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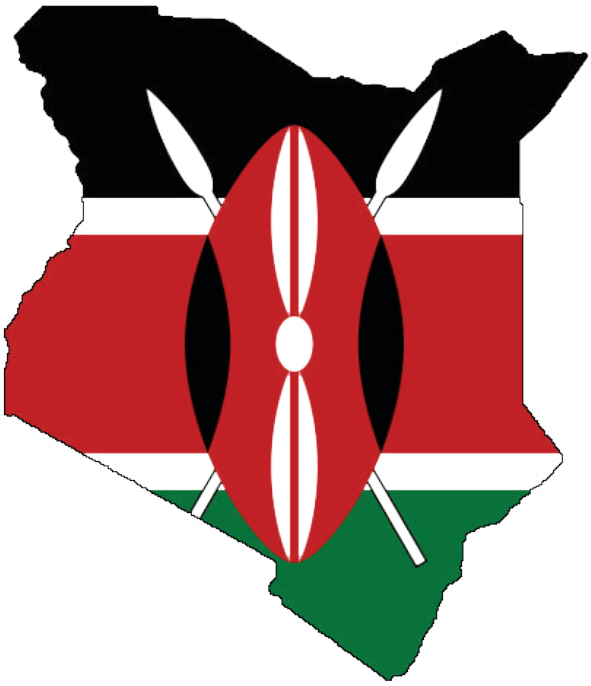
KENYA

Potentials and Possibilities for German Collaboration in Agriculture



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This report is work in progress and continuously being updated. Any feedback and suggestions for further improvement are welcome and can be sent to pari@uni-bonn.de.

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1 General background information of the agricultural and food sectors

Agriculture plays an important role in the Kenyan economy. The sector engages over 40% of the total population, over 70% of the rural population and 18% of formal employment and provides livelihood opportunities to the growing youth population. The sector has performed relatively well in recent years as it recovered from negative growth of -2.1% in 2000 to 2.9% in 2013. Although its growth is lower compared with the other sectors of the economy. The growth experienced by the sector in the last decade (from 1.7% to 7.2%) plummeted in 2008 to -4.1% due to the prolonged drought and other factors. Nonetheless, the sector has resumed a positive growth and development path and has now reached 2.9%. Key to recovery has been the vibrant internal demand for major staples and pulses, livestock products and horticultural goods, and a return to growth in key export sub-sectors, such as coffee, tea, pyrethrum, fruits, vegetables and cut flowers. Horticulture contributes 27% while coffee contributes 5% and tea 32% from 2007 - 2013 average.

Opportunities for spurring growth in the agricultural sector and broader economy co-exist with challenges in translating such growth into greater food security for the Kenyan population. The key challenges revolve around productivity in the key sub-sectors, improvement in land and natural resource management, improvement in market access and trade, enhanced private sector participation, institutional reforms and improved coordination of the research and technology transfer components. All these are ingredients for a fully functional agricultural sector and while a lot has been done to address the various elements, a lot still needs to be done. Recent efforts by the Government of Kenya to develop the sector are well expressed in its medium-term investment plan which is aligned to the CAADP framework for the continental agricultural development. The plan gives adequate recognition to the diversity of agro-ecological conditions and stakeholder configuration and proposes investment in six strategic thrusts drawn from the Kenya CAADP alignment (Gerecke, 2007; Kibaara, 2009):

1. Increasing productivity, commercialization and competitiveness;
2. Promoting private sector participation;
3. Promoting sustainable land and natural resource management;
4. Reforming delivery of agricultural services;
5. Increasing market access and trade;
6. Ensuring effective coordination and implementation.

The potential for German collaboration in fostering Kenya agricultural growth and development is enormous, ranging from research partnerships for technology generation to development of pathways and systems for translating research output into development outcomes. The need to build external collaboration on existing progressive initiatives and the government pathways for the development of the sector is very essential to ensure complementarity and synergy.

1.1 Pan-African policies and strategies

A number of strategies and frameworks exists in Africa for agricultural development; many of these frameworks are developed at the level of the Africa Union and other continental bodies. The frameworks often provide political support and seek implementation at the country level to foster continental growth. A few recent frameworks are as follows:

- Comprehensive Africa Agricultural Development Program (CAADP) framework: This is developed by the Africa Union Commission (implemented by NEPAD). If follows the

Maputo declaration in 2003 and represents the commitment of African countries to commit at least 10% of their budget to agriculture with the projection that it will lead to 6% annual growth rate for the sector. Kenya embraced the CAADP compact in 2008, and started to implement the framework in 2010;

- The African Peer Review Mechanism (APRM) in 2004, implemented one year after endorsement of the CAADP;
- Abuja Declaration on Fertilizer for an African Green Revolution (2006) in which the AU Member States resolved to increase fertilizer use from 8.0 kilograms to 50.0 kilograms of nutrients per hectare by 2015;
- Malabo declaration (June 2014) on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods through Harnessing Opportunities for Inclusive Growth and Sustainable Development, also marking the 10th Anniversary of the Adoption of the CAADP;
- The Science Agenda for Agriculture in Africa (S3A) was developed in 2014 by a coalition of actors under the leadership of the Forum for Agricultural research in Africa (FARA). The S3A is an African-owned and African-led process that articulates the science, technology, extension, innovations, policy and social learning that Africa needs to apply in order to meet its agricultural and overall development goals. The strategic thrusts of the S3A in the short- to medium-term are the implementation of CAADP, increase of domestic public and private sector investment, creating the enabling environment for sustainable application of science for agriculture and doubling the current level of Agricultural Total Factor Productivity (ATFP) by 2025 through the application of science for agriculture. In the medium- to long-term the science agenda is to build systemic science capacity at national and regional levels, capable of addressing evolving needs for farmers, producers, entrepreneurs and consumers, especially given strategic and foresight issues such as climate change and urbanisation.

1.2 National (and regional) policies and strategies

A number of documents exists on the progress of Kenya's national policies in agriculture. Various authors (Gitau *et al.*, 2008; Ronge *et al.*, 2005; Alila and Atieno, 2006) identify three general periods in the recent agricultural policy history of Kenya: post-independence, liberalization, and stakeholder participatory approach (post liberalization) periods. The current regime - **Post-liberalization period** – has seen a number of reforms, for example the Poverty Reduction Strategy Paper (PRSP) in 2001 and the National strategy for economic recovery in 2003. In this strategy, agriculture was identified as one of the three "movers" of the economy, together with trade and industry, and tourism.

The Strategy for Revitalizing Agriculture (SRA), 2004-2014 was launched to implement the Economic Recovery Strategy for Wealth and Employment Creation (ERS) in the agriculture sector. In June 2008 Kenya adopted the **Kenya Vision 2030** as a new blueprint for the country's development, and to give continuity to the policy achievements of the ERS. In the Vision, agriculture is identified as a key sector in achieving the envisaged annual economic growth rate.

The Agriculture Sector Development Strategy (ASDS) 2010-2020, was established following a revision of the Strategy for Revitalizing Agriculture, 2004-2014. ASDS sets out a detailed plan to 'position' the agricultural sector as a key driver for delivering the 10% annual economic growth rate envisaged under the economic pillar of Vision 2030.

The National Climate Change Response Strategy (NCCRS) and National Climate Change Action Plan (NCCAP) of 2010 highlight various measures for adaptation and mitigation to the impacts of climate change on agriculture such as early maturing and high yielding crop varieties, drought and pest resistant crop varieties and disease-resistant livestock. The Second Medium Term Plan 2013-2017 identifies key policy actions, reforms, programs and projects to be implemented in the 2013-2017 period in line with government priorities.

1.3 Data on food and nutrition security

The following section includes information about important socio-economic indicators, production and trade data and data on consumption and nutrition status.

Table 1: Selected national economic and health-related data

Indicator	Data	Year
Population, total	45,545,980	2014
Population growth (annual %)	2.1	2014
Rural population (% of total population)	75	2014
GDP per capita, PPP (constant 2011 international $)	2,776	2014
GNI per capita, PPP (constant 2011 international $)	2,762	2014
Poverty headcount ratio at $2 a day (PPP) (% of population)	67	2005
Poverty headcount ratio at $1.25 a day (PPP) (% of population)	43	2005
Poverty headcount ratio at national poverty lines (% of population)	46	2005
Rural poverty headcount ratio at national poverty lines (% of rural population)	49	2005
Agricultural land (% of land area)	48	2012
Agricultural irrigated land (% of total agricultural land)	0.04	2009
Agriculture value added per worker (constant 2005 US$)	396	2014
Agriculture, value added (% of GDP)	30	2014
Access to electricity, rural (% of rural population)	7	2012
Employees, agriculture, female (% of female employment)	68	2005
Employees, agriculture, male (% of male employment)	55	2005
Employment in agriculture (% of total employment)	61	2005
Literacy rate, adult total (% of people ages 15 and above)	72	2007
Ratio of female to male secondary enrolment (%)	93	2012
Mortality rate, under-5 (per 1,000 live births)	71	2013
Malnutrition prevalence, weight for age (% of children under 5)	16	2009
Malnutrition prevalence, height for age (% of children under 5)	35	2009
Maternal mortality ratio (modelled estimate, per 100,000 live births)	400	2013

Source: World Bank, http://data.worldbank.org/country

1.4 Data on most relevant crops and value chains

The most relevant crops in Kenya include maize, wheat, tubers (potatoes and sweet potatoes), bananas and plantains, cassava, fruits, vegetables and legumes (beans, cowpeas). There is also coffee and tea production and a significant livestock sector. Production and consumption data are provided below.

1.4.1 Production

Table 2 presents the top 10 crops produced in Kenya, taking into account the cultivated area, the volume produced and the sales value.

Table 2: Top 10 crops produced by area, volume and value

Area harvested (ha)		Production volume (tons)		Production value*	
Top 10	% of total	Top 10	% of total	Top 10	% of total
Maize	38.5	Sugar cane	26.4	Potatoes	10.3
Beans, dry	19.0	Maize	16.1	Milk, fresh cow	10.0
Sorghum	4.1	Potatoes	11.6	Maize	8.5
Cow peas, dry	3.7	Bananas	6.2	Tea	8.2
Tea	3.5	Sweet potatoes	4.3	Meat indigenous, cattle	8.2
Pigeon peas	2.6	Cassava	4.2	Meat, cattle	8.2
Potatoes	2.5	Cabbages and other brassicas	3.2	Bananas	6.1
Wheat	2.5	Vegetables, fresh nes	2.7	Milk, whole fresh camel	6.0
Coffee, green	2.3	Beans, dry	2.7	Beans, dry	3.5
Millet	1.9	Mangoes, mangosteens, guavas	2.4	Tomatoes	2.7

Sweet potato: 1.2% of area harvest (rank 16), 2.2% of production value (rank 11)
* Gross Production Value (constant 2004-2006 million US$)
Data: average 2011-2013, FAOStat, accessed 2 July 2014
Note: AIC value chains marked in red; nes refers to Not elsewhere specified

1.4.2 Consumption and nutrition status

Table 3: Food supply by tons, kg per capita and kcal per capita

Food supply quantity (tons)		Food supply quantity (kg/capita/yr)		Food supply (kcal/capita/day)	
Top 10	% of total	Top 10	kg	Top 10	kcal
Maize and products	16.0	Maize and products	76	Maize and products	663
Potatoes and products	10.3	Potatoes and products	49	Wheat and products	254
Vegetables, Other	7.4	Vegetables, Other	35	Roots & Tuber Dry Equiv	206
Wheat and products	7.2	Wheat and products	34	Sugar, Raw Equiv	156
Sugar cane	5.7	Sugar cane	27	Sugar (Raw Equiv)	148
Bananas	5.5	Bananas	26	Sugar, Refined Equiv	148
Roots & Tuber Dry Equiv	4.4	Roots & Tuber Dry Equiv	21	Rice (Milled Equiv)	111
Cassava and products	4.2	Fruits, Other	20	Rice (Paddy Equiv)	111
Fruits, Other	4.2	Cassava and products	20	Beans	108
Sweet potatoes	4.0	Sweet potatoes	19	Palm Oil	108

Data: average 2011-2013, FAOStat, accessed 2 July 2015
Note: AIC value chains marked in red.

1.4.3 Trade

Table 4: AIC Value Chains: Sweet potato, Dairy (Horticulture crops)

Import volume (tons)		Import value (US$)	
Top 10	**Share of Total**	**Top 10**	**Share of Total**
Wheat	35.6	Wheat	17.0
Rice – total (Rice milled equivalent)	11.9	Oil, palm	16.6
Oil, palm	9.6	Rice – total (Rice milled equivalent)	9.9
Maize	7.7	Tea	7.2
Sugar refined	4.0	Sugar refined	5.2
Sugar Raw Centrifugal	2.8	Maize	4.2
Tea	2.1	Sugar Raw Centrifugal	3.9
Flour, wheat	2.0	Food prep nes	3.0
Cake, sunflower	1.7	Tobacco, unmanufactured	2.8
Beans, dry	1.5	Flour, wheat	1.6
Sweet potato	0.0	Sweet potato	0.0

Data: average 2010-2012, FAOStat, accessed 31 Oct 2015
Note: AIC value chains marked in red; nes refers to Not elsewhere specified

Table 5: Top Ten exports in Kenya

Export volume (tons)		Export value (US$)	
Top 10	**Share of Total**	**Top 10**	**Share of Total**
Tea	37.3	Tea	36.0
Beer of barley	6.8	Crude materials	25.0
Coffee, green	5.2	Coffee, green	9.7
Sugar confectionery	4.6	Beans, green	4.4
Pineapples canned	3.8	Cigarettes	3.0
Beans, green	3.7	Vegetables, fresh nes	2.3
Oil, palm	3.4	Pineapples canned	1.6
Sorghum	2.0	Oil, palm	1.4
Vegetables, preserved nes	1.9	Sugar confectionery	1.4
Vegetables, fresh nes	1.9	Nuts, nes	1.2
Sweet potato	0.0	Sweet potato	0.0

Data: average 2010-2012, FAOStat, accessed 31 Oct 2015
Note: AIC value chains marked in red; nes refers to Not elsewhere specified

Wheat, rice and palm oil play the most important roles in import trade. Tea is the most important export good, which accounts for more than 37% of the export volume and 36% of the export value. The AIC value chains (sweet potato and dairy products) cannot be found in the Top 10.

1.5 National (and regional) innovation system:

1.5.1 Research system and organizations

Kenya, like other nations, is directly dependent on agriculture has established national agricultural research system (NARS) units, such as KALRO (formerly KARI), KEFRI, universities etc. Innovation efforts and outcomes also stem from interventions of the regional and international agricultural research and development centers that are based in Kenya, the civil society organizations including NGOs (Non-Governmental Organization), FBOs (Faith Based Organization) etc. The contributions of these non-governmental organizations include

the implementation of different projects and programs that are funded both locally and internationally. About 10 out of 15 CGIAR centers have ongoing initiatives in Kenya.

1.5.1.1 International and Regional

A large number of international organizations have been actively conducting agricultural research and coordinating efforts to support agricultural growth in Kenya as part of larger economic development agendas, including:

- The United Nations Food and Agriculture Organization (FAO);
- The United Nations Development Program (UNDP);
- Countries such as the United Kingdom or European Union, USA have risen to particular prominence, wielding influence and exerting impacts on what research is to be conducted beyond their national interest;
- The Consultative Group International Agricultural Research (CGIAR):
  - Bioversity International;
  - Center for International Forestry Research (CIFOR);
  - International Center for Tropical Agriculture (CIAT);
  - International Food Policy Research Institute (IFPRI);
  - International Institute of Tropical Agriculture (IITA);
  - International Livestock Research Institute (ILRI);
  - International Maize and Wheat Improvement Center (CIMMYT);
  - International Potato Center (CIP);
  - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT);
  - World Agroforestry Centre (ICRAF);
- The BecA-ILRI Hub.

A number of regional organizations have also contributed to agricultural development in the country, including:

- World Vegetable Center (AVRDC);
- Alliance for Green Revolution in Africa (AGRA);
- African Agricultural Technology Foundation (AATF);
- Forum for Agricultural Research in Africa (FARA);
- Association for Strengthening Agriculture Research in Eastern and Central Africa (ASARECA).

1.5.1.2 National

The National Agricultural Research Systems (NARS) in Kenya has undergone reform. More recently in 2013, reformed the sector through the formation of the Kenya Agricultural and Livestock Research Organization (KALRO) in line with the second medium term plan. KALRO is a corporate body created under the Kenya Agricultural and Livestock Research Act of 2013 is mandated to establish suitable legal and institutional framework for coordination of agricultural research in Kenya (www.kalro.org). The formation of KALRO was aimed at restructuring agricultural and livestock research into a dynamic, innovative, responsive and well-coordinated system driven by a common vision and goal. KALRO has several institutes each dealing with a particular or combination of crops or livestock research activities (www.kalro.org).

1.5.2 Innovation platforms

FARA has participated in the process for the set-up of different innovation platforms in Kenya, indicated in Table 6.

Table 6: List of Innovation platforms in Kenya

IP Name	Location	Name of focal point	Email/phone Web page	Commodity of interest
Sorghum Value-Chain Development Consortium (SVCDC)	Nairobi	Dr. Christine Onyango	cakoth2002@yahoo.co.uk	Sorghum
eRAILS2	Nairobi	Boniface Akuku	Boniface.Akuku@kalro.org http://www.runetwork.org/html/en/articles/journals/309	various
Busia IPTA*	Busia County (W. Kenya)	Michael Odongo	refso202@yahoo.com	Orange fleshed sweet potato
Bungoma IPTA	Bungoma County (W.Kenya)	Gladyce Nabiswa	creadis2000@yahoo.com	Orange fleshed sweet potato
Mumias IPTA	Kakamega County (W. Kenya)	Benard Yaite	byaite@yahoo.com	Orange fleshed sweet potato
Ugunja IPTA	Siaya County (W.Kenya	Charles Ogada	charles@ugunja.org	Orange fleshed sweet potato
Kirinyaga	Central Kenya, Kirinyaga County	Tiras Githaiga	githaigah@yahoo.com www.catolicdiocesemuranga.org	Quality protein maize
Maragua	Central Kenya, Murang'a County	Tiras Githaiga	githaigah@yahoo.com www.catolicdiocesemuranga.org	Quality protein maize
Embu	Eastern Kenya, Embu County	Njana Kinyua	alexmati@yahoo.com www.doecaritas.ac.ke	Quality protein maize
Karurumo	Eastern Kenya, Embu County	Njana Kinyua	alexmati@yahoo.com www.doecaritas.ac.ke	Quality protein maize
Kathonzweni	Eastern Kenya, Makueni County	Jonathan Munyao	m.ngila@yahoo.com	Quality protein maize
Kilifi	Coastal Kenya, Kilifi County	Benjamin Musyimi Muli	musimuli2@gmail.com http//kari.org	Quality protein maize

NB: This list is not exhaustive, a comprehensive assessment is ongoing.
* IPTA: Innovation Platform for Technology Adoption

1.5.3 Extension system and organizations

i. The National Agriculture and Livestock Extension Program (NALEP)

This program was formulated in 2000 in partnership with the Swedish International Development Cooperation Agency (SIDA). NALEP became the implementation framework for National Agricultural Extension Program (NAEP). NALEP was implemented as follows:

- NALEP I (2000–2006) – this program was positively evaluated in 2006 as an innovative approach to demand-responsive and holistic extension.
- NALEP II (2007–2011) – this is the follow up program to NALEP I and was implemented between 2007 and 2011 (Cueller *et al.,* 2006).

ii. The National Agricultural Sector Extension Policy (NASEP)

National Agricultural Sector Extension Policy (NASEP) is the extension program for the Agricultural Sector Development Support Program (ASDSP) (GoK, 2005). The National Agricultural Sector Extension Policy (NASEP) has been developed to guide and harmonize management and delivery of agricultural extension under the ASDSP. ASDSP was established to provide support services at a variety of levels within the framework and other institutional actors. ASDSP's overall objective is to support the transformation of Kenya's agricultural sector into an innovative, commercially oriented, competitive and modern industry that will contribute to poverty reduction and improved food security in rural and urban Kenya.

The objectives of NASEP are to:

- Facilitate the development of pluralism in service delivery;
- Improve the efficiency and effectiveness of extension service provision from public and private sectors;
- Establish a regulatory system to guide service providers and modalities of setting operational standards, quality and norms (GoK, 2005).

1.5.4 Private R&D activities

Private sector and private philanthropic groups

The private sector players dominating agricultural innovation ecosystem in Kenya presently are large multinational companies, including:

- Monsanto;
- BASF;
- Bayer Crop Science;
- Syngenta;
- Dow AgroSciences;
- Land O'lakes (for dairy technology).

Private philanthropic groups have also played significant roles in research, including:

- The Rockefeller Foundation;
- Bill and Melinda Gates Foundation;
- Ford Foundation.

While the number of institutions supporting agricultural research has expanded over time, public expenditure and investments in agricultural innovation have not been sufficient to maintain the levels of annual growth in crop yields and conduct research in climate resilience agriculture. Government has significantly scaled back support for agriculture R&D at a time when innovation was most needed in crop and livestock production systems. Increased private funding has helped to pick up some of the slack, and has led to the

commercialization of higher yielding varieties of a handful of major crops. Industry research is aimed, for the most part, not at basic science, but rather at adding recoverable value to seeds by imparting to them the ability to overcome specific problems like disease, pests or weeds. It is primarily focused on major crop species (maize, cotton and potatoes) whose seeds are sold in sufficient quantity to provide industry the opportunity to recoup significant R&D costs through sales.

1.6 Key challenges, emerging needs and potentials in the agricultural sector

The key areas of policy concern are:

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

Key policy concerns include:

- Declining agricultural performance;
- Limited high potential agricultural land and over-reliance on rain fed agriculture;
- Limited diversification of agricultural production;
- Poor and inadequate rural infrastructure;
- Inadequate and declining research in agriculture;
- Lack of agricultural sector financing and related activities;
- Limited development and exploitation of the livestock sector;
- Lack of a comprehensive land use policy.

Based on the general approach (see Africa-wide study Chapter 4) and in pursuit of efficiency and effectiveness, investments by Germany into the agricultural and food sector are suggested in those African countries, which

- Show actual progress in sustainable agricultural productivity driven by related innovations, as indicated by comprehensive productivity measurement and innovation actions on the ground;
- Have a track record of political commitment to foster sustainable agricultural growth, as indicated by performance under CAADP, and
- Prioritize actions for hunger and malnutrition reduction and show progress, but where agricultural and rural development and nutrition interventions are likely to make a significant difference, as indicated by public policy and civil society actions.

Based on this approach, investments into the agricultural and food sector of Kenya can be expected to have significant effects on food and nutrition security improvements in the country.

Table 7: Country level Performance Indicators

Indicators	Index	Performance (%)
1. Number of Years with more than 6% agricultural growth (2005 to 2014)	7	70
2. Percentage point change in TFP index between 2001 and 2008	24	100
3. Number of years with more than 10% government expenditure (2005 to 2014)	0	0
4. Average share of agricultural GDP spent on R&D (2005 to 2011) in %	1.1	100
5. Steps in CAADP completed	6	75
6. Percentage point improvement in undernourishment between 2001 and 2011	8.5	60
7. Global hunger index (2014)	16.5	60
Total score (weighted)		68

Source: Own computation based on World Bank (2015), FAO (2014), ASTI database and von Grebmer *et al.* (2014)
Note: the % performance (rounded) is defined as follows for the respective indexes: 1. % out of 10 years; 2. classes: if <1, or negative= 0; 1 – 7= 30, 8-15= 60, > 15= 100; 3. % out of 10 years; 4. % of the AU target value of 1% spent on R&D; 5. % of the desired 8 steps; 6. classes: if < 2 = 0; if 3-5= 30; if 6-10=60, if>10=100; 7. classes: if < 12= 0; 12-16: = 60; 17-20: = 60; > 20= 100.
Total score (weighted) performance and need to invest: (sum of (1.+2.)/2 (expected growth performance); + sum of (3.+4.+5.)/3 (expected government commitment); + sum of (6.+7.)/2 (performance in food and nutrition security and need)) divided by 3.

Results of assessment (Table 7):

Expected agricultural growth performance:

- Kenya has significantly increased its agricultural growth by having seven years more than the annual 6% agricultural growth target defined by CAADP between 2005 and 2014 (www.resakss.org).
- Agricultural total factor productivity in Kenya has improved by 24% between 2001 and 2008 (Fuglie and Rada, 2011), indicating that Kenya´s commitment to research and development into the agricultural and food sector is significant.

Government commitment:

- Kenya has a track record of political commitment to foster sustainable agricultural growth by being active in the CAADP process and having completed six out of the eight steps in the CAADP process (www.resakss.org).
- Kenya spends 1.1% of its agricultural GDP on agricultural research and development, which is higher than the CAADP target value of 1% (www.asti.cgiar.org). This indicates that Kenya´s investment on agricultural innovation is high.
- However, the Kenyan government has not shown a strong willingness to invest in the agricultural sector. In no single year between 2005 and 2014, Kenya achieved the CAADP 10% agricultural expenditure target (www.resakss.org).

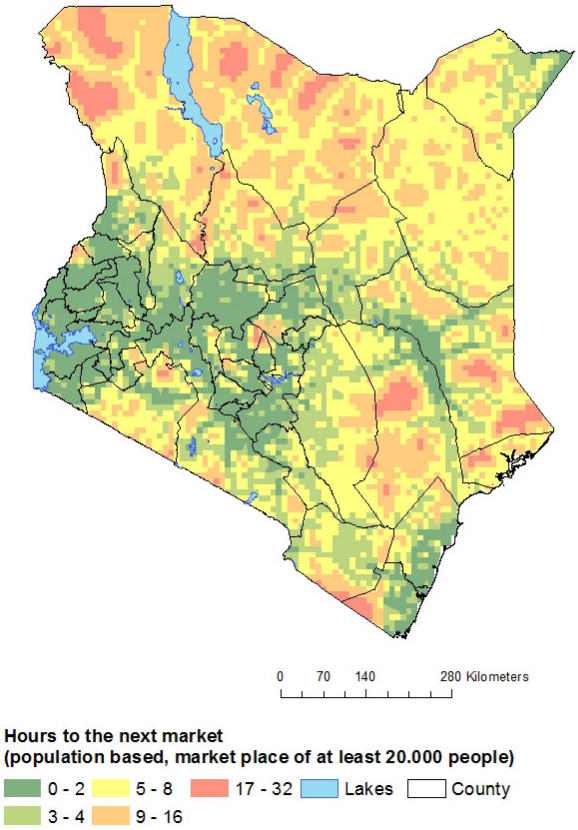
Food and nutrition security progress and need:

- Kenya is only modestly prioritizing actions for hunger and malnutrition reduction and shows less than 9% improvement in undernourishment between 2001 and 2011 (FAO, 2014).

- In addition, Kenya has the GHI score value of 16.5, reflecting a serious level of hunger (von Grebmer *et al.,* 2014)[1]. This makes the investment into the agricultural and food sector in Kenya very urgent to fight the high numbers of food in secured people.

The economic, political, and social/nutrition framework in Kenya strongly suggests accelerated investment into the agricultural and food sector of the country.

Figure 1: Distance to market



Data sources: Hours to next market - HarvestChoice, 2015;
Administrative areas: http://www.gadm.org/, accessed 20.9.2015
Inland water bodies: http://www.diva-gis.org/gData (water bodies), accessed 20.9.2015

Transportation intensive products should be promoted in areas indeed are well connected to markets, whereas the remote areas should focus on low volume and Livestock Value Chain segment.

[1] GHI score Values less than 5.0 reflect low hunger, values from 5.0 to 9.9 reflect "moderate" hunger, values from 10.0 to 19.9 indicate a "serious" level of hunger, values from 20.0 to 29.9 are "alarming," and values of 30.0 or greater are "extremely alarming"(von Grebmer *et al.,*2014).

2 Most relevant value chains in Kenya

2.1 AIC value chains

The value chains that were chosen for the agricultural innovation centres (AIC) include sweet potatoes and dairy.

2.1.1 Sweet potato value chain

In Kenya, sweet potato is considered a subsistence or famine relief crop by many households. When there is shortage in maize, sweet potato and other indigenous tubers, such as cassava, become very important in the diet of many rural households. Demand for sweet potato is also growing rapidly among the urban population due to changing consumption patterns and population growth. Generally, production of sweet potato in Kenya has steadily increased over the years. According to the Ministry of Agriculture (2011), sweet potato production increased by 89% between 2004 and 2009, a development mainly due to the availability and use of improved cultivars and farming methods which have helped increase yield per unit area (Kenyon *et al.,* 2006). In the recent past, there have been renewed efforts by the government and other players in the agriculture sector to promote production of traditional high value crops of which sweet potato is among them. For example, through the traditional high value crops (THVC) program, the government distributes to farmers improved planting materials for the crops as one of the activities in efforts to promote their production. These efforts are a result of the recognition of the important role of these crops in contributing to food security through increasing food supply to both the producers and consumers and generating income to the producers.

Sweet potato is produced mainly in Nyanza and Western province. Some cultivation of the crop is also carried out in parts of Eastern, Central and Coast provinces. Nyanza province accounts for over 50% of national sweet potato production. Homa-Bay and Migori counties in the province are the main production areas. Sweet potato production in these areas is primarily rain-fed, with few farmers practicing irrigation along rivers. The sector is dominated by smallholder farmers who practice semi-subsistence mixed farming, engaging in both livestock keeping and production of a range of crop enterprises, but not on a fully commercialized basis. The small-scale production system usually translates into scattered small quantities of output which, combined with the bulkiness and perishability of the crop, makes marketing of the sweet potato a major challenge. It is estimated that over 80% of sweet potatoes in Kenya are sold fresh and the market for the commodity is not well-organized. Post-harvest losses and low producer prices are a challenge.

2.1.2 Dairy value chain

The dairy sector is relatively well organized with a strong domestic processing presence, dominated by the cooperative sector. Competitive dairy requires significant capital investment, but allows producers to significantly leverage profitability of a relatively small plot of land. The processors tend have quite good control over the supply chain, and a ready and stable off-take market in terms of local supermarkets and groceries. As a result, financiers are more interested in opportunities in the dairy sub-sector, to the extent of looking at potential products for producers. The dairy value chain in Kenya is extensive in Kenya. It is estimated to include 5.7% of Kenya's households participate in the dairy value chain and contributes to about 3.5% of the national GDP and the annual income per producer is around US$ 600 (Pelrine, 2009). Further, both production volume and prices have increased around 19% between 2006 and 2008 (ibid).

2.1.3 Vegetables Value Chains

Vegetable production in Kenya is broadly divided into two categories: subsistence household production with minimal sales, and medium to large commercial farming/out-grower production focusing on exports and urban supermarkets (Wiersinga and Jager, 2007; Mausch *et al.,* 2006) ''Approximately 22% of the vegetables produced with an FOB (free on board) value of KES 6.8 billion are exported. The total market value of vegetables in Kenya is about US$ 188 million. While it is estimated that 3 million Kenyans grow vegetables for cash sales, only about 220,000 are engaged in vegetable production on a commercial basis and these are clustered close to major urban centers where consumers and exporters are located." (Pelrine, 2009)

2.2 Other relevant value chains

2.2.1 Maize value chain

Maize is the main staple food in Kenya, accounting for 65% of total staple food caloric intake and 36% of total food caloric intake (FAO, 2009). The average person consumes 88 kg of maize products per year (Ariga and Jayne, 2010). A more recent study shows that households in the first and second quintiles spend the greatest proportion of 'staple budget' on maize and maize products i.e. 37% and 29%, respectively (Kamau *et al.,* 2011). The Kenyan maize sector has many actors, including farmers, input suppliers (seed companies, fertilizer and pesticide suppliers), traders, millers, retailers and consumers.

2.2.2 Wheat value chains

Wheat is the second most important staple in Kenya. It accounts for about 17% of staple food consumption and its share in household food expenditure has overtaken that of maize among urban households (Muyanga *et al.,* 2005). Wheat production in Kenya is largely dominated by large-scale producers. However, demand for wheat outpace supply from both large-scale and small-scale production and thus, 60% of national wheat consumption is imported (Pelrine, 2009; Ariga and Jayne, 2010).

2.2.3 Beans value chain

Beans are the third most important staple food nationally, accounting for 9% of staple food calories and 5% of total food calories in the national diet (Ariga and Jayne, 2010).

2.2.4 Mango value chain

The mango sub-sector is characterized by a large number of small-scale producers producing low quality mangos for domestic consumption. There is limited processing, export, and value addition in the value chain. Indeed, waste in the mango value chain is relatively high with much of the crop spoiling before it reaches consumers. Another problem typical with tree fruit crops is the relatively long payback period required before an economic crop is produced. There was little finance oriented towards the mango sub-sector.

The mango value chain clearly meats strong domestic demand and has a potential for international markets. However, like the chains for other tree fruit, it is also constrained by:

- Poor quality local production unsuitable for export or juicing;
- Slow return on investment for replanting;
- Relatively weak agri-processing;
- Exposure to strong international competition;
- Poor logistics and post-harvest handling**.**

3 Innovations in value chains in the past 20 years

3.1 The most crucial limiting factors in Kenya / AIC-region / in AIC-Value Chains

The agricultural sector in Kenya has had a relatively steady growth in recent years, but more is required to ensure that the sector can respond to the national needs in a sustainable manner. Opportunities for spurring growth in the agricultural sector and in the broader economy co-exist with challenges in translating such growth into greater food security for the Kenyan populace. The key challenges revolve around productivity in the key sub-sectors, improvement in land and natural resource management, improvement in market access and trade, enhanced private sector participation, institutional reforms and improved coordination of the research and technology transfer components.

The government of Kenya aims to achieve success on these strategic thrusts through the use of holistic approaches which include consistent increase in funding to agriculture from the current 5% of GDP to the 10% as stated in the Maputo declaration. The government intends to increase the budgetary allocation by 30% which translates to 36.04 billion Kenya Shillings in 2015. The government will further adjust the existing programs and projects and will develop new projects to respond to emerging needs in the sector. These include the adverse effects of climate change and the increasing use of smart technologies and green energy as well as a shift from mechanical hoe to more efficient and environmentally friendly options. The issue of broad based capacity development is also projected as an area of interest. Towards this end, staff has already been trained to various levels through long and short term courses to ensure availability of skills that are commensurate with the demands of the sector stakeholders.

A key reform in the agricultural sector is the reform in the research bodies where the Kenya Agricultural and Livestock Research Organization (KALRO) was reorganized in 2013 with a two-pronged focus. One was to promote, streamline, co-ordinate and regulate research in crops, livestock, genetic resource and biotechnology in Kenya and the second was to expedite equitable access to research information, resources and technology and promote the application of research findings and technology in the field of agriculture. Through its 14 research institutes which are commodity based, KALRO has generated a lot of technologies that have been translated into innovations that have contributed to economic and environmental benefits in the country. The selected technologies include tissue culture bananas, improved indigenous chicken, etc.

3.2 The most important / beneficial innovations in the relevant Value Chains in Kenya

Innovation activities and strategies related to the crops sub-sector include: use of crop varieties suited for the changes in moisture and temperature; switching to farming practices that conserve soil moisture and nutrients; controlling soil erosion and improving water uptake by crops; use of seasonal forecasts; forestry and agroforestry; small-scale irrigation; disease and pest control; and conservation agriculture and micro-dosing. Among the important interventions identified for the animal sub-sector are participatory breeding of the local breeds, establishment of fodder banks, replanting rangelands, and diversification of livestock enterprises.

3.2.1 AIC value chains

A tiered approach to multiplication of orange fleshed sweet potato

Brief description

The orange fleshed sweet potato (OFSP) is a cheap source of β-carotene important in control of vitamin A deficiency, a major nutritional problem in Kenya. KARI (now KALRO)-Kakamega in collaboration with the International Potato Centre (CIP) and farmers developed a number of sweet potato technologies to increase the benefits from OFSP varieties, planting material production techniques, agronomic practices, integrated pest and disease management, post-harvest handling, storage, product development and marketing. These activities were carried out in Busia and Bungoma districts. This has led to shifting of sweet-potato from subsistence to a commercial crop. Some 17 new superior varieties have been released from 2008 to 2013. Multiplication of planting material for the OFSP varieties was done at Primary, Secondary and tertiary levels. The primary multiplication sites were established at KARI-Kakamega (0.48 ha) Alupe sub centre (0.48 ha), Yala Swamp (0.2 ha) Kibos Sugar Research Foundation (KESREF) (0.36 ha) and Muhande farm in Bungoma district. A total of 200 bags of cuttings were obtained from the primary multiplication sites. This material was then used to establish the secondary multiplication sites which later gave 600 bags of planting material. This was then multiplied further in the tertiary multiplication sites in Busia and Bungoma districts.

Why the innovation is considered a success: A three-fold root yield increase from 10 t/ha to 30 t/ha, high quality tubers are a boon to food and nutritional security in terms of calories and vitamin A content.

Drivers of success: The multi-stakeholder nature of the process led to the success realized. These actors comprised key players in the sweet potato product value chain including farmers, seed multipliers, market traders, extension agents/TOT, processors, media and CBOs.

Ways of up/out scaling the innovation: Formulation of policies that would motivate marketing of sweet potatoes as well as establishment of value addition centers such as drying and flour making would enhance the uptake of this innovation. Involvement of human health actors would play a significant role in promoting orange fleshed sweet potato as a health product.

3.2.2 Other value chains and cross-cutting innovations

(i) Promotion of Tissue Culture Banana adoption through PPP

Bananas in Kenya are a major fruit which is produced by small holder farmers and are produced in many parts of Kenya where different banana varieties are grown for different uses. The source of planting material has always been through suckers obtained from old orchards. This practice has phyto-sanitary implications since infected suckers transfer harmful pests and diseases to new sites. In response to declining banana production caused by disease-pest complexes, banana tissue culture innovation was introduced in 1997 through a collaborative project between the Kenya government, non-governmental organizations and private sector and the farmers. Tissue culture banana is a product of biotechnology. The cultivars include the Cavendish group, Williams hybrid, Gold finger, Lacatan, Valgy and Paz. Funding was from the Rockefeller Foundation of the United States of America and the International Development Research Centre (IDRC) of Canada. Implementation was by ISAAA, with KARI (now KALRO) as the host institute, working closely with other strategic partners like the Genetic Technology Laboratory (GTL) for production of

Tc-banana plantlets, the Institute of Tropical and Sub-tropical Crops (ITSC) of South Africa in the provision of technical backstopping services, amongst others. The innovation comprised preparation of tissue culture bananas in private and government laboratories, hardening in community owned hardening nurseries, technical backstopping by NGOs, public institutions and private companies. The farmers were advanced 80 banana plantlets each which is the economical banana orchard unit which they were to pay at harvest time. This micro-credit scheme worked very well and at the end of the first season farmers were willing to expand their banana orchards after paying off their credit. The farmers replaced their orchards and established new ones in various banana growing parts of Kenya. The acceptance of the TC banana propagation and the up scaling model used exceeded the *ex-ante* skepticism of its viability.

Why the innovation is considered a success: The banana TC innovation led to an increase in the quality and yields of bananas (from 10 kg per bunch to over 80 kg) and there was uniformity in maturity thus facilitating bulk marketing. Over 500,000 small-scale banana producers benefited from the innovation and banana production has been rejuvenated.

Drivers of success: Involvement of private and public actors at an early stage and especially the end users and other key players contributed to the success realized. The innovation was also introduced at a time when it was needed most and solved the challenge that was at hand.

Ways of up/out scaling the innovation: Capacity building of the end users is critical to enhance their banana production skills. It is also important to accommodate user feedback since production contexts vary from site to site. Streamlining of markets through appropriate policies would go a long way in motivating the producers

(ii) Provision of high yielding Cassava planting material

A survey conducted during the late years of 1990s showed that cassava production in the coastal lowlands of Kenya was declining in acreage and yield per unit area. The low yields were attributed to the use of local cassava varieties susceptible to Cassava Mosaic Virus and Cassava Brown Streak Disease. The declining acreage was due to inadequate planting materials at farm level.

To address the challenge, a breeding program was initiated at KARI (now KALRO) Mtwapa with the objective of developing high yielding and disease tolerant cassava varieties and in July 2008, six high yielding cassava varieties were released. The new varieties yielded between 50 and 70 t/ha, compared to 3 to 9 t/ha by the local varieties grown by farmers. The new cassava varieties were given local descriptive names such as: Karembo, Tajirika, Shibe, Karibuni, Siri and Nzalauka. Each of the names portrayed a characteristic of the variety. For example Karembo has shiny beautiful leaves, Tajirika roots are straight and preferred in the market, Karibuni can accommodate other crops and therefore good for intercropping while Nzalauka is first maturing and is the first one to 'send hunger away' which is the literal translation of the name. To enhance uptake, twenty four farmers were selected in six districts to undertake the planting material multiplication. These farmers were trained on clean cassava planting material production and entrepreneurship and encouraged to plant at least one acre of the new cassava variety which would in turn produce materials enough for 12 to 24 acres depending on spacing used.

Why the innovation is considered a success: Approximately 1.2 million cuttings of various cassava varieties were produced by the 20 entrepreneurs by the end of January 2011. In general, the entrepreneurs realized KES 597,000 from sale of cassava planting materials and

roots. One major drawback voiced by some farmers was inadequate marketing outlets for fresh cassava roots. This tended to slow down the anticipated cassava planting material business since some farmers felt they did not want to grow a crop that had no market.

Drivers of success: Development of high yielding varieties, capacity building of the farmers and availability of clean and high yielding cassava led to initial uptake. However, the bulkiness of the roots as well as the long transportation distances to the markets led to a slowing down of the uptake.

Ways of up/out scaling the innovation: There is need for setting up of small-scale processing plants at the community level and sensitizing rural communities on the use of blends of cassava flour with maize or wheat to make the commonly used meals (porridge, ugali, mahamri and chapati)

(iii) Commercialization of indigenous chicken:

Kenya has approximately 29 million indigenous chicken (IC) with over 80% of the households keeping them. Mortality rates for indigenous chicken are high, due to poor production practices, especially in feeding, housing, disease control and a lack of commercial orientation. A few farmers produce ICs intensively or through semi-intensive systems (flock sizes of 20 to over 100 chicken), which have proved profitable. The local chicken market is poorly developed and mostly informal despite significant demand for their products. A broody indigenous hen can only hatch a maximum of 10-12 chicks which take 7-8 months to attain 2kg live weight and produce about 100 eggs per year.

The Kenya Agricultural and Livestock Research Organization embarked on a program to improve performance of local chicken through selection and production/multiplication of improved indigenous chicken with varied plumage coloration. These chickens are suitable for extensive, organic and rural production systems. The improved KALRO (KARI) breeds lay between 180 – 220 eggs per year and reach slaughter weight (2kg live-weight) in 4 months. Sale of improved day old chicks from KALRO Naivasha has increased from 500 to 250,000 in the last five years through the use of automated hatcheries.

Why the innovation is considered a success: The improved hens start laying at 5 months compared to 7 months in the unimproved. They lay between 180-220 eggs in a year compared with 100 in unimproved chicken and attain slaughter weight at 4-5 months compared to 7 months in unimproved chicken. The KARI Kienyenji hen innovation has been rapidly adopted by farmers in different parts of the country. Due to this demand the poultry unit at KALRO Naivasha increased day old chick production from 74,830 to over 240,000 chicks valued at KES 24 million in 2014. In 2013 the National Gross value of the KALRO improved chicken was estimated at KES 670 million. Many resource poor farmers including IDPs have adopted the technology and are now able to take their children to school and pay for other services from the eggs and birds sold.

Drivers of success: The project took a value chain approach in the development and dissemination of the technology. Apart from developing the improved breed, disease control, feeds and feeding, good husbandry, housing and marketing were addressed. The available research facilities in Naivasha were improved and expanded to produce day old and 4-week old chicks for farmers. Therefore, making the improved breed available to farmers. Due to its relatively low input requirement this technology is popular with farmers in different parts of the country and has been used for emergency restocking programs in ASALs after droughts.

The project took a business orientation and successful businesses have been started at the Coast, Eastern, Western and Rift Valley regions thus ensuring sustainable contribution to food security. The creation of public-private partnerships to upscale indigenous chicken technologies to meet the growing existing demand. A total of 330 indigenous chicken service providers mainly from NGOs, faith based organizations and farmer groups have been trained and provide services at the local level. Another factor is the rapid increase in chicken consumption over the last decade (by over 8% p.a.) providing a market for the farmers produce. A robust indigenous chicken industry will generate incomes for the smallholder farmers who dominate its production, support the processing industry and increase supply to consumers while improving the living standards of all value chain actors.

In addition, the use of multiple information channels has raised awareness, including use of information and communication technologies to disseminate information. The project has a documentary on Youtube and a total of 36,200 hits have been recorded. Other channels include participation in breeders' show, field days, World egg day, county showcases etc.

Ways of up/out scaling the innovation: KALRO has a hatching capacity of about 200,000 day-old chicks and to sell 200,000 fertile eggs per year against an estimated national demand of 1.5 million annually. Therefore, there is need to expand the capacity at KALRO Naivasha and Kakamega Centres to improve accessibility. Currently farmers have to wait for up to 6 months to access day-old chicks. There is also need to develop a PPP strategy in the hatching of chicks from the KALRO breed. This will allow private sector to multiply the chicks under the supervision of KALRO to avoid unscrupulous people defrauding the farmers. Finally, capacity building for farmers owning small incubators is required to improve hatching percentage. Currently many of the farmers are attaining less than 10% hatch rate.

3.3 Most promising approaches for farmer and small business related VC innovations

- pending further information -

4 Suggestions for Collaboration

4.1 Promising Agricultural Products and Value Chains

Besides assessing the returns of investments into institutional innovations in Kenya, analysis to choose the most promising value chains in the country is also undertaken. In compliance with the availability of data and the purpose of the study four criteria that focus on poverty and market potential are used to select the five most promising agricultural products from the long list of agricultural products the country produces and sells.

The first indicator, the trade potential (revealed comparative advantage (RCA) index), is computed to identify value chains over which the country has revealed (but not potential) comparative advantage. In the present case, the RCA index compares the share of a given agricultural product in Kenya's export basket with that of the same product in total world exports. The second indicator, yield gap, is used to assess the expected return of the envisaged Germany investment on the given AIC country value chains. A third indicator, average yield growth, is used to examine the potential of the product for poverty reduction. The production share of total supply is also used to assess the present integration of the poor in the market (relevance).

The summary of the most five promising value chains based on Revealed Comparative Advantage (RCA) index, average yield growth and relative yield gap is reported in Table 8

below. The production share, RCA index, actual yield growth and relative yield gap for the GIZ-selected value chain(s) is also reported at the bottom of the table, when they are not included in the list of the first five most promising value chains.

Table 8: Selection of promising agricultural products /value chains

	Rank by RCA		Rank by Yield progress***		Rank by yield gap		Rank by relevance of crop	
Rank	**Name of agricultural product**	**RCA index (2012)**	**Name of the crop**	**Average annual yield growth (2005 to 2012)**	**Name of Stable crop (rain fed)**	**Relative yield gap (%)****	**Name of agricultural product**	**Production share of supply (2012)***
1	Beans, green	11,516	Cassava	18	Maize	87	Cloves	200
2	Tea	5,231	Wheat	12	Millet	86	Pineapples and products	125
3	Peas, green	4,370	Rice, paddy	12	Sorghum	86	Pulses, Other and products	106
4	Nuts, nes	1,211	Bananas	8	Wheat	86	Cream	105
5	Crude materials	663	Beans, dry	8			Coffee and products	102
GIZ selected	Milk, whole fresh cow	79	Papaya	8			Sweet potatoes	100
	Sweet potatoes	24	Sweet potatoes	-3			Butter, Ghee	100

Source: * Own computation based on FAO 2015 data, ** from Van Bussel *et al.* (2015)
Note: *** a minimum of 0.5% production (volume) share threshold is used as a screening (crop relevance) criteria.

Results of assessment (Table 8):

- The trade potential (revealed comparative advantage (RCA) index) is very high for green beans, tea, green peas, nuts and crude materials. This indicates that Kenya has a comparative advantage (in the export) of these commodities The RCA value for the two GIZ selected value chains, namely dairy and sweet potatoes, is also very high indicating that Kenya still performs better than the world average in the exports of these products;
- The yield performance indicating progress suggests that over the CAADP period (2005 to 2012), cassava, wheat, paddy rice, bananas (selected by GIZ) and dry beans are the five most promising crops. Other horticulture crops such as papayas and avocados also as the top ten promising crops according to the yield progress indicator. However, the yield growth of the other selected value chain, sweat potatoes, was negative over the CAADP period;
- Yield gaps indicate potentials from another angle, and is observed to be high for rain fed maize, sorghum, millet and wheat indicating the high potential return of investing on these value chains;
- In terms of relevance (production share of supply) cloves, pineapples and products, pulses, cream and coffee value chains are the leading. The total production of these commodities exceeds the total market supply. The result also indicates that total market supply of the two GIZ selected value chains are domestically produced.

4.2 A systematic assessment of promising partnerships for each promising innovation area

There is long standing collaboration between the organizations in German and Kenya on agricultural research and development. The different partnership revolved around various research themes for technology generation. However, there is new thinking amongst the African agriculture stakeholders that tends to give more attention to research activities and the process to translate research outputs to development outcomes and impact on the country's economy.

This thinking has led to the use of the innovation systems approach and the development of the innovation platforms as the implementation framework for technology generation, dissemination, adoption and use. The innovation systems approach also give attention to the complementary process that will translate research output into development outcome, outside the demand driven research process and other benefits.

FARA has developed the Integrated Agricultural Research for Development (IAR4D) concept, which provided the guidelines that aid the generation of measurable impact from research endeavors. In the last eight years, it has conducted trials towards the proof of the IAR4D concept and this precedes the scaling-up and scaling-out of the concept across the continent.

The scaling-up of the Innovation platforms in the different countries is a major area for partnership which the countries would like to explore with stakeholders from Germany. This will however be best placed along the strategic commodities and themes in the different countries.

4.3 Some potential partners for the German collaboration: in science and research, private sector and NGOs and governmental organizations

A good partnership framework is essential to bring the Germany – Kenya collaboration to fruition. Prospective partners with Germany in Kenya will include the apex research institution in Kenya, *Kenya* Agricultural and Livestock Research Organisation (KALRO), the ministry of agriculture, Livestock and Fisheries, the Universities, the advance research institution and the civil society organizations, viz., the farmers' association, the non-governmental organization and the relevant private sector.

4.4 Needed implementation research

The agricultural development plans of the Kenya government, alongside the strategic priorities of the national agricultural research systems has identified a number of prime commodities and value chains to be given attention and indicated in the last chapter. Collaboration in research for technology generation along these commodities will be a vital route for collaboration for impact.

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