Progress in On-Farm Production and Productivity in the East African Community: 50 Years after Independence

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Abstract
This paper reviews progress made on productivity against a population that was 35 million in 1960 and rose to 142 million in 2011. During the 50 years since independence, the EAC countries moved from a food surplus to a food deficit region. It is evident that productivity has not kept pace with demands for consumption and export despite availability of modern technologies such as high yielding variety of crops and improved livestock germplasm. The region also missed the green revolution of 1970’s and is now crafting its own alliance for green revolution with other African countries. Production is carried out by small scale farmers (constituting 80%) whose numbers have increased but arable land size has declined. The predominance of shifting cultivation in the 1960’s has given way to intensive and continuous cropping. Heterogeneity of the environment permits mixed livestock-cropping to mono-cropping a highly rain fed dependent systems. Tree crops such as coffee, tea and cashew nut dominates export. In recent years, dairy and horticulture have sprung up as cash earners. The staples range from cereals (maize, rice, sorghum/millet, bananas) to potatoes and cassava. These energy sources are complemented by green legumes and livestock products namely meat and milk. In livestock production, ruminants and non-ruminants plays a major role in the livelihood of the poor. Introduction of high yielding livestock breeds have improved supply of milk, meat and other livestock products but productivity of both indigenous and exotic stocks is limited by shortage of feeds, poor adoption of improved technologies and inadequate access to quality veterinary services. The region is endowed with fresh water and marine (Kenya and Tanzania) fisheries. It is noted that aquaculture is a fast growing sub-sector with great potential but face limitations similar to those of livestock production. Indigenous poultry hitherto neglected has received increased investment. Agricultural productivity in general is hindered by paucity of inputs such as fertilizers, quality seeds, agronomic packages, extension interventions, environmental factors, particularly variable weather and climate change. Insufficient volumes of produce and products are a function of poor farmer organization, market access and infrastructural constrains and poor information flow. The jubilee period witnessed the emergence of new areas like agro forestry, genetically modified organisms (GMOs), modern biotechnology, organic, greenhouse including wildlife farming. As well, there increasing concern for sustainability whereby productivity to enhance environmental quality is the norm. There has been a decline in forest cover across the countries but agro forestry apart from fruit trees has reduced the pressure on demand for timber and wood fuel products. It is recommended that in the future, greater emphasis be placed on staples, food quality, and agribusiness and value addition. Actions should also be directed towards water use efficiency, water harvesting and irrigation in order to minimise dependence on rain fed agricultural production. Considering the large proportion of marginal and dry lands in EAC and their potential for productivity, these areas deserve more attention in the future. There is an urgent need to promote orphan crops and adoption of appropriate mechanization technologies. Programmes targeting youths in agriculture will be vital for sustained labour and skills in agriculture. In this regard the role of ICT in agricultural development should receive high priority.
About the authors

Shellemiah Okoth Keya is professor of Land Resources Management and Agricultural Technologies, University of Nairobi and Chancellor Dedan Kimathi University, Kenya. He holds distinguished awards from the African Academy of Sciences/Ciba-Geigy Gold Medal & Soka Gakkai Award of Highest Honor, consisting of Gold Medal; University of Nairobi Staff Merit Award for outstanding contribution towards the University’s Mission and nine other academic prizes. Principal investigator in various research projects embracing soil health/fertility with focus on Biological Nitrogen Fixation by legume rhizobia-symbiosis. Major research accomplishments include the development, production and promotion of legume inoculants in East and Southern Africa. He is a member of over ten scientific societies and academies and has consulted for FAO, UNEP, UNESCO, World Bank, AGRA and NGOs. Served on several national and international Boards such as Chair of Moi University, Senate and its Committees; Board Chair Kenya Forestry Research Institute (KEFRI) 1992-1996; Board of Directors, Kenya Agricultural Research Institute (KARI); African Centre for Technology Studies (ACTS). Was member of ICIPE Governing Council; Tribunal of Kenya Industrial Property Organization; UNESCO/UNEP/ICRO Microbiology Panel and participated either as Chair or Board Member of 35 different organizations. National and international appointments and responsibilities include Director of Microbiological Resource Center (MIRCEN) 1976–1978; Dean, Faculty of Agriculture, 1984–1988; Principal, College of Agriculture & Veterinary Sciences April-June 1988; Vice-Chancellor, Moi University, 1988-1994; Executive Secretary, Technical Advisory Committee, CGIAR/FAO, 2001-2003 and interim council CGIAR/FAO 1996-2000. Assistant Director General Research & Development and Advisor to the Director General-AfricaRice Center (WARDA) 2004-2007 and 2008- Jan 2009 respectively. These successive and progressive professional pursuits shaped his science and technology policy, research and science management at national and international levels. His inspiration is to make science work for the ordinary farmer in the fight against hunger and poverty.

Prof. Patrick Rubaihayo is an Emeritus Professor of Crop Science at Makerere University, Uganda, with expertise in plant breeding, genetics, plant tissue and cell culture, biosafety/biosecurity/bio-policy and genomics. He is widely travelled and has researched on a number of crops including: grain legumes, bananas, tomatoes, potatoes, maize, and sorghum. Professor Rubaihayo progressed through the ranks from Lecturer to Associate Professor in the Department of Crop Science, Makerere University between 1971 and 1976 and was appointed Professor in 1995. Between 1981 and 1985, he was a Member of the Ugandan Parliament and Minister of State for Agriculture and Forestry. Prof. Rubaihayo is a Fellow and Council member of Uganda National Academy of Sciences where he is chair of Research and Publication. He is credited with introducing modern Agric - biotechnology practices in Uganda. His tireless effort in service has earned him several scientific accolades from various institutions including but not limited to: Makerere University, African Crop Science Society, Bean/Cow Pea Collaborative Research Support Program of USAID, East African Biotechnology, Biosafety and Biopolicy Research Network, and the prestigious 2008 Doctor of science in Agriculture of the University of Helsinki. By the time he retired in 2006, Professor Rubaihayo's research involved banana production systems in Uganda; tissue and cell culture and molecular diversity in bananas; molecular diversity studies in sweet potatoes; indigenous and exotic palms in Uganda; variability in potato and cowpeas viruses in East Africa; and genes controlling cassava starch branching enzymes.
Prof. Rubaihayo is currently coordinating a PhD regional programme in plant breeding and biotechnology offered at Makerere University.

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1.0 Introduction

1.1 Introduction

Agriculture has been and is still the backbone of most Sub-Saharan Africa economies. The sector is dominated by small-holder farmers who occupy the majority of land and produce most of the crop and livestock products. In the EAC, agriculture is the main contributor to the GDP contributing about 35%, 28%, 32%, 23% and 28% in Burundi, Kenya, Rwanda, Uganda and Tanzania respectively (Table 1). The sector employs about 75% of the labour force in EAC states underscoring the importance of the sector in job creation and poverty reduction across the region.

There are tremendous efforts since independence towards attaining food sufficiency and security, through development and adoption of appropriate technologies particularly those that favour small-scale farmers. Since the late 1970’s to mid-1980, a number of EAC have implemented macro-economic, sectoral and institutional reforms. By becoming signatories to the MDGs charters, EAC member states had recommitted themselves to ensuring sustainable economic growth, food security and poverty reduction.

Increasing agricultural productivity boosts food security and rural incomes. However, the increase in food production has been insufficient to substantially reduce the number of undernourished people. The growth in cereal yields (1.3%) did not keep pace with population growth in Africa where population rose from 819 in 2000 to 965 million 2007; indicating a consistent deficit in food availability. For EAC, the population increased from 35 million in 1960 to 145 million in 2012 (Faostat, 2011). In response to increased food demand, production in the sub-region was raised by opening more land however, productivity per unit area has remained low. Cropland expansion has intensified competition with other land uses such as livestock keeping and conservation of natural resources.

Africa heavily dependent on rain fed agriculture that is susceptible to vagaries of nature; in particular, rainfall variability. As such production has remained low for the last four decades. Evidence available suggests that it is possible to increase cereal yields by a factor of five, under rain fed production system provided there are no growth limitations from nutrients, pests or diseases. In addition, cropping intensity can be increased by 50% under high input levels. To realize these potentials, constraints in agro ecological, economic and socio institutional domain should be addressed.

| Table 1: Economic profile and contribution of Agriculture to the economy, 2011 |
|---------------------------------|-----------------|--------------|-------------|-----------------|-----------------|
| Economic Indicator              | Burundi         | Kenya        | Rwanda      | Uganda          | Tanzania        | Average        |
| Population, total (million)     | 8.6             | 41.6         | 10.9        | 34.5            | 46.2            | 141.8*         |
| Population growth (annual %)    | 2.3             | 2.7          | 3.0         | 3.2             | 3.0             | 2.84           |
| GDP (USD billion)               | 23.3            | 33.6         | 63.8        | 16.8            | 23.9            | 32.28          |
| GDP growth (annual %)           | 4.2             | 4.4          | 8.3         | 6.7             | 6.4             | 6              |
| GDP per capita (current US$)    | 271.2           | 808.0        | 582.6       | 487.1           | 516.6           | 533.1          |
| Agricultural land (% of land area) | 86.4           | 48.2         | 77.8        | 70.4            | 42.1            | 46%            |
In comparison, Sub-Saharan Africa agricultural output has grown at a paltry 2.4% compared to a 2.8% in Latin America and 3.6% in Asia. Therefore, as per capita food production has fallen, Africa has turned from a food exporter to a net food importer. Projections into the future further show that this trend is set to persist past 2022 period. Recent developments in natural resource discoveries in most EAC for example oil in Uganda and Kenya, natural gas in East Coast of EAC and underground water reserve (Kenya) may alter this scenario. World Bank (2012) reports an average growth rate of 5.4% for EAC with a likelihood of shooting further. It therefore becomes imperative that an examination as to why the agronomic developments in the region have not yielded the expected results despite the availability of numerous technologies in offer within the EAC.

1.2 Objective of the paper

This paper was commissioned by KILIMO Trust as a precursor to celebrating the golden jubilee of African independence. The paper is intended to re-awaken the debate and create re-engineering of interests and priorities in and into the agricultural sector by identifying gaps and opportunities for increasing crop production and productivity whilst managing soil health and the greater environment. In particular, the paper tackles issues relating to: the historical perspective of African agriculture development, crop production and productivity, delves on factor productivity, agricultural mechanization, considers challenges facing agricultural production, and discusses the current and future of face of EAC agriculture.

1.3 Methodology

This paper is largely drawn from review of literature and personal experiences of the authors during their long period of service in various capacities at regional, sub-regional and international arena. As such, the authors have had exhaustive discussions, sharing cross-border knowledge and experiences and making inferences therefore that have led to this paper. In addition, this paper utilizes data from other relevant sources including the ministries of Agriculture, National statistical bureaus, CTA, African Development Bank, FAO and World Bank data bases and published literature.
2.0 Agricultural production and productivity in the EAC

The number of undernourished people in Africa has been relatively stable at about 210 million during the last decade. Increasing agricultural productivity can increase food availability and access as well as rural incomes. However, the increase in food production has been insufficient to substantially reduce the number of undernourished people. EAC is not unique to this food insecurity and undernourishment scenario. This chapter presents an articulation of underlying agricultural production and productivity, food security situation in the East African sub-region.

2.1 Crop production

The EAC’s staples are as diverse as its people and cultures. The major staples are: Bananas, maize, potatoes (sweat potatoes and ‘Irish-English’ potatoes), cassava, millet, sorghum, rice, wheat, and pulses (beans, peas and nuts) (Table 2). Fruits and vegetables complements the cereals. Livestock products also play an important role especially in dry areas. Much of EAC’s food production has remained a preserve of smallholder farmers (up to 75%) with a high female farm labour supply.

Table 2: Staples of East African Countries

<table>
<thead>
<tr>
<th>RANK</th>
<th>UGANDA</th>
<th>BURUNDI</th>
<th>TANZANIA</th>
<th>RWANDA</th>
<th>KENYA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bananas</td>
<td>Bananas</td>
<td>Maize</td>
<td>Bananas</td>
<td>Maize</td>
</tr>
<tr>
<td>2</td>
<td>Cassava</td>
<td>Cassava</td>
<td>Cassava</td>
<td>Pulses</td>
<td>Wheat</td>
</tr>
<tr>
<td>3</td>
<td>Millet</td>
<td>Potatoes</td>
<td>Rice</td>
<td>Potatoes</td>
<td>Rice</td>
</tr>
<tr>
<td>4</td>
<td>Potatoes</td>
<td>Pulses</td>
<td>Wheat</td>
<td>Rice</td>
<td>Sorghum</td>
</tr>
<tr>
<td>5</td>
<td>Sorghum</td>
<td>Fruits/Vegetables</td>
<td>Sorghum</td>
<td>Cassava</td>
<td>Millet</td>
</tr>
<tr>
<td>6</td>
<td>Pulses</td>
<td>Maize</td>
<td>Pulses</td>
<td>Fruits/Vegetables</td>
<td>Pulses</td>
</tr>
<tr>
<td>7</td>
<td>Fruits/Vegetables</td>
<td>Maize</td>
<td>Fruits/Vegetables</td>
<td>Fruits/Vegetables</td>
<td>Pulses</td>
</tr>
</tbody>
</table>

Source: Authors of the paper, 2013

Varied production and productivity trends and potentials have been observed in East Africa. Cereal yield per hectare has remained low and virtually unchanged in all EAC from 1980-2007 (Figure 1; Salami et al., 2010).

![Figure 1: Cereal production in EAC from 1961-2011 -source FAOSTAT 2013.](image-url)
The production trends in figure 1 are way below the global average which stood at 3.3 t/ha by 2007 (FAOSTAT, 2012). Yields of rice and maize are merely about one-half to one-third of what could be produced with proper application of fertilizers, irrigation and quality seeds. Simulated studies by Thornton et al., (2008) have shown that there will be varied production and yield levels for beans and maize in the future. Moore et al., (2011) revealed variation in productivity levels across the East African region. These variations are a product of East Africa’s heterogeneity of agro-ecosystems. For example, the equatorial circulations enables double cropping and single cropping at the northern and southern regions (Moore et al., 2011). The rich agro-ecosystems gives rise to a variety of staples some of which are discussed below.

2.1.1 Bananas

Banana production in the region is variable but is estimated at 4-6t/ha. Uganda has the highest per capita annual banana consumption in the world at 0.70 kg per person daily. Uganda is the second largest producer of bananas second to India with a 10% share of global production (FAOSTAT, 2006). However, Uganda that produces food, beer and sweet types of the crop is one of the smallest exporters of bananas. Uganda Bureau of Statistics (UBOS) estimated that the national production of bananas (food type) during 2008/2009 period was about 4 million Mt from a total land area of 807, 000 hectares. The national banana yield (food type) was estimated at 5.0 Mt/ha while that of the (beer type) was estimated at about 243, 000 Mt produced from 86,000 hectares of land and the yield estimated at 2.8 Mt/Ha. Uganda also raised 37,000 Mt of sweet type of bananas from an estimated 23,000 Ha of land. The national yield of the sweet banana is estimated at 1.6 Mt/Ha. Most of Uganda’s banana production occurs in found western (61%) and central (30%) regions. Production is however constrained by the prevalence of pests and diseases that have reduced potential yield by 80% (Katungi et al., 2007).

Kenya’s production is the lowest in the EAC bloc estimated at 1 million tones with a crop value of 7 billion Kenya shillings. Forty percent (40%) of this production is approximately lost due to poor harvesting and handling techniques, inadequate market and fungal diseases. Kenya has shown the highest banana production per hectare estimated at 25 tones (Mogeni, 2012). Most of Kenya’s banana is produced in Nyanza (56%) and central (26%) provinces (Wambugu, et al., 2009). Production is generally variable and what is produced falls short of meeting the demand (see Figure 2 and 3; Kinuya, 2008).

In Rwanda, banana is the second most important food staple; second to beans and, production is mainly a preserve of smallholder farmers. Banana production occupies 213, 000 ha of land approximately 23% of total arable land (Mpyisi et al., 2003). Rwanda produces an average of 2.65 million Mt of banana per annum. However, production has declined over the years by 13% annually attributed to war and the government policy aimed at reducing the crop’s dominance (Ferris et al., 2002). Between 1990 and 2001 all banana production declined by 69% (Donovan et al., 2002). Per capita banana production is estimated at 270 Kg per annum and this is insufficient to meet the demand. Consequently, Rwanda imports a considerable proportion of banana from Uganda and DR. Congo. The highest (60%) of banana produced in Rwanda is beer type banana because of its high market value as a beverage (Ferris, 2002).
In Burundi, banana production is estimated at 1.54 Mt valued at USD 230 million (FAOSTAT, 2008). Production is dominated by smallholders producing 85% of brewing bananas and 14% of cooking banana. The preference for brewing banana is mainly a dictate of socio-cultural facets (AATF, 2009). Compared to Rwanda and Burundi, banana in Tanzania is relatively higher. The cooking banana is the major focus (52%) of smallholders in Tanzania; followed by roasting (21%) and dessert bananas (20%) while brewing accounts for only 7 percent (AATF, 2009). A declining trend in banana has been observed in Tanzania and has been attributed to decline in soil fertility (Baijukya, 2004).
2.1.2 Maize

The significance of maize as a staple in East Africa has grown tremendously over the last 30 years. In Kenya, food security is synonymous with maize availability. Maize is a staple to over 90% of Kenya’s population with about 42% dietary energy intake. The production of maize in Kenya takes a central focus thus; it occupies more land area than any other crop; estimated at 1.6 million hectares annually. Of this, over 70% production is attributed to smallholder farmers. Maize production in Kenya is below the demand (Ketiem et al., 2008) with production declining over the last three years occasioned by erratic rainfall patterns (Owuor, 2010). On average monthly maize consumption is estimated at 3.5 million bags. Kenya has generally had a scarcity of maize in surplus production years. Often maize demand outstrips production (Table 2) leading to perpetual food insecurity both anticipated and actual depending on location. Despite picking up in the 1980s
and 1990s, Kenya’s maize production has stagnated. Kenya on average imports slightly over 3 million Kgs of Maize (Ministry of Agriculture, 2010). Further, on a regional basis, Kenya is a net recipient of maize produced by other EAC countries (Figure 5) besides Southern Sudan that imports maize from Uganda. Kenya’s maize production is affected by fluctuating weather conditions, insect pests that attack maize stalks and high input-costs; in particular, fertilizers (Export Processing Zones Authority, 2005). Aflotoxin spoilage maize grain is becoming a problem when the crop is harvested during wet season, phenomenon of variable weather.

![Maize Production and Market Flows in the GHA](image)

Figure 5: Maize production and maize flows in East Africa (Source: Ihle et al., 2011).

<table>
<thead>
<tr>
<th>Period</th>
<th>Production</th>
<th>Consumption</th>
<th>Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000/01</td>
<td>2,234,758</td>
<td>2,713,500</td>
<td>-478,742</td>
</tr>
<tr>
<td>2001/02</td>
<td>2,775,926</td>
<td>2,713,500</td>
<td>62,426</td>
</tr>
<tr>
<td>2002/03</td>
<td>2,408,596</td>
<td>2,713,500</td>
<td>-304,904</td>
</tr>
<tr>
<td>2003/04</td>
<td>2,710,848</td>
<td>2,802,150</td>
<td>-91,302</td>
</tr>
<tr>
<td>2004/05</td>
<td>2,678,425</td>
<td>2,890,800</td>
<td>-212,375</td>
</tr>
<tr>
<td>2005/06</td>
<td>2,935,193</td>
<td>2,979,450</td>
<td>-44,257</td>
</tr>
<tr>
<td>2006/07</td>
<td>3,153,931</td>
<td>2,979,450</td>
<td>174,481</td>
</tr>
<tr>
<td>2007/08</td>
<td>2,879,712</td>
<td>2,979,450</td>
<td>-99,738</td>
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<tr>
<td>2008/09</td>
<td>2,429,757</td>
<td>2,979,450</td>
<td>-549,693</td>
</tr>
<tr>
<td>2009/10</td>
<td>1,800,000</td>
<td>2,979,450</td>
<td>-1,179,450</td>
</tr>
</tbody>
</table>
In Uganda, maize production is growing in importance as well as consumption. This is attributed to rising urbanization, a change in consumption patterns and the agility of smallholders to diversify into maize production as a commercial crop. During the 2008/2009 Census of Agriculture conducted by Uganda Bureau of Statistics (UBOS) the national maize production was estimated at 2.4 million Mt produced from about 1 million hectares. The national yield of maize is however very low estimated at 2.3 Mt/ha. There were 2.9 million plots of land devoted to maize production with 1.4 million (47.1%) of these being in pure stands. Farmer mean plot size is equally small estimated at 0.35 of a hectare. The adoption of maize as a major commercial crop has been rapid in eastern Uganda in the districts of Kapchorwa, Mbale and Iganga as well as western districts of Masindi and Kasese where on average smallholders’ 75-95% household production is marketed.

Maize is also a growing export commodity for Uganda within the sub-region (Kenya, Sudan, Rwanda, Burundi, Zambia and DR. Congo) with Kenya being the largest Uganda’s maize export destination. Consequently, in 2008 alone, maize generated up to USD 18.5 million in export earnings from the sale of an estimated 66,700 tones (AATF and NARO, 2010). However, like all other EAC member states, maize production in Uganda is generally low attributable to limited use of agricultural inputs. Farmers’ inputs have barely changed in the century; with the only inputs being family labour and home saved seeds (USAID, 2010). Consequently maize production in Uganda is characterized by high unit costs and low returns.

Tanzania’s maize production has been on a progressive gain since 2005. However this production is gaining at the same time when consumption is also growing. Maize production and consumption in Tanzania is in a delicate balance (Figure 6). Consequently, the surplus margin is too small to create room for export. Maize is perhaps the most widely grown crop in Tanzania, grown by 4.5 million agricultural households representing about 82% of farm households. On average, maize production is estimated at 3-4 metric tonnes. Nearly all (98%) of the maize produced in Tanzania comes from smallholder farmers (Minot, 2010).

Figure 6: Maize production and consumption trends in Tanzania (Source: Authors illustration. Data obtained from USDA, 2011).
In Rwanda maize production has catapulted from 48% to 89% in the last 5 years (2004-2008), accounting for improved food production and security. However maize production in Rwanda is constrained by lack of seeds, limited land area and disease (USAID, 2009). Burundi on the other hand is the lowest maize producer (119,360 MT) among the EAC member states. It is noted that Burundian households spends about (67%) on purchasing maize products in market (USAID, 2012).

2.1.3 Pulses

Uganda’s bean production was estimated at 660 tons between 2004 and 2006, (Akibode, 2011). Of this, approximately 80% is consumed locally with the minimal exports mainly to Kenya (UEPB, 2005). In a 2008/09 census of agriculture, it was established that Uganda’s bean production had increased to 929,000 Mt from an estimated area of 618,000 hectares. This put the national yield at 1.5 Mt/ha. On average, there are 2.3 million land plots under bean cultivation with 35.3% of these operated as pure stand (UBOS, 2009). Bean production face a number of constraints such as : high costs of improved seed, pest and disease prevalence, environmental degradation, inefficient agronomic practices, high post-harvest losses, lack of a pricing structure, low input utilization, as well as poor to lack of extension services.

Uganda leads in bean production followed by Tanzania and Kenya but the latter devotes more land (Katungi et al., 2009). With respect to French beans, Kenya produces more than Uganda and Tanzania (SNV, 2012). Common bean consumption in Kenya has grown by 19% per annum against production growth of 3% thus creating a deficit of 16 percent (Table ).These deficits are met by imports from Uganda, Tanzania and Central Africa (USAID, 2010b). The major constraints to bean production in Kenya include: climate variability and high post-harvest losses.

| Table 4: Kenya Beans production trend, 2003 – 2008 |
|--------|--------|--------|--------|--------|--------|--------|
| Year   | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   |
| Area(Ha) | 879,032 | 872,070 | 1,034,477 | 993,391 | 846,327 | 641,936 |
| Prod(90kg bag) | 4,763,928 | 2,576,020 | 4,175,772 | 5,908,887 | 4,775,512 | 2,944,217 |
| Consumption estimates (90 kg bags) | 4,611,000 | 3,444,400 | 4,449,450 | 5,111,100 | 5,826,700 | 6,626,400 |

Source: Economic Review of Agriculture 2008

In Tanzania bean yield is estimated at about 500 Kg/ha. The total annual production stands at 4,000 MT (USAID, 2010c). Constrains in production is similar as in other EAC countries. Bean is important in Rwanda in terms of income and food security and grown by approximately 97% of smallholder farmers. FAOSTAT shows that bean production is on an upward trend approaching the 500,000 MT by 2012 (Figure 7).The increase is attributed mainly to production area expansion and yet, this increase does not meet demand. It is commendable to note that Rwanda stepped up her bean production after the 1994 collapse. Unlike Rwanda, Burundi’s bean production is declining while land area is growing exponentially (Figure 8). By 2012, Burundi’s bean production (205944 MT) was lower than that of 40 years back; 1971 (284831 MT). This portrays a collapse in bean production in Burundi. Smallholder farmers in Burundi are constrained by severe shortage
of arable land, food and nutrition insecurity, lack of appropriate landraces, poor agronomic practices and shortage of strong woody stakes (Mcharo et al., 2011).

Figure 7: Bean production trend in Rwanda (1971-2012) Source: FAOSTAT (2013).

Figure 8: Bean production trend in Burundi (1971-2012). Source: FAOSTAT (2013)

5.1.4 Wheat

Kenya has a long history of wheat production in East Africa. Kenya’s wheat production is variable as prompted by weather patterns. For example, sharp drops witnessed in 1984, 1992/1993, 1999/2000 and 2008/2009 coincided with droughts events. At present Kenya’s wheat production is above the 300,000 MT (Figure 9). However, Kenya is able to meet only 40% of her national wheat demand through direct production (Gitau et al., 2012). Tanzania comes second in total wheat production in the EAC however her wheat production is below the 100,000 MT level (Figure 9). All the other three remaining countries; Rwanda, Burundi and Uganda post negligible wheat production levels. Rwanda on the other hand is showing some positive gains in wheat production.

Figure 9: Wheat Production trends in East Africa. Source: FAOSTAT (2013)

2.1.5 Cassava
Cassava production in Uganda has been growing since independence punctuated with periods of declines. The declines observed between 1978-1980/81 and 1992-1996 could be attributed to civil unrest and cassava mosaic virus respectively. Uganda cassava production is estimated at 3.3 Mt from 871,000 hectares (UBOS, 2009), while, Tanzania’s production (1980-1995) was slightly above 5.5 MT. Rwanda, Burundi and Kenya show a dismal cassava production compared to Uganda and Tanzania. It is however important to note that production in the three countries is showing a progressive gain (Figure 10).

![Figure 10: Cassava production in East Africa. Source: FAOSTAT 2013](image)

### 2.1.6 Rice

In Tanzania rice is the second most important food and commercial crop after maize. The country is also the leading rice producer in EAC since 1962. On average, rice is produced in 681,000 hectares of cultivated land representing about 18% of Tanzania’s total cultivated land area. Most Tanzania’s rice is produced under rain fed conditions with irrigated land producing 29 percent. The average yield per hectare ranges between 1-1.5 tons (Rural Livelihood Development Company, 2009). Rice production in Uganda, Kenya, Rwanda and Burundi is marginal (<5000 MT) per annum. Kenya is only able to meet 20% of the demand, producing about 90 MT but consuming about 300 MT. It should be pointed out that Kenya has the potential of putting 540,000 hectares of land into paddy rice and approximately 1 million hectares into upland rice (Gitau et al., 2001).

Uganda’s rice production has shown some improvement in the last 20 years. Per capita consumption for rice in Uganda is estimated at 8 Kg; the total national rice consumption is estimated at 240,000 MT while the production is estimated at 164,000 MT (UBOS, 2009). Uganda imports up to 60,000 MT to cover the deficits in production (MAAIF, 2009). Meanwhile, in Rwanda, rice production is becoming a significant component of the agricultural sector. By 2007, rice production was estimated to have increased up to 55,000 tons arising from an increase in cultivated area of 3,459 hectares in 2000 to 12,000 hectares in 2009 (IFAD, 2009). Rice production in Burundi is similarly inadequate to meet the country’s consumption demand. The
country imports rice from her neighbors although 90% of rice imports come from Asia (Pakistan and Vietnam) (USAID, 2010d).

Figure 11: Rice production in East Africa. Source: FAOSTAT (2013)

Plate 1a: A rice paddy in Rwanda. Source: Presentation conducted by Ouma on healf of Bavugamenshi Jonas (2008)

Plate 1b: Upland rice in Rwanda

5.1.7 Tea and Coffee

Coffee is an important foreign exchange earner in EAC. Both smallholders and large estates produce coffee. About 75% of the acres in coffee are cultivated by small growers, who account for over half the total regional production. Uganda is the highest coffee producer in the region followed by Kenya and Tanzania. However, there have been major fluctuations in the coffee production in all countries in the region (figure 12 below).
In Uganda, coffee is the top-earning export crop. Uganda Coffee Development Authority (UCDA) estimates that there are over 500,000 households who depend on coffee and the total annual coffee production is made up of 15 percent arabica and 85 percent robusta. In Kenya, since independence up to late 1980s', coffee was a major foreign exchange earner. The area under coffee as well its production increased significantly during this period. Coffee production increased from 30,000 tonnes in 1961 to 125,000 tonnes in 1988. The production however suffered a steady downward trend after 1990 with smallholder farms being worst hit despite accounting for the bulk of coffee production. Since 2001 production has stagnated below 60,000 tonnes. Just like Kenya and Uganda, coffee production in Tanzania is a significant aspect of its economy. It is Tanzania's largest export crop. Tanzanian coffee production averages between 30-40,000 metric tons each year of which approximately 70 percent is Arabica and 30 percent is Robusta. The main growing regions of Arabica are in North Kilimanjaro, Mbeya, Matengo Highlands, Mbinga, Usambara Mountains, Iringa, Morogoro, Kigoma and Ngara. The main growing region of Robusta is the Bukoba area of the Kagera Region. Coffee production in Rwanda, Burundi and Tanzania have stagnated below 50,000 tonnes/ha.

Varied reasons can explain the trend in coffee production in EAC. During the period after independence up to 1980s, the governments pursued an export-oriented growth strategy that included incentives for private industrial investment. The economy was much under government control and prices were guaranteed which gave farmers the incentive to produce. The coffee and tea industries boomed and the government especially Kenya and Uganda, made large investment in infrastructure. However, the period after 1990 had various policy influences that negatively affected production. The fluctuating international market prices and policy changes affected marketing and production leading to low payment to farmers. This created disincentives for production such that farmers neglected their coffee farms. Coffee trees were left bushy,
unpruned, unweeded and diseased (Nyangito, 2001). This factors coupled with lack of access to credit; low coffee payments due to high processing costs in the cooperatives and high marketing costs, inadequate extension services to coffee farmers and lack of resources by extension staff for effective dissemination of the technical information on coffee farming; inadequate yield-enhancing technologies in coffee production; and legal and regulatory constraints demoralized farmers from producing coffee.

5.1.7.1 Tea Production

Tea is a major source of employment, income and foreign exchange. It is normally grown in areas between 1500 and 2700 meters above sea level, and this condition confines its production to cool highlands.

![Figure 13: Tea production](image)

Kenya is the highest producer of tea in the region. Kenyan small-scale farmers account for 60 percent of the total tea produced. There are about 420,000 small scale farmers in the country. Smallholder tea production is under the management of Kenya Tea Development Agency (KTDA). KTDA is involved in the provision of extension services and inputs to farmers, collecting green leaf, processing, and marketing of made tea. Regardless of the seasonal fluctuations in both production and acreage, the tea sub sector has generally experienced a remarkable growth since Kenya gained her independence. For instance, the total production rose from a mere 1.7 per cent of the total tea production in 1963 to 61.6 percent in 2001. According to the Ministry of Agriculture, the sub sector exports have remarkably grown since the year 2007. Exports to Russia grew by 44% from 12.1 million kgs in 2007 to 17.4 million kgs in 2011, exports to United Arab Emirates grew by 64% from 13.7 million kgs to 22.6 million kgs while exports to China grew by 68% from 1.2 million kgs in 2007 to 2.1 million kgs. Kenya tea exports to Iran increased about five times from 1.1 million kgs in 2007 to 5.4 million kgs in 2011. Similarly, domestic consumption has
grown from 17 million kgs in 2007 to 20 million kgs in 2011 (Tea Board of Kenya, 2012). The remarkable growth in tea industry is attributable to a number of factors including: favorable land and investment policies, institutional support, attractive world market prices and the land redistribution policy adopted by the government at independence and completed in the mid 1970s where large scale settler farmers were bought out by the government. The land was sub-divided and given to the smallholder farmers. In addition the abolition of the policy that previously restricted the Africans from growing cash crops led to the expansion of the area under smallholder tea. Favorable investment policy for estates particularly the non-interference in production, processing and marketing encouraged tea growing by the large-scale farmers (Gitau, 2004). There have also been a number of policy reforms in the tea sub-sector which includes: deregulation of markets and prices to encourage the private sector to play a more important role in production, processing and marketing of agricultural commodities.
3.0 Livestock production

The East African Community has enormous animal resources that contribute substantially to the economies of the partner states. The regional livestock resource base is estimated to consist of 50.2 million head of cattle, 59.6 million goats, 25.3 million sheep, 6.3 million pigs, 109.8 million poultry and 0.9 million camels. On average the livestock sector causes 9% (Burundi) 8% (Uganda) 9% (Kenya) 10% (Rwanda) and 8% (Tanzania) to the GDP of the region. On the other hand, the fisheries sub-sector contributes about 4% of the overall regional GDP in the entire region. The donation of the livestock sector to the economy has been described in the subsequent sub-sections.

Table 5: Average population sizes of various livestock species in EAC in Millions (1962-2011)

<table>
<thead>
<tr>
<th></th>
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</thead>
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</tr>
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<td>0.61</td>
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<td>0.81</td>
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<tr>
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<td>0.26</td>
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<td>3.49</td>
<td>3.55</td>
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</tr>
</tbody>
</table>

*Source of data: FAOSTAT 2012 *Camel population is mainly in Karamoja sub-region
3.1 Dairy production

Uganda’s milk production is estimated at 1 million MT per year with small holders accounting for 90 percent. The milk is mainly obtained from indigenous cattle that are part of 6.3 million national stock. Exotic breeds form only 5% of the total herd. Similarly, in Rwanda, smallholder milk producers who own 95% of the cattle that accounts for about 56,000 tons of milk. This only satisfies 17% of the demand (MINAGRI, 2002). In Tanzania, there are approximately 17.5 million and 435,000 traditional and commercial dairy cattle respectively. The dairy animals produce 600 million and 400 million litres of milk per year respectively. Over the last two decades, total milk production has increased at the rate of about 2.8% per annum largely due to increases in cattle population rather than increases in productivity.

The maximum and minimum milk production levels for indigenous breeds in EAC region is 329 and 984 kg respectively with a productivity gap of 655 kg. However, the production varies from country to country. For instance, milk production from indigenous cattle was reported to range from 150 to 250 kg per year in Kenya to an average 200 kg in Tanzania (Ministry of Agriculture, 2007). Crossbreed cattle yield slightly higher than exotic breeds. For instance; lactation milk yield in crossbreds range from 900 to 1300kg in Kenya and 567 kg in Tanzania. The differences recorded were probably due to variations in genotype constitution and environmental conditions including management. Compared to other regions like the West Africa, the dairy sub-sector in EAC has the potential to increase by 60 percent. However to attain this phenomenal increase, a number of constrains identified below need to be addressed (Table 6).

| Tanzania                  | • Limited capacity of private sector to deliver veterinary services.  
|                          | • Poor quality control on veterinary drugs supplies chain.  
|                          | • Inaccessibility of Artificial Insemination (AI) service mostly due to costs.  
|                          | • Initial investment cost of high-grade animals is prohibitive e.g. On average, importation of one high grade animals costs TSh 5,000,000 (USD 5,000). |
| Kenya                    | • Poor quality of feeds and feeding regimes;  
|                          | • Seasonal fluctuations in forage availability;  
|                          | • Inadequate access to AI services  
|                          | • Inadequate enforcement of regulations on livestock movement;  
|                          | • Inadequate and high cost of animal health care;  
|                          | • Poor rural infrastructure;  
|                          | • Inefficient livestock products value chains  
|                          | • Inadequate access to markets |
| Rwanda and Burundi        | • Inadequate land  
|                          | • Limited livestock production feeds and poor genetic resources. 
| Uganda                   | • Poor livestock information resulting to low smallholder productivity.  
|                          | • Insecurity and long period of civil unrest.  
|                          | • Constrains in capital financing.  
|                          | • Low capacity in provision of livestock production services e.g. AI and healthcare  
|                          | • Limited feed quality and feeding regime |
3.2. Beef production

Beef production in East Africa takes prominence in arid and semi-arid (ASALs) environments where crop production is risky due to unfavourable climatic conditions. These areas are inhabited by pastoral and agro-pastoral communities whose livelihoods depend on livestock. There is minimal information on evaluation of beef value chain. A study by FAO reports limited adoption of exotic breeds for beef production in the region. While the targeted off-take rates in commercial farms are normally 20%, pastoralist livestock off-take is dictated by need.

There is a gap in the commercial off take rate of 74 % in the indigenous breeds in the agro-pastoral and pastoral regions of East Africa (Figure 12). The productivity index gap for indigenous and exotic cattle in commercial farms in arid and semi-arid lands is 16.3 and 19.5% respectively while that for indigenous pastoral production is 40.4 %.

![Figure 14: Percent magnitude of yield gaps for different genotypes of beef cattle for commercial off take rate and productivity index/cow/year (Kg) in East Africa, (Adopted from Mwacharo et al, 2010)](image-url)
Figure 15: Total number of cattle by district (MAAIF-UBOS, 2009)

Figure 16: Total number of goats by district (Source: MAAIF-UBOS, 2009)

Figure 17: Total number of sheep by district (Source: MAAIF-UBOS, 2009)

Figure 18: Total pig population by district (Source: MAAIF-UBOS, 2009)
3.3 Dual purpose livestock

3.3.1 CAMELS
Kenya has the highest camel population (900,000) followed by Uganda (328,700). Tanzania, Rwanda and Burundi have no reported camel population. Camels are valuable species of livestock in the ASAL of Kenya and their population is on the rise (figure 18). The ASALs of Northern Kenya accounts for 95 percent of the herd. Camel meat production is estimated at 8,000 MT annually most of which is exported. However, most of the milk produced is consumed locally at production points, because of limited market outlets.

![Figure 19: Trends in camel population in Kenya (FAOSTAT)](image)

3.4 Small-ruminants

Small ruminants contribute largely to the livelihoods of the low- and medium input livestock-keeping farmers, many of whom have few resources beyond their smallholdings and livestock (Kosgey, 2004). In the East African region, Kenya is the leading producer of both goats and sheep. Kenya contributes about 37 percent of goat stock in the region, followed by Tanzania and Uganda at 19 percent; Rwanda and Burundi at 4 and 3 percent respectively. Since 1962, the subsector has had an increasing production trends in Kenya, Uganda and Tanzania, while Rwanda and Burundi have exhibited a relatively low constant trend (figure 25). Similarly, Kenya is the leading producer of sheep, with more than 55 percent of the sheep stock. It is followed by Tanzania at 29 percent and Uganda at 9 percent. In total, Burundi and Rwanda own 4 percent of the sheep stock in East Africa region. Most of the countries, with the exception of Kenya, have experienced a relatively low constant sheep production trend over the four decades (figure 26).
The current goat milk production is estimated at 14 litres which is far below the full production potential (Mwacharo et al., 2010). Figure 27 below shows a lactation milk yields productivity gap of 3.6% in crossbreds 360% in exotic breeds and 392% in indigenous breeds.
3.5 Rabbit farming

Rabbit production is one of the fastest growing livestock enterprises in the region. Peri-urban farmers also prefer to rear rabbits as opposed to chicken because rabbits are noiseless therefore cannot be a nuisance to the neighbors (Omole, 1998). Rwanda has the highest rabbit population in EAC with over 790,000 rabbits and annual increases at 7.8 percent annually (MINAGRI, 2010). In Kenya, it is estimated that there are about 600,000 rabbits with the highest population in Central and Rift Valley. For Uganda a rabbit population of 370,000, the market for the rabbits has not been fully exploited as rabbit meat consumption is not a traditional practice in the country. A study by Luzobe (1997) reported that, only 35.5 percent of Ugandans have ever consumed rabbit meat. Therefore, rabbit rearing remains uncompetitive and unprofitable in the country.

3.6 Poultry farming

The International Food Policy Research Institute (IFPRI) estimates that by the year 2015 poultry will account for 40% of all animal proteins consumed worldwide. The genetic potential of the Sub Saharan Africa indigenous poultry populations are yet to be attained. The low productivity per bird under scavenging systems is attributable to several factors, the most important being inadequate management, lack of supplementary feed and diseases such as Newcastle (Permin and Bisgaard, 1999). However, Roberts and Gunaratne (1992) and Tadele and Ogle (1996) attribute the low productivity to poor scavenging feed resource base. Although backyard scavenging systems suffer several constraints, productivity of most genotypes is feasible and low-cost technologies are required to improve productivity. Large-scale commercial and small-scale backyard poultry production exist side by side in most countries of Sub Saharan Africa.
Table 7: Poultry production by agro-ecological zones under different production system

<table>
<thead>
<tr>
<th>Region</th>
<th>Eco-zone</th>
<th>Enterprise</th>
<th>Genotype</th>
<th>Annual Egg Production</th>
<th>Egg Size (grams)</th>
<th>Pullet weight at maturity (grams)</th>
<th>Cockrell weight at maturity (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Min</td>
<td>Mean</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
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<td>Arid/Semi-arid</td>
<td>Backyard</td>
<td>Indigenous</td>
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<td>62.40</td>
<td>70.00</td>
<td>40.60</td>
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<td>Indigenous</td>
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<td>Backyard</td>
<td>Indigenous</td>
<td>30.00</td>
<td>58.41</td>
<td>150.00</td>
<td>32.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exotic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>32.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial</td>
<td>Exotic</td>
<td>250.00</td>
<td>266.67</td>
<td>300.00</td>
<td>44.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crossbreds</td>
<td>80.00</td>
<td>120.00</td>
<td>160.00</td>
<td>44.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Indigenous</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>37.00</td>
</tr>
<tr>
<td></td>
<td>Institutional</td>
<td>Exotic</td>
<td>197.40</td>
<td>197.40</td>
<td>197.40</td>
<td>27.50</td>
<td>40.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indigenous</td>
<td>34.00</td>
<td>112.12</td>
<td>175.50</td>
<td>9.40</td>
<td>28.94</td>
</tr>
</tbody>
</table>

Source: Adapted from Mwacharo et al., 2010
Figure 23: Egg production across ecological zones (Mwacharo et al 2010)

Figure 24: Egg weight in different ecological zones (Mwacharo et al 2010)

Figure 25: Total number of chickens by district

Figure 26: Total number of exotic broilers
3.7 Aquaculture

On average, the fish industry contributes an average of (2.6, 0.8, 1.3, 1.0, and 3.0) % to the economy of Uganda, Kenya, Tanzania, Burundi and Rwanda respectively. It employs about, 12000000, 500000, 700000 and 35,000 in Uganda, Kenya, Tanzania and Rwanda respectively (Harmele et al., 2010, NISR 2007, Porter, 2010, FAO 2009, Burundi invest, 2013, Keizire 2006, MAFF, 2012). Fish products provide ready and affordable animal protein; for example in Tanzania, fish and products constitute about 27% of animal food protein consumed.

Lake Victoria (68,800 km²) is the most important fishery, followed by Lake Tanganyika in the EAC (LVEMP, 2005). Rwanda fishing is based on Lake Kivu and Kagera river basin (MAFF, 2012). Tanzania is endowed with major lakes namely Victoria, Tanganyika and Nyasa, and minor lakes such as Rukwa, Babati and Manyara all contributing a total water area of 276,920 km². Uganda’s has about 20% of the total land area covered by water, with five major lakes—Victoria, Albert, Edward, George, and Kyoga—providing the bulk of the national fish. Lake Victoria provides about 90% of the total fish catch in Kenya. Only Tanzania and Kenya have marine fisheries.

In EAC, most of the fishing is artisanal. Nile perch (Lates niloticus) and Nile Tilapia (Oreochromis niloticus L.) are the main fish species of high commercial value in Uganda, Kenya and Tanzania. Fish is mainly processed into fillets for export market (Nyapendi, 2009). In Rwanda, however, Isambaza (freshwater herring similar to the size of anchovy (Limnothrissamiodon) is the main commercial fish (MAAF, 2012). Other fish species caught in East Africa includes the snappers, Scombrids, mackerels, Nile perch from Lake Victoria, sardines from Lake Tanganyika (Stolothrissatanganicae and Limnothrissamiodon), Nile tilapia (Oreochromis spp.) and pelagic sardines (Rastrineobolaargentea). Uganda has the highest fisheries production considering the large water resources it enjoys (Figure 23). Most of the countries experienced their peak fish productivity between 1985 and 1997. Uganda however has seen a rapid increase in landings from 2003 to 2007. Besides the fresh water fisheries, Kenya and Tanzania profit from marine fisheries (Figure 27).

Figure 27: Marine catch in Tanzania and Kenya (FAOSTAT 2013)
East Africa fisheries are faced with various challenges including; unsustainable fishing practices, environmental degradation, shift to uncontrolled mechanized fishing and fish smuggling (Mkumbo, 2000, Hammerle et al 2010). Water hyacinth (plate 3) in Lake Victoria affected fisheries through reduced levels of production, a reduction in species diversity, poor quality fish, rising cost of operation resulting in lower income to fishers and higher prices to consumers (LVEMP 1995, Twongo, 1993).

![Plate 3: Water hyacinths in Lake Victoria](image)

There is increased interest in aquaculture in almost all the EA block, with various projects targeting small-scale fish farming for example PAIGELAC Program in Rwanda has improved Tilapia stocks. Kenya has also expansive small-scale fish farming particularly targeting youth (MOALF 2009). Despite this efforts, the industry is still faced with various challenges that needs to be integrated in the expansion agenda for the sector to be sustainable. Potential opportunities exist in fisheries, fish value chain players, fish feed production which accounts for (40-50%), of the variable cost (Bimosa, 2007), and by-products processing (which is 60% of the whole fish). Ornamental fish farming is another promising area in aquaculture.

### 3.8 Wildlife farming

Wildlife farming is relatively a new feature in EAC as wildlife was purely for tourism purposes. In Kenya, after the Wildlife amendment bill (Act Cap.376, 2011) allowing trade, research and farming on some selected animals known as emerging livestock/non-conventional livestock including but not limited to: Crocodile, Butterfly, plants (Aloe, *Osyrislanceolata* - East African Sandalwood) and birds (Ostrich, Vulturine, Guineafowl, Quelea).

Similarly Uganda made amendment to her wildlife act (Moyini and Masiga, 2010) recognizing and allowing wildlife trade and especially export of wildlife farming products. The amended act now allows farming of specific wildlife animals (consisting of the trade in birds, amphibians and reptiles). Trade in wildlife on average earns Uganda about US $3 million per annum. Meanwhile in Tanzania, Rwanda and Burundi, wildlife farming and trade is not a well-established practice despite their wealth in wildlife resources (Roe et al., 2002, ROR, 2011). Currently, Rwanda is in the process of developing regulations to govern the trade. Of great concern is the illegal wildlife trade which threatens the sustainability of the emerging subsector despite existence of International
Trade in Endangered Species of Wild Fauna and Flora (CITES) which controls trade in wildlife and wildlife products. All the East Africa countries acknowledge the importance of illegal trade in wildlife products on both economic and sustainability aspect of the subsector.
4.0 Natural Resources

4.1 Soil health

4.1.1 Soil and water management

In East Africa soil and water conservation (SWC) practices have changed over time. During pre-colonial era, (before 1900) land was managed by chiefs. However, these institutions were then weakened during colonial period (late 1800’s to 1961). Post-Independence (1961–67) saw a reduction of enforcement of SWC. In Tanzania, Uganda and Kenya for example, the political movement associated SWC with colonialism thus a lackadaisical enforcement (Tiffen et al., 1994, Oostendo and Zaal, 2011, Boyd et al., 2001). In the 1990s sustainable agriculture gained grounds because of the realization of the interconnectivity between conservation of natural resources and agricultural production, in fact Arkel, (2007) alludes that agriculture and environment are inseparable. Maintaining soil health (biological, chemical and physical health) is key to sustainable soil productivity in all eco-systems.

4.1.2 Soil fertility management

In many parts of Sub-Saharan Africa, to maintain soil health, farmers practiced shifting cultivation (Nye and Greenland 1960), using leguminous trees and grasses to rejuvenate the land. Smaling et al., (1997) reported high nutrient depletion rates in East African countries and that Kenya had very high depletion rates (>40, 6.6 and >33.2) kg ha⁻¹ yr⁻¹ for N, P and K respectively. Regionally, East Africa leads in nutrient depletion followed by coastal West Africa then southern Africa, with least depletion in Sahelian Belt and Central Africa. There has been a steady increase in fertilizer use since 1970 and not surprising Kenya showing huge consumption relative to other East African countries (figure 28) but lower than the global average (Sheahan 2011).

Figure 28: Fertilizer consumption trends (FAOSTAT 2013)
4.2 Water, irrigation and water conservation

East Africa has considerable land area classified as arid and semi-arid (ASALs), 83%, 40%, 51%, 20% and 5% for Kenya, Uganda, Tanzania, Rwanda and Burundi respectively (Kigomo, 2003). The degradation of ASALs is rapid and climate change and desertification are additional constrains.

Table 7: Soil and terrain suitability for surface irrigation by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Soil suitable for irrigation</th>
<th>Soil suitable for irrigation of upland crops</th>
<th>Total area of soils suitable for surface irrigation</th>
<th>% total area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burundi</td>
<td>2,783,400.00</td>
<td>302,100.00</td>
<td>286,700.00</td>
<td>21</td>
</tr>
<tr>
<td>Rwanda</td>
<td>2,634,000.00</td>
<td>226,600.00</td>
<td>80,300.00</td>
<td>11</td>
</tr>
<tr>
<td>Kenya</td>
<td>58,037,000.00</td>
<td>11,405,600.00</td>
<td>5,979,100.00</td>
<td>30</td>
</tr>
<tr>
<td>Uganda</td>
<td>23,588,000.00</td>
<td>7,652,000.00</td>
<td>237,000.00</td>
<td>33</td>
</tr>
<tr>
<td>Tanzania</td>
<td>94,509,000.00</td>
<td>23,344,700.00</td>
<td>908,700.00</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>181,551,400.00</td>
<td>42,931,000.00</td>
<td>7,491,800.00</td>
<td>24.2</td>
</tr>
</tbody>
</table>


Irrigation in EAC, is generally minimal, however in Burundi and Rwanda the potential is estimated at 105,000 ha and 600,000 ha respectively (FAO, 1997, Malesu et al, 2010). Meanwhile in Tanzania and Uganda the potential is estimated at 30,000 ha and 202,000 ha respectively. However, actual irrigated areas within the EA block is still low (Table 7). Tanzania estimates that she will require about 405,000 ha of irrigated paddy to achieve food sufficiency (GoT, 2008), Heinrich, 2011. Droogers et al, (2011) estimates that the large swamps in Uganda covering about 700,000 ha is also potential areas however this may require major works. Kenya irrigation potential is estimated at 497,400 hectares (GoK, 2009). Evidence available shows that dry lands areas can be productive given water and appropriate input. In box 1 is an illustration of gains made by one farmer in Yatta, Kenya who introduced 1 acre rule.
**BOX 1: Soil and water conservation in Yatta, Kenya**

Yatta district in Eastern (Kitui County) is one of the driest ASAL areas in Kenya with an annual rainfall of 400ml. However, an NGO has come up with 1 acre rule where half of the land is used for high value crops like Onions and other vegetables; the other half is use for the common crops maize and or beans. The group ensures that each member has a small dam constructed through collective action. The small surface dam is capable of storing water throughout the dry season. Over 3000 farmers have adopted the 1 acre rule and expanding, due to the guarantee of economic sustainability and food security, the key need s of these small scale farmers. Farmers greatly depend on roadside runoff and have greatly reduced soil erosion.

![Yatta before](image1)
![Communal dam construction](image2)
![High value crops](image3)

Photos courtesy of Mr. Musau

### 4.3 Forestry

#### 4.3.1 Natural Forest

The forest cover in EAC is variable with Uganda, Rwanda and Tanzania having 15, 18 and 38 percent cover respectively. Meanwhile Kenya and Burundi have 6 and 7 percent respectively. Uganda is experiencing an unprecedented deforestation in the region with a decline in forest cover at an average rate of 2.5% per annum. Burundi experienced gross deforestation of 3.71% by 2000 from 1990. Kenya realized relatively a lower but constant deforestation rate in the two decades. Conversely, Rwanda was able to control deforestation leading to increase in forest cover by 2.87% from 2000-2005 (figure 29). Much of the deforestation in EAC is owed to rapid population increase leading to increased demand for cultivable land and fuel wood.
Several modes of agroforestry are in operation in EAC including: (i) Agrosylvicultural -trees with crops, (ii) Mainly or partly sylvipastoral (trees with pastures and livestock) (iii) Predominantly tree component (iv) Entomoforestry (trees with insects) (v) Aquaforestry (trees with fisheries). In Kenya, the practice can be traced to late 1940’s when Leaky advocated trees along contours, while Djikman in 1950 mentioned *Leucaena* for erosion control in central Kenya. Today it has become one of the most viable commercial enterprises in the country. Cleaver and Schreiber, (1994) observed a pattern in investment in fruit trees in tropical systems in highland areas, reporting similar scenarios for Rwanda and Central Kenya. High value crops compliments subsistence farming systems leading to higher total productivity and food security, Bucagu *et al*, (2013). In Uganda, the practice was introduced in 1980’s by Forestry department and CARE. The World Agroforestry Centre (ICRAF) has played a key role in agroforestry working along National Council for Research (NCR) to promote agroforestry innovations. However, for most of these practices to succeed; they should be focused on provision of direct benefits to the communities, including raising their income.
5.0 Emerging agricultural productivity and trends in EAC

5.1 CAADP

The African Union (AU) is rekindling its position in the continent; not just a political power broker, advocate of African independence and nationalism but as a champion of African food independence and production. Through the New Partnership for Africa’s Development (NEPAD), the African Union developed the Comprehensive Africa Agricultural Development Programme (CAADP). The CAADP provides agriculture led integrated framework of development priorities aimed at reducing poverty and increasing food security through achieving a 6% agriculture growth rate per annum. To bolster the 6% annual growth rates; countries are expected to adhere to the Maputo declaration that requires a 10% GDP share equivalent allocated to agriculture with 1% channeled to research. All EA member states are signatories to the Maputo protocol. Therefore if EAC adhere to this protocol, it will represent a great leap forward; and in particular, provide fiscal space for investment in agriculture.

5.2 Sustainable agricultural intensification

Increased advocacy on sustainable intensification of agriculture both as a concept (see Figure 32) and as a practice represents an emerging opportunity. Sustainable intensification assures increased food production whilst cognizant of environmental health. The following are the vital conduits that need critical attention to propel this paradigm:

- Adoption of policies and plans that combine intensification with sustainable solutions and a focus on the food security needs of people;
- Increased financial support for global and domestic research and innovation to develop and identify suitable technologies and processes;
- Scaling up and out of appropriate and effective technologies and processes;
- Increased investment in rural agricultural market systems and linkages that support the spread and demand for Sustainable Intensification;
- Greater emphasis on ensuring that inputs and credit are accessible and that rights to land and water are secure for African smallholder farmers; and,
- Building on and sharing the expertise of African smallholder farmers in the practice of Sustainable Intensification
5.3 Regionalization

Regionalization represents another breakthrough in EAC for addressing food production and security. Binswanger-Mkhize and McCalla (2009) opine of the imperative of regionalization as a framework (box 3) that would work as anchor of a new foundation in agriculture.

<table>
<thead>
<tr>
<th>BOX 2: Why the need for regionalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Small countries dominate SSA; yet because of their size they often lack the financial capacity for adequate investments in public goods.</td>
</tr>
<tr>
<td>2. Small landlocked countries generally do worse and depend on collaboration with their neighbors to do better.</td>
</tr>
<tr>
<td>3. Expanded regional trade is needed in food and agricultural products to spur economic growth, raise farmers’ incomes, and improve regional food security. The short run management challenges of the recent food price spike and the long-run opportunities arising from higher prices add to this imperative.</td>
</tr>
<tr>
<td>4. Regional trade and food security will be improved by harmonization of standards and sanitary measures along with sub-regional and regional implementation capacities.</td>
</tr>
<tr>
<td>5. Freer borders and internal infrastructure should encourage private sector traders.</td>
</tr>
<tr>
<td>6. For small countries, regional infrastructure roads, communications, and ports are critical to access neighboring and overseas markets.</td>
</tr>
<tr>
<td>7. Reversing land degradation and desertification and preserving biodiversity require trans-boundary collective action.</td>
</tr>
<tr>
<td>8. Managing crucial but under threat forestry and fisheries resources must be approached on a transnational basis.</td>
</tr>
<tr>
<td>9. Defense against plant and animal disease epidemics requires collective responses at the sub-regional and regional levels.</td>
</tr>
<tr>
<td>10. Success in agriculture depends on indigenous scientific capacity to generate new technology, which is better done on a regional or sub-regional basis because Africa has so many small and poor countries. The Forum for Agricultural Research in Africa (FARA) and sub-regional organizations are on the right track, but efforts need to be greatly expanded.</td>
</tr>
<tr>
<td>11. Biotechnology research is expensive and requires a large critical mass. Two or three regional institutes are therefore far superior to 48 or 24 underfunded, under resourced national institutions.</td>
</tr>
<tr>
<td>12. Biosafety issues could be regulated more cost effectively at a regional or sub-regional level than nationally.</td>
</tr>
</tbody>
</table>
13. Indigenous scientific capacity requires trained people, and training is better done by regional institutions with the necessary critical mass and financial support.
14. Regional approaches to rural financial architecture could increase deposits and loanable funds and spread risk.

5.4 Focus on increasing productivity: Research and Development (R&D)

EAC scientists are teaming up at national, regional and international level to conduct cutting edge research in agriculture. Several regional and international bodies specifically Forum for Agricultural Research in Africa (FARA); the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASAREC), the Consultative Group on International Agricultural Research (CGIAR), Rockefeller Foundation and the Bill and Melinda Gates Foundation have supported the establishment of the Alliance for a Green Revolution in Africa (AGRA). The national agricultural research and development agencies, national agricultural research institutes (NARIs) have continued to play an active role in research (table 8). There is a growing engagement of private sector in R&D in EAC (table 8)

5.4.1 Biotechnology

Biotechnology has been with us for a long time for example fermentation has been practiced or very long periods however, new and broader aspects has been taking shape including but not limited to (i) Molecular diagnostics: The use of molecular characterisation to provide more accurate and quicker identification of pathogens (ii) Vaccine technology: the use of modern immunology to develop recombinant DNA vaccines for improving control of livestock and fish diseases. (iii) Tissue culture is a well-proven method for mass propagation of improved and disease free planting material for economically important crops and plant species with recalcitrant seeds (vi) Molecular breeding and marker assisted selection (MAS): the identification and evaluation of desirable traits in breeding programs by the use of molecular marker assisted selection (MAS) Virgin et al (2007). In East Africa, only Kenya and Tanzania have Biotechnology and biosafety policy however; Uganda, Rwanda and Burundi are in the process. Kenya has made great strides in Biotechnology (Mtui, 2011) and has produced about 6 GMO crops had been released by 2011. Other East African countries though making good progress in biotechnology are faced with various challenges. For example, financial constraints, insufficient skilled manpower and inadequate facilities to fully engage in modern biotechnology operations are major limitations. Despite these challenges, Uganda is expected to release commercial GM cotton in 2014, cassava 2016 and drought resistant maize by 2017. Similarly, Tanzania is affected by insufficient funding, limited capacity in research, lack of capacity to supply, service and repair scientific equipment and weak inter- institutional networks (Mneney, 2010; Bull et al.,2011). Table 8 below highlights some of the progress made by EAC member states.
<table>
<thead>
<tr>
<th>Country</th>
<th>Status of Biotechnology policy</th>
<th>Implementing Institutions</th>
<th>Examples of Case application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>Biotechnology policy 2007</td>
<td>KARI, Bill and Melinda Gates</td>
<td>Bio-fortified sorghum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bio-fortified sorghum</td>
<td>Breeding for improved chicken production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ILRI</td>
<td>Insect resistant cotton</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KARI &amp; Monsanto</td>
<td>Insect resistant maize (leaves and seeds)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KARI&amp;CIMMYT</td>
<td>Tissue culture of various food crops and ornamentals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JKUAT</td>
<td>University of Nairobi</td>
</tr>
<tr>
<td></td>
<td>In progress</td>
<td></td>
<td>Research on GM capripox virus, rider pest recombinant vaccine production and production of transgenic sweet potato, MAS sorghum</td>
</tr>
<tr>
<td>Uganda</td>
<td>In progress</td>
<td>Makerere University</td>
<td>Marker assisted selection for local cattle breeds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IITA</td>
<td>Virus resistant sweet potatoes and cassava</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AGT</td>
<td>Tissue culture production in coffee and banana</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kawanda &amp; Namulonge centers</td>
<td>Molecular breeding including transformation</td>
</tr>
<tr>
<td>Tanzania</td>
<td>Biotechnology policy 2009</td>
<td>Kizimbi, Zanzibar</td>
<td>Banana and horticultural crops</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UDSM</td>
<td>Nitrogen fixation, mycorrhizal inoculation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uyole ARI</td>
<td>Pyrethrum and aeroponics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nari</td>
<td>Virus resistant cassava</td>
</tr>
<tr>
<td>Rwanda</td>
<td>In progress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burundi</td>
<td>In progress</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors 2013
5.4.2 Production and use of legume inoculants in EAC

At independence white settler farmers in Eastern and Southern Africa were using legume inoculants to improve pasture and grain legume production. However, the inoculants were imported from either Australia or USA. It was in the early 1970s that research and development for locally produced inoculants was initiated by the Microbiological Resources Center (MIRCEN) of the University of Nairobi, Kenya. This collaborative project involved all countries in Eastern and Southern Africa and led to the setting up of pilot plants for the production of legume inoculants to serve small scale farmers of the region. By 1980 there were several pilot plants in the collaborating countries. This entailed the development of capacity for the pilot plants to produce legume inoculants using evaluated local and imported rhizobium strains and field testing. Pilot plants were established in Kenya and Uganda but Kenya remained the source of supply of inoculants to farmers for over 30 years. In 2008 MEA Limited, a private company and the University of Nairobi signed a contract culminating in the transfer of the inoculant technology to MEA Ltd. This was made possible through joint project brokered by the African Knowledge Transfer Partnership (AKTP) supported by the British Council. Through this partnership, MEA Ltd undertakes commercial production, distribution, farmer and agro-dealer training, demo-set up and marketing of the biofertilizer to farmers at an affordable price while the University continues with research and quality control of the inoculant. Today the inoculants branded BIOFIX are used in EAC countries and beyond saving farmers substantial cost of chemical fertilizers.

5.5 Green house farming

As a way to promote sustainable small scale farming due to its recognized importance, there has been vigorous campaigns by government agencies, private sector and various donor funded projects to promote small-scale greenhouse farming. Green-house farming has been shown to accrue huge benefits to farmers. Greenhouses provide controlled climate, delivers high yield and uniform maturity, and with over 90 percent of yield guaranteed year round. Infused with greenhouse technology is drip irrigation. According to Sijali and Okumu (2000), small scale drip irrigation systems are a prime example of a technology that has been widely adopted by small scale farmers. This is mainly because they reduced workload of small scale farmers; improve income and provide employment opportunities; speedy transfer of the technology; and ease of accessibility. However, drip irrigation adoption has been affected by lack of technical support, low quality of irrigation water and insufficient market for the produce (Kulecho., 2006).

5.6 Organic farming

Organic agriculture both certified and non-certified, offers considerable potentials in developing countries. Organic agriculture includes all agricultural systems that promote the environmentally, socially and economically sound production of food and fibers. Small farming communities usually have limited access to external inputs, as these are often costly or not available, while their application needs training and information (IFOAM, 2000). Organic agriculture in East Africa has grown in the last two decades to a point where it has become visible and measurable. Uganda and Tanzania are the countries with the largest organic areas in the East African region with more than 220,000 and 155,000 hectares respectively and with the largest number of organic producers.
Initiative has been implemented on a pilot basis in six countries: Kenya, Tanzania, Uganda, and Ethiopia in eastern Africa; this is with the aim of lobbying a comprehensive range of stakeholder capable of unlocking the potential that organic agriculture offers the region.

In Kenya there are currently over 180,000 hectares of land under organic certification for export markets plus another 853 hectares in conversion. There are five (5) international certifiers operating in the country. They are; the Soil Association (SA), Ecocert International, Institute for Market-ecology (IMO), the United States Department of Agriculture (USDA), National Organic Programme and Bio Suisse. Many of the exporters are large-scale farmers, already engaged in the export agriculture and horticulture that are diversifying into organic production to meet demand from their established customers. Certified organic produce includes French beans, runner beans, mange tout, salads and tea (for the UK), hibiscus tea and jam (for Japan and Austria) and macadamia nuts and oils (for Germany and Japan) (Walaga, 2003).

5.7 Urban and peri-urban agriculture

Urban agriculture (UA) is a common feature in many towns in East Africa. It is estimated that 40 percent of the urban population in the region are participating in UA (Foecken, 2005). UA is on the rise in many African countries because of the need to improve food and income securities among the poor urban population. In Kenya, it is estimated that 29 percent of the urban population practice UA (Republic of Kenya, 2010). UA can provide farmers with additional opportunities for employment, income and subsistence food (Lynch et al., 2001; Thorton, 2008). Income can be directly realized through the sale of crops or indirectly as a result of the need to purchase less food. A study by Kangethe et al., (2008) revealed substantial direct incomes from selling crops and selling livestock products, milk in particular by the participating households. However, there is a conflict related to UA as most cities/town bylaws discourage farming particularly livestock production. There is also the challenge of swelling in urban fueling the already land scarcity situation.

5.8 Agriculture mechanization

Agricultural mechanization in EAC raises three fundamental issues: (i) agricultural mechanization requires more discussion and fact finding as well as identification of best practices; (ii) the low agricultural productivity in EAC is partially attributed to limited mechanization compared to the successes achieved in Asia and Latin America; and, (iii) even where mechanization is taking pace such as in EAC the export value and export quantity are not in tandem. The EAC region has witnessed a negligible improvement in mechanization over the last 40 years; the situation is that of a declining trend despite improvements at the global level. Kenya, Uganda and Tanzania had more tractors in use than India in the 1980’s however; by 2005 India had 100 times more tractors in use than the three East African countries combined.
Table 9: Tractor numbers as an indicator of mechanization from 1961-2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>120,000</td>
<td>600,000</td>
<td>6,000,000</td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td>383,000</td>
<td>637,000</td>
<td>1,800,000</td>
<td></td>
</tr>
<tr>
<td>Near East</td>
<td>126,000</td>
<td>260,000</td>
<td>1,700,000</td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>172,000</td>
<td></td>
<td>275,000</td>
<td>221,000</td>
</tr>
</tbody>
</table>

NB: 70% of all tractors in SSA are in South Africa and Nigeria


Box 3 summarises UNIDO’s major thrusts on investment on agricultural mechanization in Africa while box 4 highlights the major policy issues that need to be addressed for successful agricultural mechanization.

BOX 3: Main conclusions on investment in agricultural mechanization in Africa

1. Mechanization is not just a question of supplying farmers with tractors and machinery or of making mechanization services available to them through the public sector. This has been tried and has failed.
2. The best way to mechanize is for farmers to own their own machines or for them to hire services from other farmers.
3. Tractors need service, repair and spare parts. A tractor or machine without these is more of a liability than an asset.
4. The best way to supply machinery is through the private sector, although this does not necessarily preclude public-sector participation. However, this must be done in the correct manner.
5. In many Asian countries where mechanization has expanded so greatly, agricultural pricing policy has been used as an instrument for this.
6. In many African countries today, numerous farmers cannot afford mechanization. This depends to a large extent on farm-gate prices, which in many countries are volatile and often too low.
7. The overwhelming reason why farmers do not purchase machinery is a lack of finance. Commercial banks are generally not interested in lending to farmers, and their interest rates are far too high for farmers to use loans effectively. Farmers lack collateral, in many cases because of land-ownership and registration problems.
8. There are too few rural banks.
9. Local manufacturers lack skills and investment. There are often high tariffs on imported steel and materials. Also, the cost of doing business is often high.
10. There is a general lack of technical skills and other human capacity. There are inadequate training facilities.
11. There are often stifling regulations against the use of farm tractors for operations other than farming.
12. Development agencies and financial institutions are still not convinced that increased investment in mechanization is required.
13. There is often a poorly coordinated approach to mechanization. Mechanization issues are not a concern of agriculture ministries alone. Industry, finance, education and other ministries are also involved.
14. There is little or no consumer protection for those investing in agricultural equipment - no financial protection and no codes of practice.
There is too little networking of interested parties at both national and interregional levels.

**BOX 4: Main Policy Issues**

1. Is it government policy to increase agricultural production, and is increased mechanization seen as an essential means to achieving this?
2. What is to be the role of the public sector in promoting agricultural mechanization?
3. Subsidies – should mechanization and/or the manufacture/importation of machinery be subsidized and, if so, how?
4. Should the pricing of farm products be used as an instrument to increase investment in agriculture and, if so, what mechanisms are needed?
5. Finance – How can farmer’s best gain access to finance? Should the public sector be involved in financing farmers through, for example, agricultural rural banks or funds?
6. What should be the policy towards donors who wish to use ‘aid in kind’ (e.g. the supply of tractors) as development aid?
7. What is the policy regarding protection of farmers against bad commercial and/or financial practices?
8. What are the land-ownership and registration policies? Can farmers use land as collateral?
6.0 Cross-cutting issues

6.1 Climate variability and change

The productivity potential of crops in Africa is high due to intense solar radiation and elevated temperatures enabling crop production all year round. Studies reported by (Rosegrant et al., 2002) have shown that by 1995, 96% of cereals in Sub-Saharan Africa were sown on rain fed agricultural systems generating 89% of cereal production. Yet, yields in rain fed systems are lower than in irrigated systems. It is further shown that these proportions are less likely to change in 2021-2025 projection period. Accordingly, Sub-Saharan Africa has been identified as one of the most vulnerable regions to impact of climatic change; in particular, effect on crop production. Climate change will affect crop production in SSA by altering average temperatures, changing the rainfall regimes, rising atmospheric Carbon-dioxide concentrations, climate variability and extreme events including sea water-land interactions. Climate change affects infrastructure associated with inputs distribution, food processing and food distribution all of which have a compounding negative effect on crop production.

6.2 Governance, institutions and policy

In SSA Africa public policies and investments tend to be biased against the resource poor farmers and consumers, women and less favored areas (Cohen, 2010). Infrastructure is inadequate and/or dilapidated; access to land is inequitable; markets are poorly functioning and less integrated; and there is a lack of access to credit and technical assistance in form of extension and advisory services.

In some instances countries do not have an agricultural policy yet they have an agricultural investment plan. It is further observed that agricultural productivity increases when women obtain similar inputs as men however, minimal attention is often paid to gender dimensions in policy design. Even some of the inputs distributed to women have a masculine design as such their adoption among women remains low.

“Development depends upon good governance. That is the ingredient which has been missing in far too many places, for far too long... .....Africa doesn’t need strongmen, it needs strong institutions... .....Get your act together.....”

US President: Barack Obama’s Speech to Ghana’s Parliament and a call to African leaders.

“People starve where poor governance prevail” Nobel Laureate Amartya Sen

Governance, often than not, is an ignored component of discussion in food production and productivity enhancement. However, poor governance is a major issue in most African countries, and in it has considerable repercussions for agricultural production and productivity that
subsequently determine the food security situation. The World Bank has identified up to six governance indicators that influence productivity: (i) voice and accountability; (ii) government effectiveness; (iii) regulatory quality; (iv) rule of law; (v) political stability and absence of violence; and, (vi) control of corruption. Despite being signatories to several international treaties; that profess to uphold fundamental Human Rights, seek to empower and franchise the citizenry problems relating to collusion, corruption and nepotism seem to prevail unabated in many African countries. These practices impede the capacity of governments to deliver envisioned development efforts (Rosegrant et al., 2005); in agriculture and other sectors at large.

6.3 Seeds and animal genetic resource system
The importance of the right seed for agricultural development cannot be overstated; since access to improved seeds and inorganic fertilizers is crucial in determining food security of farmers in the region. Nevertheless, the informal seeds sector and seed supply schemes of government and non-governmental organizations continue to play a role in all the five EAC countries. This is mainly because the formal seed sector is poorly developed. A study by Monyo, et al., 2004 shows that 66 to 85 percent of seeds used by resource poor farmers in Sub-Saharan Africa are is derived from informal markets.

6.4 Youth, Agriculture and ICT
The EAC population is estimated to be around 145 million with an average annual growth rate of 2.8% compared to world 1.14%. The population with 24 years and below is 70.3%, 61.5%, 64.4%, 61.8% and 65.5% for Uganda, Kenya, Tanzania, Rwanda and Burundi respectively (CIA, 2013). The unemployment among the youth is very high, exceeding 20% in most of these countries. The constant supply of labor-seeking youth cannot be absorbed as formal economy is unable to create enough employment opportunities. Agriculture faces labour force challenges as there is huge migration to urban centers while agricultural production is relegated to the old. The place of agriculture and its potential to absorb the youth is found in many county reports (World bank, 2010; Young Leaders Think Tank for Policy Alternatives, UNDP, 2013; Malunda, 2011).

Most of the East Africa states have acknowledged the important role technology can play to enhancing e-agriculture which can easily attract youths to on farm production. Embracing ICT could revitalize sharing research results, information dissemination, input and market networking and extension service (Andrea Jimenez, 2013; GoK 2010, CTA 2012). Adoption of e-agriculture platform is gradually taking shape in East Africa. In Tanzania DIA-PESA and e-kilimo partnering with various bodies like postal co-operation and Airtel money has opened up e-agriculture. Kenya so far has more than five agriculture applications that has helped her boost the e-agriculture
structure these includes MPESA, Airtel Money, mFARM, iCOW, m-kilimo. In Uganda, Nodumo Dhlamini & ODL Network, 2010 showed how integrated ICT use boosted farmers were linked to researchers, traders and financial in Kabale, Western Uganda. The Rwanda Development Board technology department (RDB-IT) deployed a national web-based, crop price tracker and other tools like mobile phones under the e-soko project to boost marketing.

Despite these steps, there is still a lot to be done to encourage youths to venture into agriculture. Strong educational background in high schools and tertiary colleges that infuse ICT in their programmes/curriculum to equip the youths with skills and knowledge should form the first steps towards young generation of farmers.

6.5 Agribusiness and value addition
Economic growth in most African countries is mainly through export of commodities like oil, minerals and agricultural products which most often are not processed (UNIDO, 2011). The ambitious annual agricultural growth targets as envisaged in the Comprehensive African Agricultural Development Programme (CAADP) are unlikely to be realized unless agribusiness approach is adopted. To achieve CAADP targets, EAC must therefore reorient their subsistence small scale farming systems where value addition of agricultural produce and development of markets structure is mainstreamed. Agribusiness (all businesses involved in agricultural production, including farming and contract farming, seed supply, agrichemicals, farm machinery, wholesale and distribution, processing, marketing and retail sales,(UNIDO,2011). Value addition and agro-processing is an opportunity with great potential but remains largely unexploited. National growth agenda outlined in individual countries’ plans, looks into transforming agriculture from subsistence activities, marked by low productivity and value addition, to competitive, modern agricultural systems where innovation and technology application will play a key role (GoK, 2011, RoR 2010, URT, 2011,GoU, 2012). Through this new approach to agriculture, the EAC government’s aim to tackle food insecurity, poverty and unemployment.
Recommendations

We have summarized major observations as follows;

- Scientific and technological development over the last fifty years has generated high yielding improved, clean planting materials. These germplasm with disease resistant and adapted traits have boosted crop productivity. The same can also be said of animal genetic resources. However the use of these materials of plants or animals is still very low. These technologies should be made accessible and affordable to farmers.

- There is scarcity or poor data on typology and numbers of small-scale farms in EAC. This calls for innovative ways of collecting and consolidating the available information into centralized forms. A starting point could be creation of local (village-level) databases which are linked to central databases such as DAGRIS, DADIS etc.

- It is paramount to differentiate the contributions of genetics, nutrition and animal health to the overall productivity gaps observed in each genotype/breed-environment category. Such an exercise would inform targeted investments and subsequent interventions and finally impacts.

- Reliable livestock census data at genotypic or breed levels (indigenous, crossbred, exotics), including the related GPS data are currently missing.

- Information available shows that there is huge potential in wildlife farming; however, there are still legal and technical bottlenecks for farmers to exploit this enterprise in a sustainable way.

- There are many technologies in soil and water conservation yet adoption is low. There is need to find out why there is low adoption despite availability of technologies before more research is carried out.

- Fertilizer use has improved but still the quantities used are below the recommended levels. Governments should work in hand with private sector to ensure farmers can access fertilizers and at affordable prices. Construction of fertilizer Factories within the EAC region should thus be fast tracked in view of the discoveries of gas and oil.

- It is expected that by 2020 majority of the EAC populace will be in urban centers. The economies of these countries are also expected to have made steps towards being industrial economies. On farm production to meet the food demand of urban dwellers is both an opportunity and a challenge. Urban and peri-urban agriculture will play a major role in boosting national food security. As well agribusiness could generate employment levels hitherto an illusion for the youth.

- EAC farming systems has been stagnant partly due to meager investment in appropriate mechanization including fragmentation of holding and pattern of settlement. It is recommended that land consolidation could be the answer but a pre-requisite is proper land tenure and inventory systems.

- Agribusiness, value addition; strong agro-based enterprises where market is the focal point, and strong value chain systems fused with deployment of ICT is vital to unlocking small-scale farmers potential.
• Climate change and variability; the changing climatic condition is expected to impact farmers greatly and across all agricultural sub-sectors. Mainstreaming climate change in developmental agenda will be vital in absorbing the shocks attributed to climate risks thus cushioning farmers.

• The majority of EAC population is young, unfortunately this cadre is shying away from agriculture yet if this massive labour force is channeled into agriculture, the issue of youth unemployment will be minimized. The governments must look into ways of attracting youths into farming.

• EAC population currently stands at about 140 million. This is a huge market. Nonetheless for EAC countries to benefit from this market there is need for faster and proper integration structure allowing for free movement of goods and labour.

• Research and development in agriculture is core to any serious agricultural development. Governments must consider this a priority and put at least 10% of the national resources into agriculture as suggested in Maputo declaration.

• High turnover of agricultural scientist due to poor remuneration packages and working conditions in most of the National Agricultural Research Institutes (NARI). Governments must find mechanisms to recruit train and retain scientists.

Conclusions

EAC region has potential for greater agricultural production than currently realized given a proper mix of inputs, investments, innovations as well as stabilization in governance and a strengthened institutional environment
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