high-rainfall areas. The key dairy breeds are Ayrshire, Friesian, Guernsey, Jersey and cross-breeds *(MOA, Kenya 2016).*

Dairy production for the last five years is presented in the table. The quantity of raw milk delivered to processors continued to increase for a second time after dropping in 2012. The milk delivered to processing plants rose from 523.0 million litres in 2013 to 541 million litres in 2014. The output of fresh milk and cream from processors increased marginally by 3.1 per cent. Similarly, the volume of processed butter and ghee rose by 17.4 per cent to 1,445.0 tonnes in 2014. However, the quantity of cheese processed dropped by 0.6 per cent in the same period.

Table 12. Dairy production over the years in Kenya[14]

Year	Recorded Milk Production (Mn litres)	Wholemilk and cream (Mn litres[1])	Butter and ghee (Tonnes)	Cheese(Tonnes)
2005	340	191	1,261	270
2006	360	225	1,549	243
2007	423	282	1,752	215
2008	399	262	1,218	155
2009	407	323	1,080	188
2010	516	358	1,967	263
2011	549	374	1,995	290
2012	495	332	1,801	255
2013	523	407	1,231	267
2014*	541	419	1,445	266
* Provisional				
[1] Wholemilk equivalent.				

The ongoing Livestock projects implemented by the State Department of Livestock are:

- Smallholder Dairy Commercialization Project (To increase the incomes of poor rural households that depend substantially on production and trade in dairy products for their livelihoods)
- Regional Pastoral Livelihoods Resilience Project (To enhance drought resilience of pastoralists and agropastoralists in drought prone areas)
- Mainstreaming Sustainable Land Management in Agro-pastoral Production Systems of Kenya (SLM) [To provide a basis for economic development, food security and sustainable livelihoods

[14]Source: Kenya Dairy Board.

- while restoring ecological integrity]
- Establishment of Coast Disease Free Zone (To increase market access for animal and animal products)

3.3 Apiculture

Beekeeping (apiculture) is practiced in most parts of Kenya. However only 20% of the country's honey production potential (estimated at 100,000 metric tonnes) has been tapped. 80% of Kenya consists of arid and semi-arid lands (ASALs) which have high potential in production of honey and apicultural activity is a major occupation in these areas due to the abundance of bee flora. Modern beekeeping in Kenya started towards the end of 1960s and has since become an important enterprise in the livestock sub-sector. 80% of the honey comes from the traditional log hive.

In addition to contributing directly to household incomes, bees play an important role in plant pollination. Due to the low investment and variable costs involved, beekeeping is becoming increasingly popular in rural areas *(MOA, Kenya 2016).*

The farmers lacking adequate skills on managing bees and handling hive products is one of the major challenges in this sector.

3.4 Aquaculture

The history of management and utilization of fishery resources can be traced back to the early 1900's. The colonial Government gave prominence to the fisheries that were of interest to them namely; Pearls, Beche-de-mer and Ambergris amongst others. In Kenya, fisheries are mainly composed of freshwater (lakes, rivers and dams), coastal and marine (Indian Ocean) and aquaculture. The aquaculture subsector in Kenya has the potential of significantly contributing to the national economy by creating employment, earning foreign exchange, reducing poverty and supporting food security. Demand for fish is rising owing to the growing population and their changing feeding habits among Kenyans as they move towards healthy living. With its cholesterol-free white meat, fish offers the best nutrition profile for humans. Aquaculture is the only sustainable source of fish and has great potential for growth in Kenya due mainly to the presence of a wide variety of water sources such as rivers, springs, dams, lakes and the Indian Ocean. In addition, most of the land that is suitable for other agricultural activities is also suitable for aquaculture as are swampy and marshy areas, which are unsuitable for crop production.

Aquaculture can also be integrated with other production activities such as rice farming, poultry and dairy production to increase production efficiency per unit area.

Commercial aquaculture enterprises are increasing. This is a paradigm shift from subsistence aquaculture, which has been practised in Kenya over the years. Due to aggressive extension, aquaculture has increased fourfold over a short time. This makes aquaculture the fastest growing production subsector in the country deserving due attention and support.

The main constraints facing the development of aquaculture include: inadequate support to aquaculture infrastructure such as fish hatcheries, poor-quality fish seed and feed, inadequate budgetary provision, inadequate market information and marketing uncertainties, limited aquaculture research, lack of aquaculture policy, inadequate provision of extension services, poor link between production and marketing, lack of national aquaculture extension guidelines, and lack of baseline data for aquaculture investment *(MOA, Kenya 2016)*

Table 13. Fisheries / aquaculture production[15]

	Production [1000 t]			
	1995	**2000**	**2005**	**2010**
Total	194	216	148	155
Inland	187	210	140	135
Marine	5	5	7	8

During the period 2010 – 2014, fishing recorded an improved performance .Fish from fresh water sources remained the major contributor to fish landed in the country, accounting for 94.6 per cent of the total output in 2014. Lake Victoria and fish farming remained the two major sources of fresh water fish and accounted for 76.7 and 14.4 per cent of the total fish output, respectively in 2014. Most lakes in the rift valley experienced increases in water volume partly explaining the significant increases in production of fish from Lake Naivasha. The volume of fish landed from marine sources may have been hampered by inadequate fishing facilities and technologies for fishing in deep water.

[15]Source: FishSTAT, FAO of the UN, Retrievable from http://www.fao.org/fishery/statistics/software/fishstat/en

Overall, the quantity of fish landed in the country increased by 4,470 metric tonnes, to stand at 167,859 metric tonnes in 2014. Quantity of fresh water fish landed increased by 3.0 per cent from 154,253 metric tonnes to 158,871 metric tonnes in 2014. Fish catch from Lake Victoria increased from 124,643 metric tonnes in 2013 to 128,708 metric tonnes in 2014, accounting for 81.0 per cent of freshwater fish catch. Fish production from fish farming increased by 2.5 per cent from 23,501 metric tonnes in 2013 to 24,096 metric tonnes in 2014. The quantity of fish from marine sources increased slightly from 7,667 metric tonnes in 2013 to 7,786 metric tonnes in 2014, an increase of 1.6 per cent. However, despite the general upward trend in fish production in 2014, the quantity of crustaceans landed dropped by 30.5 per cent while that of molluscs declined by 3.4 per cent. The decline in the quantity of crustaceans landed may partly be explained by changes in climate that affect sea water temperatures.

Total earnings from fish landed rose from KSh 21.3 billion in 2013 to KSh 21.9 billion in 2014. Value of fresh water fish rose from KSh 20.0 billion in 2013 to KSh 20.5 billion in 2014. Value of marine fish increased marginally from KSh 921.4 million in 2013 to KSh 960.9 million in 2014.

Table 14. Quantity and value of Fish landed, 2010 - 2014[16]

	Quantity (Metric ton)					Value to Fishermen (Kshs '000)				
	2010	**2011**	**2012**	**2013**	**2014 ***	**2010**	**2011**	**2012**	**2013**	**2014***
Fresh Water Fish										
Lake Victoria	111,868	111,619	118,992	124,643	128,708	9,472,016	11,684,808	11,775,377	13,858,682	14,310,635
Lake Turkana	6,430	7,250	3,001	4,338	4,165	182,598	317,209	307,382	438,646	433,789
Lake Baringo	53	158	251	263	201	2,707	13,524	23,514	25,008	21,362
Lake Naivasha - Commercial	209	217	143	231	331	9,349	13,695	15,460	17,542	40,664

[16]Source: Kenya National Bureau of Statistics

Lake Jipe	103	106	112	116	115	6,114	6,351	16,715	16,910	19,249
Lake Kanyaboli	215	280	125	194	134	11,329	10,270	8,479	12,004	10,466
Lake Kenyatta	369	353	33	54	51	11,290	10,361	2,182	3,770	3,899
Tana River Dams	583	943	967	705	1,024	27,854	61,861	81,609	73,024	98,311
Tana River Delta	362	283	39	208	46	29,587	31,691	2,409	16,009	3,574
Aquaculture/fish farming	12,153	19,265	21,487	23,501	24,096	2,521,156	3,681,056	4,633,673	5,522,735	5,601,722
Total	**132,345**	**140,474**	**145,150**	**154,253**	**158,871**	**12,274,000**	**15,830,826**	**16,866,800**	**19,984,330**	**20,543,671**
Marine Fish by County:										
Lamu	2,250	2,257	2,103	2,103	2,198	120,698	114,514	139,410	175,872	176,187
Tana River	107	97	390	643	295	7,724	13,627	57,950	47,421	31,706
Kilifi	2,295	2,348	2,076	2,076	2,139	191,350	211,169	337,450	348,248	316,157
Mombasa	715	700	893	893	990	80,476	102,355	155,090	147,539	183,604
Kwale	1,916	2,020	2,015	1,952	2,164	156,752	187,992	187,655	202,311	253,294
Total	**7,283**	**7,422**	**7,477**	**7,667**	**7,786**	**557,000**	**629,657**	**877,555**	**921,391**	**960,948**
Crustaceans by County:										
Lamu	165	169	195	162	174	55,211	55,577	71,942	96,198	90,210
Tana River	35	40	63	117	62	10,512	15,131	13,140	22,699	27,421

Kilifi	91	98	150	196	50	18,700	20,109	76,555	86,857	20,669
Mombasa	132	145	230	223	165	20,100	35,871	42,703	53,115	49,772
Kwale	96	97	101	101	104	22,331	29,335	28,960	27,581	45,829
Total	**519**	**549**	**739**	**799**	**555**	**126,854**	**156,022**	**233,300**	**286,450**	**233,901**
Other Marine Fish by County:										
Lamu	25	24	68	68	56	3,120	4,860	20,805	19,789	11,548
Tana River	19	22	29	29	26	1,165	1,126	1,806	1,762	2,237
Kilifi	132	131	156	181	152	10,597	15,796	27,615	28,736	46,566
Mombasa	66	63	62	62	59	7,452	5,835	7,097	6,726	8,711
Kwale	362	361	334	330	354	22,065	33,099	38,955	33,319	49,079
Total	**604**	**601**	**649**	**670**	**647**	**44,399**	**60,716**	**96,278**	**90,332**	**118,141**
Grand Total	**140,751**	**149,046**	**154,015**	**163,389**	**167,859**	**13,002,253**	**16,677,221**	**18,073,933**	**21,282,503**	**21,856,661**

The projects being implemented by the Department of Fisheries are:

- Aquaculture Mini Processing Plants (To reduce post-harvest losses and promote marketing along the value chain)
- Offshore Patrol Vessel (To conduct surveillance and inspection of fishing vessels in the exclusive economic zone)
- National Fish Quality Laboratories(To build capacity for national fish testing for improved market)
- MCS Center (To facilitate fisheries surveillance in Kenya EEZ)
- Marine and Ocean Service Centre(To facilitate marine fisheries research)
- Kenya Coastal Development Project (KCDP) [To promote environmentally sustainable management of Kenya's coastal and marine resources]

3.5. Challenges and Potential

Challenges in the horticulture sector include low participation of smallholders due to high management costs, increasing freight costs, poor infrastructure, increasing labour costs and

obsolete technology. The country has a reputation of being an important exporter of horticultural projects, which could be improved maintained by focusing on labour saving production and post-harvest techniques.

Kenyan livestock sector is dominated by small producers and cattle diseases is one of the major constraints. Provision and delivery of livestock services (which include veterinary and extension services) is a pre-requisite for disease control and improved cattle production.. Therefore, farmers and the veterinary extension officers need to be trained in disease control, management, feed production and utilization.

Skills in intensive livestock production are lacking, which needs to be addressed for overall improvement of this sector.

The performance of the aquaculture sector has remained static due to a number of constraints such as unavailability of efficient and inexpensive fish feeds for different stages of development, poor feed management skills, limited varieties of the cultured fish species and low quality seed fish. Most Kenyan fish farmers have mentioned fish feed and feed management as their major challenges (Shitote et al, 2011). Most Kenyan farmers are generally unaware of the importance of applying appropriate feed transport, handling and storage techniques. Capacity building in this sector should therefore focus on improved feed formulations; nutrient composition and selection, manufacturing processes, storage, and on-farm feed management practices.

4 POST-HARVEST PROCESSING, MECHANIZATION ETC.,

At the harvest, you know how good the millet is. All cassavas have the same skins but not all taste the same

– Kenyan proverbs

4.1 Processing

In Kenya, major activities in processing include,

- Processing and preserving of meat
- manufacture of dairy products
- processing and preserving of fruit and vegetables
- processing and preserving of fish, crustaceans and molluscs
- manufacture of vegetable and animal oils and fats
- manufacture of grain mill products
- manufacture of bakery products
- manufacture of sugar
- manufacture of cocoa, chocolate and sugar confectionery and
- manufacture of tobacco products .

Kenya, a major fruit processor, had accounted for 20% of total processed volumes in Sub-Saharan Africa in 2011.

Table 15 shows the production particulars of important foodstuffs in Kenya.

Table 15. Production of Important Foodstuff, 2008 - 2014[17]

Commodity	Unit	2008	2009	2010	2011	2012	2013	2014*
Maize Meal	Tonnes	351,283	458,116	473,436	509,077	524,036	562,543	587,231
Wheat Flour	,,	564,845	619,635	757,054	815,296	844,797	884,179	976,628
Rice	,,	26,800	23,435	45,675	50,554	52,650	57,002	57,191
Bread	,,	78,240	77,419	84,228	90,773	84,835	89,419	98,722
Ghee and Fats	,,	205,254	208,248	212,096	190,605	206,051	234,705	265,622
Cooking Oil	,,	113,094	134,229	135,585	146,913	159,054	191,833	186,143
Processed	`000	260,725	322,509	359,559	375,770	325,406	350,368	419,053

[17]Source: Kenya National Bureau of Statistics.

Milk	Litres							
Refined Salt	Tonnes	265,061	165,451	241,514	253,965	230,872	207,147	223,295
* Provisional.								

Table 16. Major processed agricultural products in Kenya - 2012[18]	(Tonnes)
1. Oil groundnut	
2. Cotton lint	3,800
3. Sugar raw centrifugal	536,912
4. Oil maize	13,950

4.2 **Kenya Agriculture Value Chain Enterprises**:

The Kenya Agricultural Value Chains Enterprises Project is the flagship *Feed the Future Initiative*project in Kenya. The project promotes value chain growth and diversification, increase the productivity andincomes of smallholder farmers and other actors along the value chain working in the dairy, maize and otherstaples and horticulture sectors. The project works with more than 30 Kenyan government and private sectororganizations (MENA Report, 2014)

Duration:

January 2013 – January 2018

Activity Goals:

- Improve economic stability and food security
- Improve nutritional outcomes, reducing chronic under-nutrition
- Build and diversify sustainable value chains
- Increase the productivity and incomes of 500,000 smallholders

4.3 **Mechanization**[19]

[18]Key figures (FAOSTAT http://countrystat.org/home.aspx?c=KEN&p=ke)

[19]A review on how the National Policy of Kenya affects the expansion of Agricultural mechanization in the country is found at the URL:

Despite the importance of Agriculture in Kenya there are generally low levels of mechanization in both livestock and crop production. In Kenya 50 % of the land preparation depends on human power, 20 % on animal draught power and 30 % on machines. This has been associated with low productivity and high cost of production, which inevitably leads to low profitability in major agricultural enterprises.

Mechanization has a significant roleto play at all levels along the entirevalue chain in terms of modernizing and intensifying agriculture; it createsemployment in rural areas. Considerable emphasis is being placed on increasing the efficiency with which land, water and nutrients are being used, however farm power appears to be a 'forgotten resource'. A consequence of low farm mechanization is high labour drudgery throughout the production cycle. Sustainable intensification in SSA will require an increase in power supply via improved access to mechanization and/or a decrease in power demand via energy saving technologies such as conservation agriculture (CA) [Bymolt and Zaal, 2015]

Over the past 50 years or so there has been phenomenal growth in the number of tractors in use in Asia, Latin America and the Caribbean (Mrmema et al 2008). However, the current state of mechanization in SSA is one of underutilization. SSA has the lowest uptake of mechanization out of all the world regions and remains heavily dependent on manual labour.

Table 17. Kenya: Machinery usage[20]	
	Machines [n/1000 ha of arable land and land under permanent crops]

http://facasi.act-africa.org/file/20160125_review_workshop_on_national_policy_effects_on_the_expansion_of_smallholder_mechanization_university_of_zimbabwe_2015.pdf

[20]Sources:
- FAOSTAT, FAO of the UN, Retrievable from http://faostat.fao.org/site/377/default.aspx#ancor
- FAOSTAT, FAO of the UN, Retrievable from http://faostat.fao.org/site/576/default.aspx#ancor

	1987	1992	1997	2002
Combine harvester/threshers	0.13	0.11	0.14	0.15
Agricultural tractors	1.83	1.82	2.19	2.33

A review by Lagat et al,(2007)on the status of agricultural mechanization n Kenya concluded that:

1. The state of agricultural mechanization is below that recommended by agriculturalextension officers and this has contributed to decline in crop yields.
2. The state of *jua kali* (i.e.informal sector) workshops, where a majority of farmers take theirimplements/machinery for servicing and repair, is below that recommended bymanufacturers.

The following recommendations can be made for promotion of mechanization:

1. The Government of Kenya should subsidize the cost of farm implements/machinery sothat farmers can acquire the right ones for specific farm operations and hence reversethe decline in crop yields.
2. The Government of Kenya should strengthen agricultural financial institutions so thatfarmers can access affordable loans to enable them buy the appropriateimplements/machinery and hence reverse the decline in crop yields.
3. The Government of Kenya should rehabilitate the Agricultural Mechanization Services(AMS) stations, which can assist in giving farmers technical services at appropriatetimes and at affordable costs.
4. The Government of Kenya should assist in upgrading the skills of *jua kali* mechanicsso that they can appreciate the need for high quality work in their repair and servicingof agricultural implements/machinery.
5. The Government of Kenya should assist *jua kali* mechanics access affordable loans toenable them buy the right tools/equipment for their workshops.

To promote mechanization, the Government of Kenya had set up the Agricultural Mechanization Research Institute (AMRI), whichis one of the 16 research institutes under the Kenya Agricultural and Livestock Research Organization (KALRO) that was established in November 2015. The main function of AMRI is to generate and disseminate agricultural

mechanization technologies /innovations across livestock and crops value chains in Kenya. The Agricultural Mechanization Research Institute is located at Katumani in Machakos County

4.4 Agri-business Strategy of Kenya

The Government of Kenya has formulated a Agri business strategy during 2012 to guide the agricultural sector'sdevelopment and transformation towards its re-orientation from afocus on subsistence to a new focus on meeting competitively thedemands of the market and of commercialization (National Agri-business strategy, Government of Kenya, 2012).

The strategy has four objectives:

- Remove barriers and create incentives for the private sectorto invest in agribusiness and related business opportunities;
- Invest public resources more strategically to trigger growthin agribusiness;
- Make agribusiness systems more competitive, easilyadaptable and 'fleet-footed' in order to deal with dynamicmarkets and the opportunities they bring; and
- Encourage 'the right kind' of institutional frameworks thatenable all actors to utilize market opportunities

To stimulate agribusiness and agro-industrial development, Kenya has introduced the following[21]

1. Trade policies, including export promotion policies and incentives schemes for foreign direct investment (FDI), concessionary duties on import of processing machinery, raw materials, and intermediate inputs;

2. The Structural Adjustment Policies (trade liberalization, price controls, privatization);

3. Regional Economic Integration Policy (East African Community [EAC] and Common Market for Eastern and Southern Africa [COMESA]);

4. Revamped legal and regulatory framework, including improved customs procedures, food safety and standards, labelling and certification.

4.5 Challenges and Potential

[21]See http://www.foodsecurityportal.org/kenya/food-security-report-prepared-kenya-agricultural-research-institute

The sector analysis had shown that Kenya is considered food-insecure, with a deficit in production, particularly of staple foods; maize, wheat, beans, rice and sugar, and this is supplemented by imported food commodities. The processing sector is under-developed in the country compounding the problem. Sugar industry for instance faces the challenge of low cane productivity levels (about 60t/ha). Other challenges in the processing sector include, limited access to equipment for processing, packaging, storage and distribution, localization of technical capacity in urban areas, poor enforcement of quality standards and low capacity of training professionals in food science and technology.

The current state of mechanization in Kenya is one of underutilization. The Sub-Saharan Africa has the lowest uptake of mechanization out of all the world regions and remains heavily dependent on manual labour. However, Kenya has taken a few efforts to promote mechanization one of which is import of low-cost tools from countries such as India. The sector analysis would reveal that there is an urgent need to upgrade the skills of the stakeholders in both formal and informal sectors so that they can appreciate the need for high quality work in their repair and servicing of agricultural implements/machinery, as farmers have to mechanize as human muscle-power alone cannot feed Kenya's growing population.

5. STATUS OF AGRICULTURAL EXTENSION AND RESEARCH SYSTEM

5.1 Overview of Agricultural Extension System in Kenya

5.1.1 History

Agricultural extension in Kenya dates back to the early 1900s, but its only notable success was in the dissemination of hybrid maize technology in the late 1960s and early 1970s. The government through its Ministry of Agriculture provided the bulk of extension services to both small-scale farmers and commercial producers. After the implementation of structural adjustment programs (SAPs) in the 1980s, the Kenyan government came under considerable pressure to scale down its dominant role in national economy. Kenya's agricultural extension budget together with extension staff numbers has plummeted significantly. The traditional public extension system was perceived as outdated, top-down, paternalistic, uniform (one-sizefits-all),

inflexible, subject to bureaucratic inefficiencies and therefore unable to cope with the dynamic demands of modern agriculture.

5.1.1.1 Agricultural extension system in the recent past

To respond to these challenges, the Ministry of Agriculture and Rural Development formulated the National Agricultural Extension Policy (NEAP) to guide improvements in delivery of extension services in 2001. The NEAP recognized the need to diversify, decentralize and strengthen the provision of extension services to increase their sustainability and relevance to farmers. The NEAP was meant to form the basis for all extension work within the government and in its interaction with other stakeholders in agricultural research and development. To operationalize the NEAP, the ministry prepared a National Agricultural and Livestock Extension Program (NALEP) and NALEP Implementation Framework. There has been a desire to reform the public extension into a system that is cost effective, responsive to farmers' needs, broad-based in service delivery, accountable and with in-built sustainability mechanisms. There has also been a call for stronger involvement of stakeholders and beneficiaries at grass root level.

Rural and agricultural development is integral to any strategy to alleviate poverty and promote broad-based growth in Kenya, and the importance of agricultural extension in relation to the fight against poverty has been underscored in the Strategy to Revitalize Agriculture (SRA). It is envisaged that the economic expansion momentum will be consolidated further through Vision 2030 Strategy, which is a successor to the ERS (MOA, 2008). Extension is identified as a critical area that requires immediate action and is one among the six SRA first-tracked interventions.

Kenya's small farmers had traditionally benefited from two major types of extension systems. The first is the government extension system focusing on mainly food crops. The government has tried a number of extension styles, including progressive or model farmer approach, integrated agricultural rural development approach, farm management, training and visit (T&V), attachment of officers to organizations, farming systems approaches and farmer field schools (FFS).

The second type of extension system includes the commodity-based systems run by government parastatals[22], outgrower companies, and cooperatives. The commodity-based extension deals mainly, but not exclusively with commercial crops such as coffee, tea, pyrethrum and sisal. These extension services are deliberately motivated by profits, and tend to work well when both the firm and farmers clearly benefit from the extension expenditures.

As a result of flaws in the public extension system, a third type of extension service has emerged: the privatized agricultural extension initiatives provided by private companies, non-governmental organizations (NGOs), community-based organizations (CBOs), and faith-based organizations (FBOs). Extension is now broadly seen as a complex system where services are provided by a range of private and public sector entities.

The National Agricultural and Livestock Extension Program (NALEP), the main government extension programme is implemented by the Ministry of Agriculture and supported by the government of Kenya (NALEP-GoK) and Swedish International Development Agency (NALEP-Sida). The program aims at enhancing the contribution of agriculture and livestock to social and economic development and poverty alleviation by promoting pluralistic, efficient and demand-driven extension services to farmers and agro-pastoralists (Muyanga and Jayne, 2006). However, there are concerns about the effectiveness of the pluralistic agricultural extension systems involving both public and private extension delivery methods in reaching target farmers and producing expected results of lifting the standard of living of smallholder rural farmers as well as boosting businesses for commercial farmers.

At the national level, Kenya public extension comprises 5470 staff members and is managed by a team of 910 senior staff according to the MEAS report (2011). One hundred and three staff member has a Master of Science degree, four staff was trained at the PhD level and the rest of the team studied at the bachelor level and agricultural diploma. Women account for 32.3% of senior management staff. There are 3,086 subject matter specialists to provide backstopping support to the field staff, all of them have a bachelor degree and 33.0% of which are female. The total number of field workers is 1464, they all hold a 2 to 3 year agricultural diploma, and 32.2% are female. There are two other groups of workers: Information,

[22]agencies owned or controlled wholly or partly by the government

Communication & Technology (ICT) Support Staff and In-Service Training Staff. Although the public sector does not employ in-service training staff, 10 workers are involved in ICT support services.

Table 18. Human Resources in the Public Extension Service in Kenya[23]

Major Categories of Extension Staff	*Secondary School diploma*		*2-3 yr. Ag diploma*		*B.Sc. degree*		*M.Sc./Ing. Agr. degree*		*Ph.D. degree*	
Gender	F	M	F	M	F	M	F	M	F	M
Senior Management Staff					246	553	48	59		4
Subject Matter Specialists (SMS)					1023	2063				
Field Level Extension Staff			472	992						
Information, Communications & Technology (ICT) Support Staff				10						
In-Service Training Staff	-	-								
Total Extension Staff: 5470			472	1002	1269	2616	48	59		4

5.1.2 The Role of Agricultural Extension

Global agricultural productivity increased greatly in the last three decades of the 20th century, driven by new technologies including improved varieties, innovative crop management

[23] *Source: IFPRI/FAO/IICA Worldwide Extension Study, 2011/* MANAGE communication

systems and superior post-harvest processing techniques. However, sub-Saharan Africa was left behind, partly because smallholder farmers could not access such technologies.

Institutional failures, market constraints and the limited transfer and adoption of improved technologies by smallholders caused agricultural productivity and growth to stall in sub-Saharan Africa for many years. This low productivity caused rural incomes to stagnate, fuelling a vicious cycle of poverty and food insecurity.

Agricultural development policy in Kenya views a well-functioning public and private sector operated agricultural extension service to be among the critical inputs in achieving its goal of the transformation of semi-subsistence farming into modern and commercial farming units necessary for the attainment of food security, improved incomes and a reduction in poverty. Ministry policy is, therefore, to ensure that agricultural extension services are adequately funded, well-coordinated and regulated. Effective linkages between extension service providers and other stakeholders involved in technology development and provision of facilitating factors are viewed as essential.

In general, the role of the extension service in agricultural development in Kenya is three-fold (Cuellar et al, 2006):

- To enhance farmer, staff and stakeholder knowledge and skills
- To support the establishment of forums and institutions that promote participation of private serviceproviders in the agricultural sector
- To promote and strengthen farmers institutions

5.1.4 ***National Agriculture and Livestock Extension Programme (NALEP)***

The agricultural extension service in most parts of Africa is dominated by the public service andNGOs. It has for a long time been based on an understanding of the extension as a ‘pipeline’ that delivers technological messages to the farmers, who are expected to implement them (top-down, not empowering, not demand-driven and sometimes not appropriate). For some years now, new policies have been formulated to guide the extension service to become more demand driven, but the majority of extension providers have continued to prescribe to the farmers what they should do.

Before 1999, the government through the Ministry of Agriculture adopted the popular World Bank funded Training & Visit (T&V) approach to extension. After 1999, the National Agriculture and Livestock Extension Program (NALEP), was formulated by the then Ministry of Agriculture and Rural Development to support the implementation of the National Agriculture Extension Policy. The Sida (Swedish International Development Cooperation Agency) - supported Kenya National Agriculture and Livestock Extension Programme (NALEP) Phase I started in July 2000.

From 2000 to date, the extension services continue to be delivered through NALEP, which has since evolved from Phase I to Phase II

In 2000, the government of Kenya formulated an extension policy and its implementation framework,the National Agriculture and Livestock Extension Programme (NALEP), to improve on service delivery to the sector.

This was after the realization that the provision of agriculture extension is more complicatedthan 20 years ago when farm sizes were big, population low, natural resource base still fertile andeconomy regulated. Today the farm sizes are small, literacy levels are high, requiring highly trained personnel; population density high, needing different extension approaches; economy liberalized, requiring different extension strategies; and environmental degradation and climate change effects increased, calling for more advanced extension and adaptation and mitigation methodologies.

Best form of support to help achieve scaling-up of NALEP (Kiara, 2011):

- Training a core group of trainers on the approach.
- Supporting the development of organizations that will have competency on the demand side of themarket. This should target the small, medium and large traders and agro-processors.
- Exchange visits, where the adopting institution visits successful focal areas in Kenya and learnshow the approach is applied. This has to be complemented by visits to the adopting country by bestpractitioners (chosen from the different institutions that have evolved as a result of the approach) from the successful focal areas.

- Targeted input subsidies for the poor, vulnerable households and on new technologies.

The Department of Agriculture implements the following projects too in select counties (ERA, 2015):

- Project for Enhancing Gender Responsive Extension Services (**PEGRES**) [To improve the livelihoods of smallholder female and male farmers, pastoralists and fisher folks]
- Youth in Modern Agriculture Project (**YMAP**) [To increase youth participation in horticultural production, agribusiness and agro-processing]

5.1.3 Status of Agricultural Extension activities in Kenya

Kenya's 'Feed the Future' portfolio seeks to increase incomes, enhance food security, and improve nutritional status for women and children. It is geographically focused in selected high-rainfall areas, and arid and semi-arid lands (ASAL). It concentrates on specific value chains, primarily horticulture, dairy, maize, and other staples in the high-rainfall areas, drought tolerant crops, horticulture and diary in the semi-arid areas, and livestock in arid and semi-arid lands. The portfolio includes 22 activities ranging from multi-million dollar contracts such as Resilience and Economic Growth in Arid Lands (REGAL) to small grants for NGOs such as the Global Alliance for Innovative Nutrition (GAIN). The overall Kenyan Feed the Future effort also offers significant potential for achieving synergies between household food security, women's empowerment, nutrition, and agriculture.

USAID/Kenya follows a classic pluralistic model for its EAS support. This includes a well-established working relationship with the MOA extension department, now devolved to the county level, coordination with private sector extension providers, support to NGOs delivering extension services, and a substantial team of extension agents employed directly on contracts and grants funded by Feed the Future.

MEAS' (Modernizing Extension and Advisory Services) work in Kenya, using core funding alone, has focused on the roll-out and testing of SMART Skills[24] and Farmbook[25]. Smart

[24]The SMART (Skills for Marketing and Rural Transformation) skills curriculum module has four parts viz., 1. Lessons that provide the necessary technical information and guidance on delivery methods that field agents should use to teach the SMART Skills to farmers; 2. Quizzes for field agents to test their own

Skills is an innovative extension program being implemented by Catholic Relief Services (CRS) in Kenya, and has proven to be a valuable approach to increasing the effectiveness of extension services.

PRINCIPAL FINDINGS:

- Kenya's State Department of Agriculture is integrating Farmbook and Smart Skills into e-extension for all 47 counties;
- The pilot Map & Track cellular geotracking tool has been activated;
- East Africa regional ministries of agriculture have been briefed on Smart Skills and Farmbook in conjunction with a sensitization workshop;
- MEAS funding has leveraged other e-extension activities funded by the World Bank, DFID, SIDA, and NAAIAP in Kenya;
- The program has helped to stabilize the quality and presence of extension services in the midst of numerous disruptions stemming from the devolution process.
- MEAS has been instrumental in establishing the credibility and visibility of Smart Skills and Farmbook, which are now being used by four organizations across eight additional countries. The adoption of Smart Skills and Farmbook into the larger MOA e-leaning agenda demonstrates an impressive multiplier effect of a relatively small investment.
- The MEAS supported Internet and cellular technologies (ICT) models illustrated by Smart Skills, Farmbook, and Map & Track hold promise for application to other USAID[26] programmes.

5.1.4. Extension service providers in Kenya

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knowledge; 3. Staff exercises that give field agents the opportunity to practice their skills; and 4. Field exercises to use when training farmers

[25]Farmbook is a field-based business application that was built and tested at the request of a consortium of NGOs working in the Southern African Agro-Enterprise Learning Alliance with MEAS support. The purpose of the application is to enable field agents to help farmers plan their farm businesses more effectively and evaluate their productivity and profitability. The system was also developed as a means of training field agents to be better business advisors and also find a way for remote field agents to share data with project managers. See https://farmbookhub.crs.org/

[26]A video on how USAID had worked to improve the agricultural sector in Kenya can be found at https://www.usaid.gov/kenya/agriculture-and-food-security

Extension services are provided mainly by the public sector (central and local Governments, parastatals, research and training institutions) with a small but increasing proportion coming from private and civil society sector operators (companies, NGOs, Faith-Based Organisations, cooperatives and CBOs).

Table 19. Major extension service providers in Kenya (Kingiri & Nderitu, 2014)

Organization	**Details**
Ministry of Agriculture	Government
APHA II	Food and drugs, Nutrition education
Technoserve	Marketing of farm produce, capacity building
CARE	International NGO, Banking and credit training
Catholic Church	Religious organization/Dairy goats promotion
Anglican Church of Kenya (ACK)	Religious organization
Red Cross	Food and drug distribution
Universities	Funding agricultural projects
World Vision	Health empowerment and food distribution
FIP	Maize and soy beans promotion
HCDA	Horticultural development
PLAN International	Capacity building
Arid land project	Funds for purchase of pumps
Farm input companies	Farm visits and demonstrations
International Livestock Research Institute (ILRI)	Livestock research & extension
International Center for Research in Agroforestry (ICRAF) now known as World Resource Institute	Agro forestry research & extension
The International Crops Research Institute	Crops research & extension

Organization	Details
for the Semi-Arid Tropics (ICRISAT)	
African Women in Agricultural Research and Development (AWARD)	Capacity building and mentoring programme
Kenya National Federation of Agricultural Producer (KENFAP)	Farmers association pursuing general rural agricultural extension
Action-Aid	NGO pursuing advocacy targeting rural farming communities; dairy goats promotion and crop extension
Heifer International	NGO, livestock extension
East Africa Dairy Development Project	Livestock extension
Center-for-African-bio-entrepreneurship (CABE)	NGO with policy and practice orientation
National Commission of Churches of	Religious organization

5.1.6 Extension approaches used in Kenya over the years

The extension approaches employed in Kenya over the years were reviewed by Kingiri &Nderitu (2014) and are given hereunder.

Table 20. Extension approaches in Kenya

Extension Approach	Reference
•Field days •Group approaches •Radio programs •Farm demonstrations •Shows and exhibitions •Individual farm visit •Residential courses and seminars •Farmers tours and visits •Farmer-to-farmer extension • ICT services	RoK 2010; NALEP 2011

•Common Interest groups (CIG)	NALEP 2009
•Focal area •Farmer Field Schools (FFS) •Face-to-face on farm demonstrations •Shows •Fields days •Film shows •Adaptive on-farm trials	Ministry of Agriculture, Kenya, 2007.
• Barazas •Field days •CIG trainings •Monthly trainings	RoK 2007, NALEP 2011
•Government extension systems focusing on food crops • Commodity- based extension systems focusing on cash crops • ICT (M-PESA, mKilimo, Kilimo Salama, Radio, TV, Video	IFPRI undated
• Community- based extension approaches (Use of para-professional) • Community-based extension system	Practical Action undated

Among these methods, field days and demonstrations were found to be effective by both farmers and extension agents. This may be linked to the ability to reach many farmers as well as stakeholders. Farmers, on the other hand, also preferred individual farm visits, because they tend to be demands-driven, and extension agents tend to provide personalized attention to their specific needs. The new ICT-related methods of extension are gaining currency but they are constrained by infrastructural challenges.

5.1.7Information and Communication Technology (ICT) for Agricultural Extension

The development of the information society in Kenya can be reviewed in terms of the development of ICTs, informatics, e-government or telecommunications reform policies, which have been actively pursued since the early 1980s. According to the proposed National ICT Policy, there has been rapid growth in ICT development and adoption in Kenya. The 2009 World Bank statistics report indicated that 48.7 percent of the population of Kenya own and operate a mobile phone, and 10 percent of the population had access to internet in 2009. Several ICT tools

used in disseminating agricultural knowledge and technology elsewhere including email, internet, phone, radio, TV, and print are found in Kenya. The number of internet users grew by 23.0 per cent to 26.2 million from 21.3 million in 2013.The number of daily and weekly newspaper circulation has been declining. On the other hand, average number of online visitors per day has been growing steadily in the recent years.

An illustration of a potentially beneficial application of new technologies is found in mobile telephony. The SMS-based service offers farmers a timely source of information, as they no longer have to wait for newspapers to publish the information a day after the price is reported (Mungai, 2005). The Mumias Information & Welfare Advances (MIWA) project is currently (2011) testing the effectiveness of cell phone messages to a subset of farmers on recommended agronomic practices such as weeding, trash lining, and gapping. KACE launched an SMS-based information service—SokoniSMS64—for farmers. The Sokoni-SMS service enables these farmers to receive market prices in various market centers around the country through their mobile phones. Equipped with this information, the farmers are able to determine the most profitable market center to transport products to and circumvent middlemen who usually offer to buy the products at much lower prices.

Another example of ICT use is infonet biovision; it is a web-based information platform offering trainers, extension workers and farmers in East Africa a quick access to up-to-date and locally relevant information in order to optimize their livelihoods in a safe, effective, sustainable and ecologically sound way.

According to the latest Global Network Readiness Survey of 2015 (see Fig.2). Kenya is ranked fifth among the top ten Sub-Saharan countries with a global rank of 86.

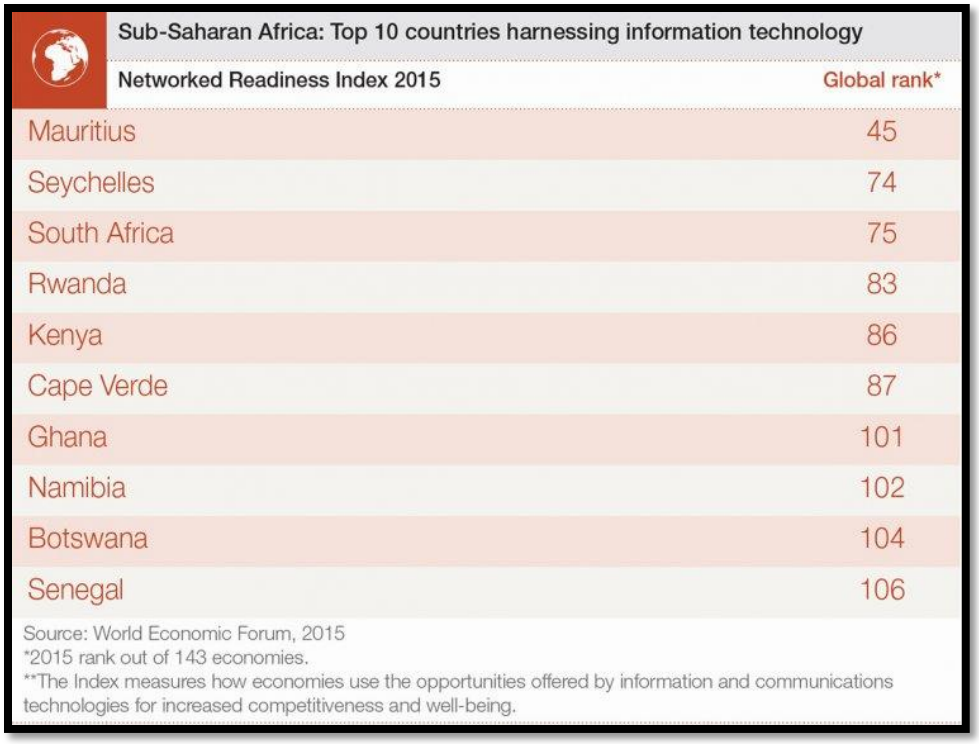

FIGURE 2. NETWORK READINESS INDEX OF SUB-SAHARAN COUNTRIES

5.2 Agricultural research system

Agricultural research in Kenya has undergone tremendous changes since its inception early in the 19th century by the colonial government. The subsector has evolved from a purely advisory services function of the mainstream ministry of Agriculture to private sector, university and semi-autonomous institutions that have the most qualified scientists and the best research capacity in sub-Saharan Africa.

Despite these developments and the importance of agricultural research in a country such as Kenya whose economy is based on agriculture, there is no national agricultural research policy. Agricultural research is guided by the Companies Act, Science and Technology Act Cap 250, Agriculture Act, Cap 318, as well as university legislations. The civil society, NGOs, and many non-state actors also claim to do agricultural research. It is evident that despite its importance and the huge human and physical capacity, currently agricultural research in Kenya is uncoordinated and exposed to risks of confusion, duplication of effort and misallocation of resources.

The Government recognizes the important role agricultural technology development and application can play in transforming and modernizing agricultural research. The *Agricultural Sector Development Strategy 2010–2020* (ASDS) seeks to rationalize, streamline and enhance coordination of agricultural research services so that the sector can play its role of delivering the 10 percent annual economic growth envisaged under the economic pillar of *Vision 2030*. In the constitution, agricultural research is placed under the responsibility of the national Government while services to farmers through agricultural extension, are placed under the county governments.

This National Agricultural Research System Policy (RoK, 2012)seeks to streamline, rationalize and put in a system that is consultative, efficient and effective and takes into account economies of scale to not only use the current scientific, human and physical capacities but also position Kenya as a hub for agricultural research and development in the region.

In Kenya, research is carried out by public and private sector institutions but without a common vision and a legal and strategic framework. This situation has led to a lack of cohesion, inefficient use of resources and limited impact. The establishment of a national institutional framework that captures the complementarities of the diverse actors engaged in agricultural research and development aims at addressing these shortcomings. The Science and Technology Act established the key building blocks of the national agricultural research system (NARS), namely: the Kenya Agricultural Research Institute (KARI), the Kenya Forestry Research Institute (KEFRI), the Kenya Marine Fisheries Research Institute (KMFRI) and the Kenya Industrial Research Institute (KIRDI). However, this attempt to strengthen and organize the NARS did not lead to systematic rationalization, integration and alignment of the various programs with national goals. Many other key players such as producers, the private sector, universities, NGOs and the civil society were largely ignored. Further, the current shift in global agricultural research towards integrated agricultural research for development and emphasis on demand-driven research call for major adjustments in the way research is organized and managed. To adapt to change processes, the Kenyan agricultural research system must be dynamic, innovative, responsive and well-coordinated, guided by a common vision, mission and goal, and have a programmatic framework. The reform agenda must also be synchronized with

transformations taking place in agricultural education, training, extension and other scientific and development fields.

5.3 Challenges, Constraints and Potential

In terms of constraints (Kingiri & Nderitu, 2014), recurring themes in the grey literature are the high levels of illiteracy, especially among the poorest, to be able to make use of extension services as well as the high cost associated with access; e.g., of internet access, which makes services out of reach, especially by the poorest. These are highlighted below:

- Extension in Kenya is delivered via knowledge-sharing forums or participatory-based methodologies. However, knowledge integration generally occurs at the farm or household level.
- Low literacy skills, management ability, negotiating capacity, and financial facility by small-scale farmers, especially in adoption of high value enterprises.
- Gender inequalities in ownership of resources like land, which reduce women's access to extension services, credit, information, etc.
- In some cases, women are not regarded as "economically active" farmers; hence they tend to be excluded from membership of farmer groups and cooperatives. This makes it very difficult to access or demand public extension services.
- Extension services are mostly designed for commercial farmers who grow cash crops, but most women farmers are smallholders who grow subsistence food crops.

Agriculture research in Kenya continues to suffer from poor management, inadequate funding and outdated technology. Inadequate research–extension–farmer linkages to facilitate demand-driven research and increased use of improved technologies continue to constrain efforts to increase agricultural productivity as farmers continue to use outdated and ineffective technologies.

As the sector analysis shows, agricultural extension need to play a key role in overcoming these constraints by disseminating knowledge, technologies and agricultural information, and in linking farmers with other actors in Kenya.

The National extension staff to farmer ration is **1: 1500** which needs to be narrowed down by recruiting more extension staff.Improvement in the management of agricultural extension organizations has been identified as a key challenge in the delivery of extension services in Kenya (Lopokoiyit et al, 2013). The capacities of the agriculture training institutes the farmer's training centres, in particular, need to be upgraded.

6. PUBLIC AND PRIVATE INSTITUTIONS IN KENYA

6.1 Major Institutions in the Agricultural sector

6.1.1 Public Sector

Agricultural extension services can be potentially provided by three main groups: the public sector, the private nonprofit sector and the private for-profit sector. The public sector includes Ministries and Departments of Agriculture and Agricultural Research Centers. In Kenya, the public sector is represented by the Ministry of Agriculture (MOA) through the Direction of Extension, Research and Technical Training, the Ministry of Livestock and Fisheries Development (MLFD) through Kenya Marine and Fisheries Research Institute (KMFRI), Kenyata University, other universities and research institutions around the country. These institutions provide extension services through various departments and institutes some of which are listed below:

6.1.1.1 Public Extension Institutions

- Ministry of Agriculture (MOA)
- Directorate of Extension, Research Liaison and Technical Training
    - Extension Services Division
    - Agricultural Sector Coordination Unit
    - Horticulture Crops Development Authority
- Ministry of Livestock and Fisheries Development (MLFD)
- Kenya Marine and Fisheries Research Institute (KMFRI)

6.1.1.2 Public Research and Education Institutions

- Kenya Agricultural Research Institute (KARI)
- Kenya Sugar Research Foundation (KESREF)
- Coffee Research Foundation (CRF)

- Tea Research Foundation of Kenya (TRFK)
- Agricultural Research and Development Investments and Capacity in Kenya
- Kenyatta University
- Center for Entrepreneurship and Enterprise Development

6.1.2 International Organizations

- International Livestock Research Institute
- GIZ - Promotion of Private Sector Development

Between 16 and 20 government departments, parastatals and/or international agricultural research centres are active in agriculture in the four districts of Trans Nzoia, West Pokot,Homa Bay and Kiambu (Rees et al, 2000)

The national blue print Vision 2030 recognizes the role of research in technology generation and creation of new knowledge; all of which are vital in national development. Vision 2030 also places great importance on value addition in agriculture and livestock as a means of raising rural household incomes as captured by the sector's driving strategy, the Agricultural Sector Development Strategy 2010-2020. In implementing the second medium term plan the Kenya Government reformed the National Agricultural Research Systems through creation of the Kenya Agricultural and Livestock Research Organization (KALRO). Its formation was aimed at restructuring agricultural and livestock research into a dynamic, innovative, responsive and well-coordinated system driven by a common vision and goal. KALRO is a corporate body created under the Kenya Agricultural and Livestock Research Act of 2013 to establish suitable legal and institutional framework for coordination of agricultural research in Kenya with the following goals:

Promote, streamline, co-ordinate and regulate research in crops, livestock, genetic resources and biotechnology in Kenya.

Expedite equitable access to research information, resources and technology and promote the application of research findings and technology in the field of agriculture.

The Veterinary Research Institute is one of the Institutes under the Kenya Agricultural and Livestock Research Organization (KALRO) established under the KALRO Act of 2013. The Institute is about 30 km North of Nairobi off the Nairobi-Nakuru Highway at Muguga in Kikuyu Division of Kikuyu District in Kiambu County

The KALRO, Sheep and Goat Research Institute is one the research institutes created under the KALR Act of 2013. Its headquarters is in Marsabit Research Centre (Marsabit County).

The KALRO Non-Ruminant Research Institute (NRI) was created under the Kenya Agricultural and Livestock Research Act of 2013. The Institute's main focus is to develop improved technologies that will support the upgrading and commercialization of the various non-ruminant value chains including poultry, pigs and emerging livestock. Upgrading these value chains will lead to wealth creation, food and nutritional security for all the players. The headquarters of the Institute are in KALRO Kakamega in Kakamega County.

The KALRO Horticultural Research Institute, is headquartered at Thika. It was created in 2014 by the Kenya Agricultural and Livestock Act of 2013.

The Dairy Research Institute is one of the Institutes under the Kenya Agricultural and Livestock Research Organization (KALRO) established under the KALRO Act of 2013. It provides technical support to the dairy sector. The Institute is located in Naivasha in Nakuru County.

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979, under the Ministry of Agriculture Livestock and Fisheries.

6.1.2 Non-public Sector

6.1.2.1 Private Sector Firms

The private nonprofit sector includes local and international NGOs, foundations, community boards and associations, bilateral and multilateral aid projects and other non-commercial associations. The private for-profit sector consists of commercial production and marketing firms (such as input manufacturers and distributors), commercial farmer or farmer group operated enterprises where farmers are both users and providers of agriculture information, agro-marketing and processing firms. In Kenya, while most extension providers in the past focused on production, currently, the private sector extension providers are going beyond production to support value addition activities and link farmers with output markets. Public sector collaborates with other development agents and the government offering extension services, to reduce cost on the part of the private non-commercial extension providers (Muyanga and Jayne, 2006). Private companies co-finance major agricultural shows and also invest in extension, which they considered as part of their marketing strategy. Through the formation of

the Kenya Private Sector Alliance (KEPSA), private sectorplayers have been organized along sector boards to mirror the public sector arrangementsand engage on issues. Key players within the agricultural sector include KENFAP, whichrepresents agricultural producers, and KNFC, which handles the commercial arm ofagriculture through the cooperative movement. Other private sector institutions includeprocessors, marketing agencies and farm input dealers that, through their profit-orientednature, have survived but can neither be regarded as strong nor organized players.

In the four districts of Trans Nzoia, West Pokot, Homa Bay and Kiambu , Organisations, institutions and individuals providing goods and services to farming communities include individual traders and stockists, trading companies, seed and livestock suppliers, agrochemical and veterinary goods suppliers, transporters, tractor and oxen rental suppliers, providers of artificial insemination and bull schemes, pest control groups and consultants, ethnoveterinarians and millers. The private sector is much more active in Trans Nzoia and Kiambu than in West Pokot or Homa Bay. The involvement of agribusiness in technology development and dissemination is largely limited to high-potential investments and cash crops/ enterprises, however. Many private sector individuals and companies are considered to be very exploitative in their dealings with smallholder farmers (Rees et al, 2000).

6.1.2.2 Non-Governmental Organizations and other Donors

In Kenya, private Non-Governmental, Faith based and Community-based organizations are currently providing farmers with agricultural extension services. Most of them are promoting commercialization of small-scale agriculture, and provide training on marketing and calenderization (not to grow when everybody is growing to avoid depressing output prices). The majority of NGOs has extension staff trained in relevant agricultural disciplines. Most of these NGOs rely on the government research institution such as KARI for technology, and others have established links with private companies as well as international research centers (ICRAFT, ICUPE, CIMMYT, CIP ICRISAT and IITA). Following is a list of selected Kenyan NGOs involved in agricultural production and agribusiness supply chain development

- Care – Kenya
- Sacred Africa
- World Vision
- Catholic Relief Services

- Winrock International Institute for Agricultural Development

6.1.2.3 Farmer Based Organizations and Cooperatives

Farmers have the tradition of organizing themselves at local level into membership-based entities (associations, cooperatives). In Kenya, farmers have organized themselves in groups to facilitate such ventures as the marketing of agricultural output, mutual help assistance and acquisition of agricultural credit. Community labor-sharing groups in Kenya are one of the successful farmers' based organizations providing supply of labor to farmers during critical periods of the cropping season. These groups allow the members to help each other to accomplish heavy farm tasks such as ploughing, planting, and harvesting. Some development organizations try to build on these local institutions to carry out their agricultural extension work.

The work groups are common in many parts of Kenya, and are known by several names, including saga, ngwatio, bulala and m'wthya. They are used by NGO and other partners to promote and share new farming and conservation practices. Using community groups is a form of farmer-to-farmer extension, as farmers learn a particular innovation and share their knowledge and skills to other farmers. Farmers are generally enthusiastic to share their skills with other farmers. Extension cannot be expected to reach every farmer - hence, the need for selectivity and reliance on farmer-to-farmer dissemination (World Bank, 1999). The Kenya National Federation of Agricultural Producers (KNFAP) is the largest farmers union in Kenya whose mission is to "empower its members to make informed choices for improved sustainable livelihoods". Other farmer organizations that provide some agricultural information and services to their members include: Fresh Produce Exporters Association of Kenya (FPEAK); Kenya Flower Council; Cereal Growers Association and Co-operative Societies.

6.1.2.4 CBOs (Community Based Organizations)

Since independence, the *Harambee* movement ('working together for development') has encouragedself-help and self-help groups. Many self-help groups are well developed, particularly in the higher potentialareas of the country. MostNGOs maintain links with CBOs, and have often been responsible for their formation. CBOs active in agriculture in the study area include women's groups, 4K clubs, youth groups, dip committees, water committees, zero-grazing groups, commodity groups and farmer cooperatives. Their primary focus is usually fundraising; agriculture tends to be the secondary focus.

In arid and semi-arid marginal areas, CBOs have often been established as part of relief food efforts.

6.2 Public – Private Partnerships (PPP)

In terms of the overall business climate, theWorld Economic Forum's Country CompetitivenessIndex 2009 ranked Kenya 98 out of 133countries. Kenya was nevertheless ranked aheadof Tanzania (100) and Uganda at 108 (World EconomicForum's Country Competitiveness associated with weakeninginstitutional environment, inefficient publicinstitutions, undue government influence, corruption,and insecurity. These challenges are also likelyto hurt agribusiness PPPs given that they affect theoverall business environment for private sector.

However, the high innovative potential coupledwith public-private collaboration in research anddevelopment and enhanced access to financialservices were expected to lead to improvement inKenya's competitiveness.

6.2.1 Characteristics of Successful public-private partnerships:

- Improve the efficiency of developinglocally-adapted innovation.
- Enable technology to be distributedmore effectively to local farmers.
- Help farmers continuously improveand make the most of sustainableagricultural practices.
- Promote the effective andresponsible application of newtechnologies.
- Provide social and economic value tofarmers and communities.

6.2.2 Scope of PPPs in Agriculture

In addition to the Vision 2030's flagship projects,the Government of Kenya supports agribusinessPPPs through collaborative projects including:

- Njaa Marufuku Kenya, "Eliminate hunger inKenya" (NMK),
- Kenya Agricultural Productivityand Agribusiness Program (KAPAP),
- AgriculturalInnovation Programme,
- Smallholder HorticultureMarketing Project (SHoMAP),
- Smallholder HorticultureDevelopment Project (SHDP),
- Private SectorDevelopment In Agriculture (PSDA),
- NationalAccelerated Agriculture Input Access Program(NAAIAP) and

- Smallholder Dairy CommercializationProgramme.

A review of successful cases of PPPs in Kenya (FAO, 2013) was made and is given hereunder:

Table 21. Case studies on Public-Private Partnership

Agribusiness PPP	Nature of PPP	Year start	Overall objective	Actions undertaken	Public Partners	Private Partners
KEVIAN Fruit processing project	Grants, con-cessions, tax holidays for private sector (government/ donor)	2005	Promotion of mango marketing and value addition / sector development	Value addition of mangoes	Kenya Gatsby Trust, ICIpE and UNDP, GTZ, and KENFAp	KEVIAN Company
BIOFIX project	Co-financing investments - public/private	2008	Commercialization of a technological product from a public institution for soil improvement	Supply organic fertilizer	University of Nairobi, British Council, AKTp	MEA Ltd, Seed companies & networks
StrigAway Maize Initiative	Development programme - private sector	2005	Eradication of StrigAway weed for increased maize yields and farm pro- ductivity	Supply Striga resistant maize seed (IR maize)	AATF, Rockefeller Foundation, NGOs,	BSF, Western Seed Company,

Agribusiness PPP	Nature of PPP	Year start	Overall objective	Actions undertaken	Public Partners	Private Partners
Warehouse Receipt Scheme	Grants, concessions, tax holidays for private sector(government/ donor)	2008	Develop grain storage structures and enhance grain trade in the region	Supply secure warehouses for storing grain	The Eastern African Grain Council (EAGC), NCpB, the Financial Sector Deepening (FSD) Trust and SIDA.	Equity Bank, growers, trans-porters, traders, storage managers, processors, millers

An in-depth analysis of the role of public and private institutions in the country has revealed the necessity to form partnerships among the public sector, the private nonprofit sector and the private for-profit sector for providing effective services.

7. CAPACITY BUILDING

"It is important to nurture any new ideas and initiatives, which can make a difference for Africa"

- Wangari Muta Maathai, Kenyan Environmentalist & Nobel Peace Prize Winner

Capacity can be defined as the people, institutions, and practices that enable countries to achieve their development goals. It encompasses human skills and institutional and organizational structures, procedures, and systems. Studies have shown that improving food security in the pastoral areas of Africa is best done by capacity building ahead of applying technology (Balleh, 2012). Community capacity building to strengthen the skills, competencies

and abilities of the farmers in developing societies such as Kenya is essential to overcome the causes of their exclusion and suffering.

1. Institutions for capacity building

Namusonge (2006) in Mwobobia (2012) noted that entrepreneurial education and training play a key role in stimulating entrepreneurship and self-employment. Those entrepreneurs with larger stocks of human capital, in terms of education and (or) vocational training, are better placed to adapt their enterprises to constantly changing business environments.

Several public institutions offer capacity-building services to the agricultural sector. These include universities, middle-level colleges and institutes, and farmer and pastoral training centres. Agricultural training institutions run by the private sector also offer general and specialized courses. Other public support institutions involved in human resource capacity building include a livestock-recording centre, a national beekeeping station, fish breeding and demonstration farms, sheep and goat stations, livestock farms, agricultural mechanization stations and rural technology development stations. These institutions provide specialized training to clients (farmers and extension personnel) and act as demonstration centres for improved technologies. The Agricultural Information Resource Centre and other resource centres, agricultural shows, field days, and open forums have been important sources of agricultural knowledge, information and technology.

1.Government of Kenya's initiatives[27]

A National Capacity Building Framework [NCBF] has been developed to support the capacity building for devolved governance. Vision 2030 of the Government of Kenya relies on the creative talents that can raise the country's international competitiveness through enhanced productivity at the micro (agribusiness) and national levels. A literate population is an asset to the agricultural sector as it provides qualified personnel and opportunities for developing and disseminating science and technology, as well as innovation-based solutions to the agricultural sector. It will also help the country to address gender imbalances, youth related problems and obstacles facing other vulnerable groups by equipping them with the skills that enable them to live more productive and satisfying lives in an expanding and diverse economy.

[27]AGRICULTURAL SECTORDEVELOPMENT STRATEGY. Govt. of Kenya, 2010–2020, 2010

Njine 2014 had reported that Agriculture training centers (ATCs) in Kenya play a key role in disseminating knowledge, technologies, and agricultural information, as well as in linking farmers with other stakeholders in the economy.

ATCs are critical change agents required in transforming traditional subsistence farming to modern commercial agriculture to promote household food security, improve income, and reduce poverty. ATC frequently offer in-service training to public sector employees, training to farmers, and short courses on demand to others in the public or private sectors.

In Kenya, the Ministry of Agriculture is usually responsible for agricultural training programs. ATCs are part of extension services and operate under the National Agricultural Sector Extension Policy within the Ministry. ATCs are headed by a principal, whose deputy is the training coordinator. The principal and his or her team carry out the day-to-day activities of the ATC. Various technical committees, composed of the district specialists and other stakeholders, are chaired by district agricultural officers and oversee the implementation of programs. The training coordinator is in charge of the school and the farm manager heads the farm activities. Other staffs include an agro-processing officer, a home economics officer, a livestock officer, a crop officer, and support staff (clerks, drivers, housekeepers, etc.).

ATCs were created in Kenya in the 1950s after the launch of the Synerton plan, which called for intensification of African agriculture (MoA, 2011). These centers have played a major role in the development of both livestock and crop production in the country.

Currently there are 27 ATCs located in different agro-ecological zones.

2. Human Resource Development in Agriculture : Training for Extension Professionals

Human Resource Development is an important factor in capacity building and improving the overall efficiency of functionaries involved in implementation, monitoring, evaluation, research and extension programmes. The importance of training in capacity building of extension experts is the key in strengthening of extension services and dissemination of agricultural technology to the farming community.

The quality of extension staff may well be a more important constraint on the diffusion of innovations and adoption of new technologies than the farmers themselves. Training agricultural professionals increases the skills of extension staff in the field. Agricultural training institutions in Kenya (Kenyatta University and Egerton University) like in many other East African countries

provide formal training in agriculture and agriculture related fields at the degree and diploma level. The Directorate of Extension, Research Liaison and Technical Training of the Ministry of Agriculture oversees the planning, utilization and management of technical human resources requirement and training needs for the Ministry. The Ministry has two colleges; Bukura Agricultural College for training and upgrading skills of serving officers from certificate to diploma level and Embu Agricultural Staff Training College (EAST College), which focuses on short refresher courses for in-service agricultural professionals (MOA, 2008).

3.Enrolment in institutions

A study on the enrolment in agricultural training institutions of Kenya reveal that over the past few years, quite a number of public universities have continued offering agricultural courses at degree level. During the years 2010-2014, the number of trainees pursuing agricultural degree courses in public universities recorded an increase of 27.9 per cent from 9,535 students in 2013 to 12,196 students in 2014. Over the years, the number of male students continued to be higher than that of female students.

Table .22. Enrolment in Kenyan Agricultural Institutions[28]

	2010	2011	2012	2013	2014*
Degree level- Public Universities: All Universities	4949	6672	7546	9535	12196
Diploma Level – Public Universities: Egerton	2570	2513	2351	1820	1470
Diploma level – MoA Bukura Institute of Agriculture	483	709	1058	1179	964
Certificate level Naivasha Dairy Training Institute	94	142	214	205	231

[28]Source: Ministry of Agriculture, Livestock and Fisheries: Public Universities and other Institutions, Kenya

Table .22. Enrolment in Kenyan Agricultural Institutions[28]					
	2010	**2011**	**2012**	**2013**	**2014***
Animal health Training Institutes					
Kabete	98	122	105	116	187
Nyahururu	53	80	78	80	78
Ndomba	112	153	156	184	295
Sub-Total	263	355	339	380	560
Short Term Vocational Courses					
Naivasha Dairy training school	93	134	194	166	289
Athi River M.T.School	53	69	94	94	83
Sub-Total	146	203	288	260	372
* **Provisional**					

7.4 Institutional constraints

Institutional constraints in human resources development include (Kenya – Agricultural sector development strategy 2010-2020) :

- inadequate levels of funding for public training institutions leading to deterioration of infrastructure and facilities for training and technology demonstration;
- limited capacity to train in emerging areas such as indigenous animals and plants husbandry, and organic farming; advanced biotechnology;
- the slow pace of commercializing services offered by training institutions; and
- failure to respond to market demands for specialized courses

The capacities of the agriculture training institutes in the country have to be upgraded with *international support* to meet the growing needs of the stakeholders in the agricultural sector.

8. TRAINING PRIORITIES

Any training activity should aim at eliminating or narrowing the "gap" between "realistic condition" and "ideal condition".

Kenya's government has ambitions of creating 'ideal conditions' in the agricultural sector with the implementation of its 'Vision 2030' plan. This national long-term development blueprint is aimed at transforming Kenya into a newly industrialising, middle-income country. For this to happen, the country has to tide over the issues of Corruption, high unemployment and low infrastructure investment that have hampered Kenya's economy (CIA World World FactBook[29]) and appropriate capacity building programmes need to be formulated.

As the demand analysis in the previous sections show, most of the challenges in the agricultural sector are caused by lack of information and knowledge on how to avoid them or how to solve or circumvent those that cannot be avoided.

Further, Kenya's Agricultural sector development strategy: 2010-2020 says that the productivity and competitiveness of the crops and land development subsector have been challenged and constrained by weak institutional capacity attributed to deficiencies in determining training needs and in monitoring and evaluating training undertaken, as well as high turnover of senior personnel, which lead to loss of institutional memory and change of priorities. These challenges can be solved if effective capacity building, extension and advisory services are accorded to the stakeholders, especially the smallholders and extension personnel.

Based on the overview of Kenya's agricultural and allied sectors, demand analyses, existing policies, programmes, vision documents, case studies, research articles and documents available with MANAGE[30], the following training priorities have been identified.

1. *Post-Harvest Technology and Management*

Postharvest losses, especially of perishable produce are high in Kenya, while poor postharvest handling of cereal maize and related products compromises food safety because of *aflatoxin* contamination putting farm families, livestock and consumers at risk, further exacerbating the food insecurity situation in the country. Post-harvest management has been a major challenge in Kenya's agricultural sector with an estimated loss of 20%-30% of harvested crops. Maize, one of the important crops in Kenya suffers heavy post-harvest losses estimated at

[29]See http://www.itwebafrica.com/business-intelligence/500-kenya/231723-ict-country-profile-kenya-africas-silicon-savannah#sthash.GPtdZyvL.dpuf

[30]Offer of training opportunities under the 'Feed The Future' Training Programme for Kenya

20-30%. The major factor behind this could be the lack of knowledge and skill in handling the post-harvest produce and access to improved storage facilities, which can be addressed by imparting appropriate training programmes.

2. Agricultural Extension Management

Improvement in the management of agricultural extension organizations has been identified as a key challenge in the delivery of extension services in Kenya. It is essential that along with technical skills the extension personnel need to be trained in management competencies as well. Competencies in extension management are important from four perspectives. First, in the management of extension service programs and projects, secondly in management of extension staff, and thirdly the management of networks, collaborations, and partnerships with stakeholders in the agriculture industry. Finally, but most importantly, in managing farmer relations to build trust and an enabling environment for effective extension service delivery (Lopokoiyit et al, 2013). The training areas could include imparting interpersonal skills, social intelligence, presentation skills, public speaking & written communication.

3. Public Private Partnership in Agriculture Extension Management

Partnerships can form the basis of the country's extension projects. The PPPs providing advisory services that involve the government, universities, NGOs, and commercial partners are likely to create an impact in improving the capacities of stakeholders. Kenya, as mentioned elsewhere in the report, has run a few successful PPP projects and capacity building programmes on PPP in Agricultural Extension Management technologies too need to be initiated.

4. ICT application in Agricultural Extension

Kenya is ranked third in Africa with the highest number of internet users a situation that has propelled the country towards being knowledge-based economy[31]. Among the African top four technology countries, Nigeria, South Africa, Kenya and Egypt, only Kenya was found by the report to have improved in networked readiness over the years. Strong demand for mobile and internet services has characterized Kenya's technology market. This potential has to be tapped for providing an effective advisory service to the farmers of the country. The Government

[31]See http://www.information.go.ke/?p=1829

has already made right steps in the direction by creating digital villages called 'Pasha centres' to address the ICT disparities between urban and rural populations.

Human capacity constraints such as inexperienced users (among both farmers and extension personnel) and lack of technical support for implementing ICT projects should be overcome by planning appropriate training programmes.

5. *Agri-entrepreneurship Development*

Developing stakeholder capacities in agri-entrepreneurship could be a step in the right direction in a country like Kenya where the unemployment rate is as high as 40 %. About 750,000 youth enter the labour market annually. By creating training opportunities in agri-entrepreneurship, the youth of the country could be retained in agriculture as the average age of the Kenyan farmer is about 60 years. Imparting training in this area could transform the Kenyan youth from a job seeker to a job creator.

6. *Agribusiness, Value Addition of Agricultural Products and Marketing*

In Kenya, agro-processing has a tremendous potential for increasing income through value addition and increasing shelf life and access to food security through the establishment of small scale agro-processing enterprises and rural based industries. Opportunities to add value to agricultural produce are largely unexploited. The training priorities in this sector should focus on (Onyango & Nyaberi, 2016):

- Creating avenues for information dissemination and guidance in contract design, food product design, quality standards, good manufacturing practices, market development, funding options, land and building investments, legal and policy frameworks governing the agro-food processing sector, food processing and logistics, etc.;
- Conducting advocacy for and showcasing good industry practices;
- Facilitating R&D and technology transfer through capacity building and information dissemination;
- Enhancing training of and recognition of food science and technology experts

Though Kenya has the highest agricultural value added in the East African region, lack of knowledge and skills in operating machinery has been one of the major constraints. A few farmers in Central Kenya have found a lifeline in adding value to their harvested produce that is not only increasing the produce's shelf life but more than tripling earnings, at a time when over-

production and a shrinking market have taken a toll on earnings. Developing the capacities of the stakeholders in this area, could go a long way in improving their standard of living.

7. International Agricultural Trade and Policy

Currently more than 90 percent of Kenyan produce is exported in raw or semi-processed form, leaving many opportunities for income and employment generation underused.

Kenyan agricultural exports are considered less competitive in global markets. The smallholder agriculture that is predominant in Kenya will have to be transformed from subsistence activities, marked by low productivity and value addition, to 'an innovative, commercially-oriented, internationally competitive and modern agricultural sector'.

Therefore, there is need to build capacities in the farmer organizations on the WTO and similar international Agreements on Agriculture and their impacts on the farmer. Only then, these stakeholders should be able to participate in the negotiations of such agreements.

Improving capacity building of the stakeholders in this area , especially in market-driven product development and value addition and creating a quality brand 'Kenya', will also help the country to compete globally.

8.8. Food Processing Technologies and Management

Traditionally Kenyan farmers' obsession with certain crops has worked against them as evidenced in market oversupply. Farmers would produce the same crop at the same time, which would be harvested at the same time and taken to the same market, yielding low prices. Edible and other oils produced locally include butter, ghee and margarine as well as sunflower, rapeseed, cottonseed, sesame, coconut and corn oils, while a large quantity of palm oil is imported. 'Vision 2030' of Kenya had identified food processing as the most important single sub-sector in terms of its contribution to GDP (28.7%) Both processed foods and basic food processing machinery are good contenders for that increased penetration. Capacity building of stakeholders on various aspects of processing starting from the time of production to reaching domestic and global markets will provide a fillip to this sector.

8.9 Advancement in Fisheries Technologies

The National Oceans and Fisheries Policy of 2008 had lamented that fisheries sector in Kenya lacks training institutions and sufficient numbers of suitably trained personnel. The

Oceans and fisheries sector plays an important role in the Kenya's economy by providing food, employment and income to a large population and earns the country Kshs 5 billion annually from the foreign exchange.

Training needs in this sector should focus on the need to improve feed formulations; formulate species- and life-stage specific diets; and improve the understanding of ingredient quality, nutrient composition and selection, manufacturing processes, storage, and on-farm feed management practices. Capacity building of stakeholders in this sector could help in overcoming the constraints in aquaculture development in the country.

8.10 Farm Mechanization for small Farmers

Promoting mechanization in agriculture means that more tasks can be completed at the right time, more efficiently and saving labour and energy.

Capacity building of small farmers across the country would enhance uptake of machines and tools, in farm activities. Training programmes have to be developed to cover the needs of farmers, operators, mechanics and other relevant stakeholders involved in the provision of agricultural machinery services in the country.

8.11 Modern Technology in Dairy and Poultry Management

Dairy and poultry production and management requires more specialized, knowledgeable and experienced investors, managers and dairy farm workers. Small-scale poultry rearing is common, mainly by women and children, but they face challenges such as frequent disease incidence.

Both sectors face the challenge of keeping up with the anticipated changes in production, as knowledge and skills are important for quick adoption of appropriate technology. Training programmes for these two sectors have to be evolved keeping in view the changing needs.

8.12 *Bee Keepingand Production of Mushrooms*

Bee keeping in Kenya has been practiced since time immemorial and the communities still use indigenous knowledge. Beekeeping contributes close to 4.3 billion Kenya Shillings annually and production is estimated at, 100,000 metric tons annually. Inadequate training for both farmers and extension staff is one of the major challenges in this enterprise. This can become an important enterprise in the livestock sub-sector if modern beekeeping technologies are adopted as there is a ready market for bee products , both locally and internationally.

Animal protein is beyond the reach of many low-income groups, which constitute a large proportion of Kenyans. Malnutrition in terms of protein deficiency is one of the major factors responsible for high mortality and morbidity in Kenya.

Capacity building in terms of spawns production, mushroom production, processing and value addition of mushrooms can help in reducing the malnutrition levels in the country.

8.13 *Other Basic Priorities*

Capacity building is a lengthy process, particularly where initial capacity is very weak. Kenya ranks 145th among 187 countries in the United Nations Development Programme's Human Development Index, which measures development in terms of life expectancy, educational attainment and standards of living and therefore, capacity building programmes planned for the country need to be a continuous, sustained process.

Therefore, besides the advanced areas of training mentioned above, the following training areas may also have to be incorporated in the scheme of things for effectiveness.

- Package of Practices for Food, Commercial and Horticultural crops
- Package of Practices for Livestock, Fisheries & Forestry
- Soil &Water Conservation and Management

Number of Participants

It is also important to consider the size of the group being trained. The optimal number of participants in a training session is 15-20 persons, to facilitate discussion and to hasten the learning process.

For each training programme to be conducted based on the aforementioned priorities, **twenty (20) officers** could be considered.

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9. CAPACITY BUILDING

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1.Government of Kenya's initiatives[32]

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Njine 2014 had reported that Agriculture training centers (ATCs) in Kenya play a key role in disseminating knowledge, technologies, and agricultural information, as well as in linking farmers with other stakeholders in the economy.

ATCs are critical change agents required in transforming traditional subsistence farming to modern commercial agriculture to promote household food security, improve income, and reduce poverty. ATC frequently offer in-service training to public sector employees, training to farmers, and short courses on demand to others in the public or private sectors.

In Kenya, the Ministry of Agriculture is usually responsible for agricultural training programs. ATCs are part of extension services and operate under the National Agricultural Sector Extension Policy within the Ministry. ATCs are headed by a principal, whose deputy is the training coordinator. The principal and his or her team carry out the day-to-day activities of the ATC. Various technical committees, composed of the district specialists and other stakeholders, are chaired by district agricultural officers and oversee the implementation of programs. The training coordinator is in charge of the school and the farm manager heads the farm activities. Other staffs include an agro-processing officer, a home economics officer, a livestock officer, a crop officer, and support staff (clerks, drivers, housekeepers, etc.).

ATCs were created in Kenya in the 1950s after the launch of the Synerton plan, which called for intensification of African agriculture (MoA, 2011). These centers have played a major role in the development of both livestock and crop production in the country.

[32]AGRICULTURAL SECTORDEVELOPMENT STRATEGY. Govt. of Kenya, 2010–2020, 2010

Currently there are 27 ATCs located in different agro-ecological zones.

2. Human Resource Development in Agriculture : Training for Extension Professionals

Human Resource Development is an important factor in capacity building and improving the overall efficiency of functionaries involved in implementation, monitoring, evaluation, research and extension programmes. The importance of training in capacity building of extension experts is the key in strengthening of extension services and dissemination of agricultural technology to the farming community.

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Table .22. Enrolment in Kenyan Agricultural Institutions[33]

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[33]Source: Ministry of Agriculture, Livestock and Fisheries: Public Universities and other Institutions, Kenya

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7.4 Institutional constraints

Institutional constraints in human resources development include (Kenya – Agricultural sector development strategy 2010-2020) :

- inadequate levels of funding for public training institutions leading to deterioration of infrastructure and facilities for training and technology demonstration;
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The capacities of the agriculture training institutes in the country have to be upgraded with *international support* to meet the growing needs of the stakeholders in the agricultural sector.

10. TRAINING PRIORITIES

Any training activity should aim at eliminating or narrowing the "gap" between "realistic condition" and "ideal condition".

Kenya's government has ambitions of creating 'ideal conditions' in the agricultural sector with the implementation of its 'Vision 2030' plan. This national long-term development blueprint is aimed at transforming Kenya into a newly industrialising, middle-income country. For this to happen, the country has to tide over the issues of Corruption, high unemployment and low infrastructure investment that have hampered Kenya's economy (CIA World World FactBook[34]) and appropriate capacity building programmes need to be formulated.

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These challenges can be solved if effective capacity building, extension and advisory services are accorded to the stakeholders, especially the smallholders and extension personnel.

Based on the overview of Kenya's agricultural and allied sectors, demand analyses, existing policies, programmes, vision documents, case studies, research articles and documents available with MANAGE[35], the following training priorities have been identified.

1. *Post-Harvest Technology and Management*

Postharvest losses, especially of perishable produce are high in Kenya, while poor postharvest handling of cereal maize and related products compromises food safety because of *aflatoxin* contamination putting farm families, livestock and consumers at risk, further exacerbating the food insecurity situation in the country. Post-harvest management has been a major challenge in Kenya's agricultural sector with an estimated loss of 20%-30% of harvested crops. Maize, one of the important crops in Kenya suffers heavy post-harvest losses estimated at 20-30%. The major factor behind this could be the lack of knowledge and skill in handling the post-harvest produce and access to improved storage facilities, which can be addressed by imparting appropriate training programmes.

2. *Agricultural Extension Management*

Improvement in the management of agricultural extension organizations has been identified as a key challenge in the delivery of extension services in Kenya. It is essential that along with technical skills the extension personnel need to be trained in management competencies as well. Competencies in extension management are important from four perspectives. First, in the management of extension service programs and projects, secondly in management of extension staff, and thirdly the management of networks, collaborations, and partnerships with stakeholders in the agriculture industry. Finally, but most importantly, in managing farmer relations to build trust and an enabling environment for effective extension service delivery (Lopokoiyit et al, 2013). The training areas could include imparting interpersonal skills, social intelligence, presentation skills, public speaking & written communication.

3. *Public Private Partnership in Agriculture Extension Management*

[35]Offer of training opportunities under the 'Feed The Future' Training Programme for Kenya

Partnerships can form the basis of the country's extension projects. The PPPs providing advisory services that involve the government, universities, NGOs, and commercial partners are likely to create an impact in improving the capacities of stakeholders. Kenya, as mentioned elsewhere in the report, has run a few successful PPP projects and capacity building programmes on PPP in Agricultural Extension Management technologies too need to be initiated.

4. ICT application in Agricultural Extension

Kenya is ranked third in Africa with the highest number of internet users a situation that has propelled the country towards being knowledge-based economy[36]. Among the African top four technology countries, Nigeria, South Africa, Kenya and Egypt, only Kenya was found by the report to have improved in networked readiness over the years. Strong demand for mobile and internet services has characterized Kenya's technology market. This potential has to be tapped for providing an effective advisory service to the farmers of the country. The Government has already made right steps in the direction by creating digital villages called 'Pasha centres' to address the ICT disparities between urban and rural populations.

Human capacity constraints such as inexperienced users (among both farmers and extension personnel) and lack of technical support for implementing ICT projects should be overcome by planning appropriate training programmes.

5. Agri-entrepreneurship Development

Developing stakeholder capacities in agri-entrepreneurship could be a step in the right direction in a country like Kenya where the unemployment rate is as high as 40 %. About 750,000 youth enter the labour market annually. By creating training opportunities in agri-entrepreneurship, the youth of the country could be retained in agriculture as the average age of the Kenyan farmer is about 60 years. Imparting training in this area could transform the Kenyan youth from a job seeker to a job creator.

6. *Agribusiness, Value Addition of Agricultural Products and Marketing*

In Kenya, agro-processing has a tremendous potential for increasing income through value addition and increasing shelf life and access to food security through the establishment of small scale agro-processing enterprises and rural based industries. Opportunities to add value to agricultural produce are largely unexploited. The training priorities in this sector should focus on (Onyango & Nyaberi, 2016):

[36]See http://www.information.go.ke/?p=1829

- Creating avenues for information dissemination and guidance in contract design, food product design, quality standards, good manufacturing practices, market development, funding options, land and building investments, legal and policy frameworks governing the agro-food processing sector, food processing and logistics, etc.;
- Conducting advocacy for and showcasing good industry practices;
- Facilitating R&D and technology transfer through capacity building and information dissemination;
- Enhancing training of and recognition of food science and technology experts

Though Kenya has the highest agricultural value added in the East African region, lack of knowledge and skills in operating machinery has been one of the major constraints. A few farmers in Central Kenya have found a lifeline in adding value to their harvested produce that is not only increasing the produce's shelf life but more than tripling earnings, at a time when over-production and a shrinking market have taken a toll on earnings. Developing the capacities of the stakeholders in this area, could go a long way in improving their standard of living.

7. International Agricultural Trade and Policy

Currently more than 90 percent of Kenyan produce is exported in raw or semi-processed form, leaving many opportunities for income and employment generation underused.

Kenyan agricultural exports are considered less competitive in global markets. The smallholder agriculture that is predominant in Kenya will have to be transformed from subsistence activities, marked by low productivity and value addition, to 'an innovative, commercially-oriented, internationally competitive and modern agricultural sector'.

Therefore, there is need to build capacities in the farmer organizations on the WTO and similar international Agreements on Agriculture and their impacts on the farmer. Only then, these stakeholders should be able to participate in the negotiations of such agreements.

Improving capacity building of the stakeholders in this area , especially in market-driven product development and value addition and creating a quality brand 'Kenya', will also help the country to compete globally.

8.9. Food Processing Technologies and Management

Traditionally Kenyan farmers' obsession with certain crops has worked against them as evidenced in market oversupply. Farmers would produce the same crop at the same time, which would be harvested at the same time and taken to the same market, yielding low prices. Edible and other oils produced locally include butter, ghee and margarine as well as sunflower, rapeseed, cottonseed, sesame, coconut and corn oils, while a large quantity of palm oil is imported. 'Vision 2030' of Kenya had identified food processing as the most important single sub-sector in terms of its contribution to GDP (28.7%) Both processed foods and basic food processing machinery are good contenders for that increased penetration. Capacity building of stakeholders on various aspects of processing starting from the time of production to reaching domestic and global markets will provide a fillip to this sector.

8.14 Advancement in Fisheries Technologies

The National Oceans and Fisheries Policy of 2008 had lamented that fisheries sector in Kenya lacks training institutions and sufficient numbers of suitably trained personnel. The Oceans and fisheries sector plays an important role in the Kenya's economy by providing food, employment and income to a large population and earns the country Kshs 5 billion annually from the foreign exchange.

Training needs in this sector should focus on the need to improve feed formulations; formulate species- and life-stage specific diets; and improve the understanding of ingredient quality, nutrient composition and selection, manufacturing processes, storage, and on-farm feed management practices. Capacity building of stakeholders in this sector could help in overcoming the constraints in aquaculture development in the country.

8.15 Farm Mechanization for small Farmers

Promoting mechanization in agriculture means that more tasks can be completed at the right time, more efficiently and saving labour and energy.

Capacity building of small farmers across the country would enhance uptake of machines and tools, in farm activities. Training programmes have to be developed to cover the needs of farmers, operators, mechanics and other relevant stakeholders involved in the provision of agricultural machinery services in the country.

8.16 Modern Technology in Dairy and Poultry Management

Dairy and poultry production and management requires more specialized, knowledgeable and experienced investors, managers and dairy farm workers. Small-scale poultry rearing is

common, mainly by women and children, but they face challenges such as frequent disease incidence.

Both sectors face the challenge of keeping up with the anticipated changes in production, as knowledge and skills are important for quick adoption of appropriate technology. Training programmes for these two sectors have to be evolved keeping in view the changing needs.

8.17 *Bee Keepingand Production of Mushrooms*

Bee keeping in Kenya has been practiced since time immemorial and the communities still use indigenous knowledge. Beekeeping contributes close to 4.3 billion Kenya Shillings annually and production is estimated at, 100,000 metric tons annually. Inadequate training for both farmers and extension staff is one of the major challenges in this enterprise. This can become an important enterprise in the livestock sub-sector if modern beekeeping technologies are adopted as there is a ready market for bee products , both locally and internationally.

Animal protein is beyond the reach of many low-income groups, which constitute a large proportion of Kenyans. Malnutrition in terms of protein deficiency is one of the major factors responsible for high mortality and morbidity in Kenya.

Capacity building in terms of spawns production, mushroom production, processing and value addition of mushrooms can help in reducing the malnutrition levels in the country.

8.18 *Other Basic Priorities*

Capacity building is a lengthy process, particularly where initial capacity is very weak. Kenya ranks 145th among 187 countries in the United Nations Development Programme's Human Development Index, which measures development in terms of life expectancy, educational attainment and standards of living and therefore, capacity building programmes planned for the country need to be a continuous, sustained process.

Therefore, besides the advanced areas of training mentioned above, the following training areas may also have to be incorporated in the scheme of things for effectiveness.

- Package of Practices for Food, Commercial and Horticultural crops
- Package of Practices for Livestock, Fisheries & Forestry
- Soil &Water Conservation and Management

Number of Participants

It is also important to consider the size of the group being trained. The optimal number of participants in a training session is 15-20 persons, to facilitate discussion and to hasten the learning process.

For each training programme to be conducted based on the aforementioned priorities, **twenty (20) officers** could be considered.

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Based on the overview of Kenya's agricultural and allied sectors, demand analyses, existing policies, programmes, vision documents, case studies, research articles and documents available with MANAGE[39], the following training priorities have been identified.

1. *Post-Harvest Technology and Management*

Postharvest losses, especially of perishable produce are high in Kenya, while poor postharvest handling of cereal maize and related products compromises food safety because of *aflatoxin* contamination putting farm families, livestock and consumers at risk, further exacerbating the food insecurity situation in the country. Post-harvest management has been a major challenge in Kenya's agricultural sector with an estimated loss of 20%-30% of harvested crops. Maize, one of the important crops in Kenya suffers heavy post-harvest losses estimated at 20-30%. The major factor behind this could be the lack of knowledge and skill in handling the post-harvest produce and access to improved storage facilities, which can be addressed by imparting appropriate training programmes.

2. *Agricultural Extension Management*

Improvement in the management of agricultural extension organizations has been identified as a key challenge in the delivery of extension services in Kenya.It is essential that along with technical skills the extension personnel need to be trained in management competencies as well. Competencies in extension management are important from four perspectives. First, in the management of extensionservice programs and projects, secondly in management of extension staff, and thirdly the management of networks,collaborations, and partnerships with stakeholders in the agriculture industry. Finally, but most importantly, in managingfarmer relations to build trust and an enabling environment for effective extension service delivery (Lopokoiyit et al, 2013). The training areas could include imparting interpersonal skills, social intelligence, presentation skills, public speaking & written communication.

[39]Offer of training opportunities under the 'Feed The Future' Training Programme for Kenya

3. *Public Private Partnership in Agriculture Extension Management*

Partnerships can form the basis of the country's extension projects. The PPPs providing advisory services that involve the government, universities, NGOs, and commercial partners are likely to create an impact in improving the capacities of stakeholders. Kenya, as mentioned elsewhere in the report, has run a few successful PPP projects and capacity building programmes on PPP in Agricultural Extension Management technologies too need to be initiated.

4. *ICT application in Agricultural Extension*

Kenya is ranked third in Africa with the highest number of internet users a situation that has propelled the country towards being knowledge-based economy[40]. Among the African top four technology countries, Nigeria, South Africa, Kenya and Egypt, only Kenya was found by the report to have improved in networked readiness over the years. Strong demand for mobile and internet services has characterized Kenya's technology market. This potential has to be tapped for providing an effective advisory service to the farmers of the country. The Government has already made right steps in the direction by creating digital villages called 'Pasha centres' to address the ICT disparities between urban and rural populations.

Human capacity constraints such as inexperienced users (among both farmers and extension personnel) and lack of technical support for implementing ICT projects should be overcome by planning appropriate training programmes.

5. *Agri-entrepreneurship Development*

Developing stakeholder capacities in agri-entrepreneurship could be a step in the right direction in a country like Kenya where the unemployment rate is as high as 40 %. About 750,000 youth enter the labour market annually. By creating training opportunities in agri-entrepreneurship, the youth of the country could be retained in agriculture as the average age of the Kenyan farmer is about 60 years. Imparting training in this area could transform the Kenyan youth from a job seeker to a job creator.

6. *Agribusiness, Value Addition of Agricultural Products and Marketing*

In Kenya, agro-processing has a tremendous potential for increasing income through value addition and increasing shelf life and access to food security through the establishment of small scale agro-processing enterprises and rural based industries.Opportunities to addvalue to

[40]See http://www.information.go.ke/?p=1829

agricultural produce are largely unexploited. The training priorities in this sector should focus on (Onyango & Nyaberi, 2016):

- Creating avenues for information dissemination and guidance in contract design, food product design, quality standards, good manufacturing practices, market development, funding options, land and building investments, legal and policy frameworks governing the agro-food processing sector, food processing and logistics, etc.;
- Conducting advocacy for and showcasing good industry practices;
- Facilitating R&D and technology transfer through capacity building and information dissemination;
- Enhancing training of and recognition of food science and technology experts

Though Kenya has the highest agricultural value added in the East African region, lack of knowledge and skills in operating machinery has been one of the major constraints. A few farmers in Central Kenya have found a lifeline in adding value to their harvested produce that is not only increasing the produce's shelf life but more than tripling earnings, at a time when over-production and a shrinking market have taken a toll on earnings. Developing the capacities of the stakeholders in this area, could go a long way in improving their standard of living.

7. International Agricultural Trade and Policy

Currently more than 90 percent ofKenyan produce is exported in raw or semi-processed form, leaving manyopportunities for income and employment generation underused.

Kenyan agricultural exports are considered less competitive in global markets.The smallholder agriculture that is predominant in Kenya will have to be transformed from subsistenceactivities, marked by low productivity and value addition, to ‘an innovative,commercially-oriented, internationally competitive and modern agriculturalsector’.

Therefore, there is need to build capacities in the farmer organizations on the WTO and similar international Agreements on Agriculture and their impacts on the farmer. Only then, these stakeholders should be able to participate in the negotiations of such agreements.

Improving capacity building of the stakeholders in this area , especially in market-driven product development and value addition and creating a quality brand ‘Kenya’, will also help the country to compete globally.

8.10. Food Processing Technologies and Management

Traditionally Kenyan farmers' obsession with certain crops has worked against them as evidenced in market oversupply. Farmers would produce the same crop at the same time, which would be harvested at the same time and taken to the same market, yielding low prices.Edible and other oils produced locally include butter, ghee and margarine as well as sunflower, rapeseed, cottonseed, sesame, coconut and corn oils, while a large quantity of palm oil is imported.'Vision 2030' of Kenya had identified food processing as the most important single sub-sector in terms of its contribution to GDP (28.7%) Both processed foods and basic food processing machinery are good contenders for that increased penetration. Capacity building of stakeholders on various aspects of processing starting from the time of production to reaching domestic and global markets will provide a fillip to this sector.

8.19 Advancement in Fisheries Technologies

The National Oceans and Fisheries Policy of 2008 had lamented that fisheries sector in Kenya lacks training institutions and sufficient numbers of suitably trained personnel. The Oceans and fisheries sector plays an important role in the Kenya's economy by providing food, employment and income to a largepopulation and earns the country Kshs 5 billion annually from the foreignexchange.

Training needs in this sector should focus on the need to improve feed formulations; formulate species- and life-stage specific diets; and improve the understanding of ingredient quality, nutrient composition and selection, manufacturing processes, storage, and on-farm feed management practices. Capacity building of stakeholders in this sector could help in overcoming the constraints in aquaculture development in the country.

8.20 Farm Mechanization for small Farmers

Promoting mechanization in agriculture means that more tasks can be completed at the right time, more efficiently and saving labour and energy.

Capacity building of small farmers across the countrywould enhance uptake of machines and tools, in farm activities. Training programmes have to be developed to cover the needs of farmers, operators, mechanics and other relevant stakeholders involved in the provision of agricultural machinery services in the country.

8.21 Modern Technology in Dairy and Poultry Management

Dairy and poultry production and management requires more specialized,knowledgeable and experienced investors, managers and dairy farm workers. Small-scale poultry rearing is common, mainly by women and children, but they face challenges such as frequent disease incidence.

Both sectors face the challenge of keeping up with the anticipated changes in production, as knowledge and skills are important for quick adoption of appropriate technology. Training programmes for these two sectors have to be evolved keeping in view the changing needs.

8.22 *Bee Keepingand Production of Mushrooms*

Bee keeping in Kenya has been practiced since time immemorial and the communities still use indigenous knowledge. Beekeeping contributes close to 4.3 billion Kenya Shillings annually and production is estimated at, 100,000 metric tons annually. Inadequate training for both farmers and extension staff is one of the major challenges in this enterprise. This can become an important enterprise in the livestock sub-sector if modern beekeeping technologies are adopted as there is a ready market for bee products , both locally and internationally.

Animal protein is beyond the reach of many low-incomegroups, which constitute a large proportion of Kenyans. Malnutrition in terms of protein deficiency is one of the major factors responsible for high mortality and morbidity in Kenya.

Capacity building in terms of spawns production, mushroom production, processing and value addition of mushrooms can help in reducing the malnutrition levels in the country.

8.23 *Other Basic Priorities*

Capacity building is a lengthy process, particularly where initial capacity is very weak. Kenya ranks 145th among 187 countries in the United Nations Development Programme's Human Development Index, which measures development in terms of life expectancy, educational attainment and standards of living and therefore, capacity building programmes planned for the country need to be a continuous, sustained process.

Therefore, besides the advanced areas of training mentioned above, the following training areas may also have to be incorporated in the scheme of things for effectiveness.

- Package of Practices for Food, Commercial and Horticultural crops
- Package of Practices for Livestock, Fisheries & Forestry

- Soil &Water Conservation and Management

Number of Participants

It is also important to consider the size of the group being trained. The optimal number of participants in a training session is 15-20 persons, to facilitate discussion and to hasten the learning process.

For each training programme to be conducted based on the aforementioned priorities,**twenty (20) officers** could be considered.

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