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Agricultural Growth and Poverty Reduction in Kenya: Technical Analysis for the Agricultural Sectoral Development Strategy (ASDS)—Medium Term Investment Plan (MTIP)

Athur Mabiso, Karl Pauw, Samuel Benin

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Abstract

Kenya's Medium Term Investment Plan (MTIP) outlines the government's investment strategy for achieving the goals of the Agricultural Sectoral Development Strategy (ASDS), which are in alignment with the Comprehensive African Agricultural Development Programme (CAADP). In implementing the plan, the government seeks to prioritize investments across the country's three major agroeconomic zones (AEZ). This study, commissioned to analyze growth and investment options across the three AEZ, revised and updated Kenya's Social Accounting Matrix (SAM) so that productive activities and households are disaggregated by AEZ. Following the SAM revision, Computable General Equilibrium (CGE) model simulations were performed to identify priority subsectors and commodities within each AEZ. The simulations were based on criteria jointly established by a task team and stakeholders during expert panel sessions, taking into account the relative importance (weighting) of regional versus national poverty or of different subsector-led growth scenarios. Past public expenditures in each AEZ were then analyzed together with planned regional investments, as delineated in the MTIP, thus indicating potential outcomes that may arise from the proposed regionalized investments. Results of the CGE analysis suggest that for Kenya to achieve the CAADP goal of 6 percent agriculture GDP growth rate, subsector growth would have to increase significantly across the board, with maize, other roots, pulses, fruits and tea each requiring growth rates greater than 6 percent. Export crops would also have to perform exceedingly well, growing at 6.2 percent. Results also show that in the CAADP scenario, national poverty declines to 24 percent, which represents an additional 4.2 percentage-point poverty reduction between 2010 and 2020 as compared to the baseline scenario. Households in high-rainfall areas would benefit the most from the CAADP investment scenario compared to the baseline, in relative terms, and see their poverty rate slashed by slightly more than half to 15.3 percent. Poverty in the arid areas would drop to 50.2 percent, which in relative terms is the smallest reduction in poverty—although in absolute terms the reduction is similar to that in semi-arid areas, where a 20 percentage point poverty reduction is observed. The review of the MTIP by AEZ shows that it rightly dedicates more to the semi-arid areas, particularly for irrigation and roads infrastructure as well as value chain developments. This is in line with the CGE results and previous studies, which show that Kenya can significantly reduce national poverty if more investments are directed to semi-arid areas' irrigation and road infrastructure. The allocation of investments by subsector is however not discussed in the MTIP; ensuring adequate investments in maize and root crops in the semi-arid and high rainfall areas would be important. Also, increasing investments in traditional exports in the high rainfall areas would be critical for agricultural growth though having less effect at reducing national poverty due to weaker economywide linkages (multiplier effects). Investments in the arid areas are also important, particularly in terms of livestock and enhancing resilience to drought. However, given its smaller population and weaker linkages to the rest of the economy, investments in the arid areas are least effective at reducing national poverty. Therefore, finding ways of enhancing these linkages and of crowding in private sector investments as well as coordinating public investments at the regional level across countries could create significant synergies. Likewise, linking public investments across sectors within government and with the private sector could enhance synergies and is worth considering for the future.

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I. BACKGROUND

Kenya's Medium Term Investment Plan (MTIP) (ASCU 2010) outlines the investment strategy required for achieving the goals of the Agricultural Sectoral Development Strategy (ASDS), which are aligned with those of the Comprehensive African Agricultural Development Programme (CAADP). Key in this regard is achieving the target of 6 percent agricultural GDP growth over the period 2010–2020. Earlier analysis by Thurlow and Benin (2008) has demonstrated how agricultural growth of 6 percent is ambitious but achievable if significant increases in agricultural yields are realized (their analysis is for the period 2007–2015). Rapid agricultural growth, they find, will contribute almost one percentage point to overall GDP growth and is strongly pro-poor. For example, by 2015, an accelerated agricultural growth scenario will result in a five-percentage-point reduction in poverty over and above what can be achieved under a business-as-usual growth path.

Thurlow and Benin (2008) also warn that not everyone will benefit equally under a broad-based CAADP growth scenario; for example, provinces that grow higher-value export-oriented crops and which are better situated to larger urban markets (for example, Central Province and Rift Valley) stand to gain more than the other more remote provinces with less favorable agroecological conditions (for example, North Eastern province). Also, while both rural and urban households benefit from faster agricultural growth, rural households benefit more given their production and consumption patterns. Growth in maize (or cereals in general) and traditional export crops tends to have a larger impact on poverty reduction at the national level; hence, the structure of agricultural growth matters for poverty reduction.

Attaining 6 percent agricultural growth requires commitment and buy-in from government. Thurlow and Benin (2008) conclude that substantial increases in agricultural spending as well as improvements in the efficiency of public spending will be needed. For example, in their optimistic scenario they estimate that the Kenyan government would have to allocate 8–11 percent of its total budgetary resources to agriculture by 2015. Under a more pessimistic scenario, which assumes lower returns to investment, the allocation to agriculture would have to be 14–22 percent of the total budget. Since 2000 the budget allocation has ranged from 4–7 percent.

Currently the Government of Kenya (GOK) is looking to prioritize its investments across the three major agroeconomic zones (AEZ), as indicated in the ASDS-MTIP, which the analysis by Thurlow and Benin (2008) addresses to the extent that provinces match one-on-one with the AEZ. Since several of Kenya's provinces, the unit of analysis in the Social Accounting Matrix (SAM) used by Thurlow and Benin (2008), span more than one AEZ, this study was commissioned to assist the Kenyan government in analyzing growth and investment options

across the three AEZ. This approach to designing an agricultural development and investment strategy seems appropriate given vast differences across AEZ in terms of the types of agricultural activities that are dominant and the respective agricultural growth potential. The AEZ also differ in terms of socioeconomic outcomes (for example, poverty or access to opportunities and services).

The specific objectives are:

1. Revise Kenya's Social Accounting Matrix (SAM) so that productive activities and households are disaggregated by agronomic region.
2. Rerun the CGE simulations in order to identify priority subsectors and commodities within each agronomic region based on criteria that are jointly established with the task team and other stakeholders; particularly, the relative importance or weighting of regional versus national poverty or of different subsector-led growth scenarios.
3. Redo investment analysis to identify priority investments to achieve the agricultural growth rates and related outcomes associated with the different subsector and commodity growth rates within the different agronomic regions, taking into account any investment-growth and investment efficiency parameters established in the ASDS-MTIP document.

Next we present the features of the AEZ, followed by the new SAM and results of the CGE simulations. The investment analysis is then presented, followed by concluding remarks.

II. AGROECONOMIC ZONES

Figure 1 shows a map of Kenya with the three AEZ. Below we summarize some of the key features of each region (see Thurlow et al. 2007; ASCU 2010):

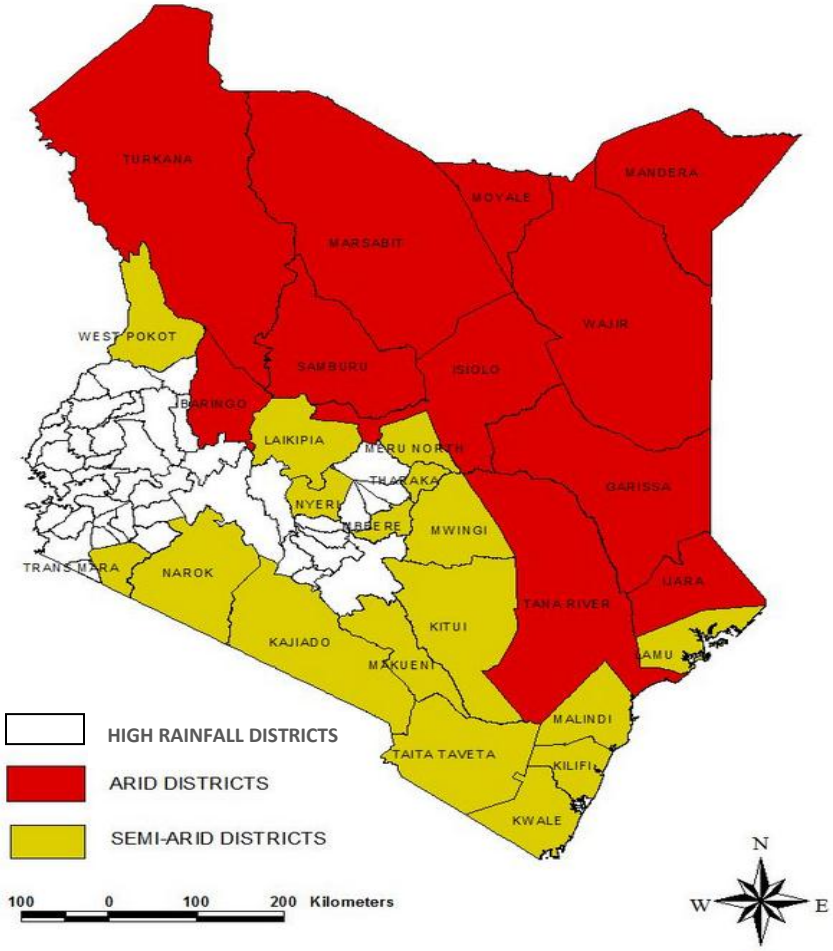
- The **arid** north (also sometimes referred to as the lowlands) receives 150-450mm of rain per year. Most farmers are pastoralists and although the population is small—about 12.5 percent of the national population (Table 3)—food security is a major concern in the arid areas. Poverty is high, estimated at around 73.3 percent, and the region contributes very little to national agricultural output (Table 4) and overall GDP (about 5 percent). Agricultural practices remain primitive, while frequent droughts make the region less suitable for crop production. Weak hydrological, sanitation, and road infrastructure further contribute to the agricultural sector's vulnerability and the region's remoteness.

- **Semi-arid** areas (or the midlands) are located mainly in the southern and coastal areas of Kenya. The region receives 450-870mm rain on average every year and is characterized by a more diverse set of agricultural activities compared to arid areas (for example, rain-fed and irrigated agriculture, agro-pastoralism, bio-enterprise, ranching, and conservation or

tourism-related activities). A large share of agricultural land is used for grazing, but the region is also home to over two million smallholder crop households; hence it serves as an important crop region. Although there is little land development and only a few irrigation schemes, the region is rapidly opening up for cultivation and is better-serviced than arid areas. The region has a very high population density (approximately eight times that of arid areas) and is home to 43.2 percent of Kenyans, and, although at 50.5 percent poverty is lower than in the north, 46.8 percent of Kenya's poor live in the midlands.

- The remaining are **high-rainfall** areas (HRA) (that receive more than 1000mm per year), also known as the highlands. The land terrain in the HRA varies significantly, thus making the region suitable for a wide range of crops (for example, maize, tea, coffee, pulses, root crops, horticultural crops and wheat) and livestock farming (for example, poultry, sheep, goats, bees and dairy cattle). Households generally have secure access to water for both domestic use and agricultural production. Land units are small, averaging less than two hectares per capita. The region is home to 44.3 percent of Kenya's population, and given its small size in terms of land area, it also has the highest population density. Rapidly expanding urban centers in the highlands continually cause agricultural land sizes to decline and expansion of agricultural land is highly limited. Thus, high population density, rapid growth, and intensive farming practices all contribute to the environment challenges facing the region, including deforestation, erosion, and diminishing water resources. Despite smaller landholdings, the favorable climate lends itself to high value horticulture, while good infrastructure generally provides better access to water and (large urban) markets. As a result poverty is much lower in the HRA (estimated at about 35.4 percent).

Figure 1.Agroeconomic Zones (AEZ) of Kenya



Source: Arid Lands Resource Management Project (ALRMP 2011) <http://www.aridland.go.ke>

III. MODELING AGRICULTURAL GROWTH AND POVERTY REDUCTION BY AEZ

In designing the accelerated agricultural growth scenario, Thurlow and Benin (2008) assumed different yield increases for different crops, based on historical trends and an analysis of crop yield growth potential, but these yield increases were assumed to be uniform within each province. A more appropriate approach would have been to assume that yield potential varies by region, depending on (for example) the suitability of growing certain crops in specific regions and the levels of public investments targeted at each crop/activity and region. In this updated complementary analysis, we follow a very similar approach to the earlier analysis of Thurlow and Benin (2008), but modify the CGE model by disaggregating across AEZ. In addition, rather than assume yield increases solely based on historical productivity growth trends and yield gaps, we use productivity growth estimates derived from focus group discussions with

agricultural expert panels in Kenya. These expert panel sessions were convened at the International Livestock Research Institute (ILRI) in February 2011 with a variety of crop and livestock experts from local research institutes, universities, and ministries in the government. Prior to attending the sessions, the expert panels were provided with information on historical yields, yield gaps, and public spending on agricultural projects in Kenya. They were also asked to review any literature they thought would be pertinent to the discussions on projecting the future yields as well as on national and region-specific public and private investments in different crops and livestock. The experts were then asked to prepare notes based on their assignments and asked to bring these to the expert panel focus group discussions. During the expert panel focus group discussion sessions, a moderator presented data on historical trends in yields for different crops in different regions of Kenya using data compiled by the Ministry of Agriculture and the Kenya Institute for Public Policy Research and Analysis (KIPPRA). This was followed by a presentation of data on public investments and agricultural projects implemented in Kenya in the last decade to enhance productivity. Having made the presentations the expert panels were asked to discuss and make projections of percentage increases in yields and productivity for different crops and livestock in each AEZ. The information gathered from these expert panels was then used in designing the accelerated agricultural growth scenario in the CGE model simulations.

With the reorganization of the CGE model, there is arguably greater homogeneity among producers within AEZ than was the case with the provincial model of Thurlow and Benin (2008); thus, production technologies embedded in the model are also thought to be more representative of farmers in each AEZ.

IFPRI's Kenya computable general equilibrium (CGE) model captures trade-offs and synergies from accelerating growth in alternative agricultural subsectors, as well as the economic inter-linkages between agriculture and the rest of the economy. The macroeconomic structure of the underlying social accounting matrix (SAM) upon which the model is based follows that of the SAM used by Thurlow and Benin (2008). The SAM is constructed from a variety of data sources, including the 2007 national accounts and the supply-use tables from the 2003 IFPRI-KIPPRA SAM (Kiringai et al. 2006).

The model identifies 53 subsectors, 24 of which are in agriculture (see Table 1). Agricultural crops fall into five broad groups: (i) cereal crops, which are separated into maize, wheat and barley, rice, sorghum, and millet; (ii) root crops, which are separated into cassava and other roots, such as sweet potatoes; (iii) pulses and nuts, which are separated into pulses, such as beans, and oilseed crops, such as groundnuts; (iv) horticulture, which is separated into fruits and vegetables; and (v) higher-value export-oriented crops, which are separated into cotton, sugarcane, coffee, tea, tobacco, and other export crops, such as pyrethrum and flowers. The CGE model also identifies five livestock subsectors, including cattle, dairy, poultry, sheep and

goats, and other livestock, such as pigs. Forestry and fisheries are also included as agricultural subsectors.

Table 1.Agricultural commodities and nonagricultural sectors in the CGE model

	AGRICULTURE		**MANUFACTURING INDUSTRIES**
	CEREALS		FOOD PROCESSING
1	Maize	26	Meat & dairy
2	Wheat	27	Grain milling
3	Rice	28	Sugar & bakery & confectionary
4	Sorghum	29	Beverages & tobacco
5	Millet	30	Other manufactured food
	ROOTS		OTHER MANUFACTURING
6	Cassava	31	Textile & clothing
7	Other roots	32	Leather & footwear
	PULSES	33	Wood & paper
8	Pulses	34	Printing and publishing
9	Oil seeds	35	Petroleum
	HORTCIULTURE	36	Chemicals
10	Fruits	37	Nonmetallic products
11	Vegetables	38	Metals and metal products
	EXPORT CROPS	39	Machinery & electronics
12	Cotton	40	Other manufactures
13	Sugarcane		**OTHER INDUSTRIES**
14	Coffee	41	Water
15	Tea	42	Electricity
16	Tobacco	43	Construction
17	Other cash crops		**SERVICES**
	LIVESTOCK	44	Trade
18	Beef	45	Hotels
19	Dairy	46	Transport
20	Poultry	47	Communication
21	Sheep, goats	48	Finance
22	Other livestock	49	Business services
23	FISHING	50	Other services
24	FORESTRY	51	Administration
		52	Health
25	**MINING**	53	Education

In addition to the rich information on the agricultural sector, the CGE model contains detailed information on the nonagricultural sectors. Five agricultural processing activities are identified in the model, including: meat and dairy; grain milling; sugar refining; beverages and tobacco; and other food processing. The model also includes ten other manufacturing sectors, other industries (which include water, electricity and construction sectors), and nine services sectors. For the purpose of this study, the provincial boundaries in the Thurlow and Benin (2008) SAM have been removed and replaced by AEZ. The 53 activities are therefore disaggregated across

Kenya's three AEZ (see Figure 1) rather than by province. Since national accounts data are not available by AEZ, GDP data from an earlier AEZ-based SAM (Kiringai et al. 2006), data on wage earnings in the Kenya Integrated Household Budget Survey (KIHBS) 2005-06 (KNBS 2007), and the most recent district-level crop production statistics collected from the Ministry of Agriculture (MoA) are used to disaggregate GDP.

Domestically produced commodities are either exported or demanded domestically by households or various downstream processing activities. The allocation of domestic production across domestic and foreign markets is determined by an elasticity of transformation function. Following Thurlow and Benin (2008), a rather high elasticity of substitution is assumed ($\sigma = 6$), which means results should be treated as optimistic about the ability of domestic producers to exploit export opportunities that may arise as a result of domestic productivity enhancements. Most exports from Kenya already originate from a few select sectors (see Table 2). Agriculture is responsible for around 27.4 percent of total export earnings, the bulk of which is supplied by export sectors. Tea alone provides 17.0 percent of export earnings. Manufacturing sectors contribute a further 20.6 percent, with textiles being the largest contributor (4.1 percent). However, the largest export sector is the services sector, with trade, transport, and hotel services together generating 47.4 percent of Kenya's export revenues. The export intensity (EI) measures the share of domestic production that is exported. With an EI of around 96 percent the agricultural export sectors are clearly dedicated to produce for the export market.

The AEZ disaggregation also applies to factors of production (land, capital, livestock, and labor). In addition to the AEZ disaggregation, labor is further disaggregated into three skill groups, namely skilled, semi-skilled and unskilled, based on KIHBS 2005-06 data. There are 18 factor groups in total. Producers maximize profits subject to a nested production structure, whereby intermediate inputs are used in fixed proportions, while substitutability between different types of factors of production is determined by a constant elasticity of substitution function. To ensure consistency between our model and the earlier analysis by Thurlow and Benin (2008), we assume a substitution elasticity of $\sigma = 3$ for all activities. As shown in Table 2. Export intensities, factor intensities and value added shares, between 15 and 20 percent of value addition in the agricultural subsectors accrue to unskilled workers, most of who can be classified as self-employed farm labor. Around two-thirds of the agricultural value added accrues to land. Livestock and fisheries are more unskilled-intensive than crops (45-50 percent value added share), while in the nonagricultural sectors skilled and semi-skilled workers capture a greater share of value added. With respect to all labor, the second part of shows that workers in agricultural sectors capture about one fifth of labor value added, despite making up more than two-thirds of total employment. This reflects low wages for unskilled workers in the agricultural sector.

Households groups are also disaggregated by AEZ. Within each AEZ we distinguish rural farm, rural nonfarm, and urban households, and each of these are in turn disaggregated by income quintile, thus giving 45 household groups in the model. Consumption patterns and income sources of these household groups are also estimated from the KIHBS 2005-06.

The CGE model captures the initial cropping patterns in each of the AEZ. The representative farmer in each region responds to changes in production technology and commodity demand and prices by reallocating land across different crops in order to maximize incomes. While this would be a strong assumption had we modeled any adverse shocks (for example, international price shocks) within any particular year, the simulations here assume steady changes in productivity across different subsectors, causing farmers to gradually change land allocation over a long period of time. These farmers also reallocate their labor and capital between farm and nonfarm activities, including livestock and fishing, wage employment, and diversification into nonagricultural sectors, such as transport, trade and construction. Thus, by capturing production information across subnational regions, the CGE model combines the national or macroeconomic consistency of an economywide model with region-level production models. The model is thus an ideal tool for capturing the growth linkages and income- and price-effects resulting from accelerating growth in different agricultural sectors.

The model endogenously estimates the impact of growth on household incomes in a micro-simulation module that is linked sequentially to the core CGE model. In this module each household questioned in the KIHBS 2005-06 is linked to one of the 45 representative household groups in the CGE model. Changes in representative households' consumption and prices in the CGE model are passed down to the corresponding households in the survey, where total consumption expenditures are recalculated. This new level of per capita expenditure for each survey household is compared to the official poverty line, and standard poverty measures are calculated for each modeled scenario. For further detail on behavioral assumptions and model equations see Thurlow and Benin (2008). Table 3 and Table 4 summarize some of the key population and (crop) agricultural characteristics of the three AEZ, while Table 2 summarizes information on the distribution of value added across sectors and different types of factors of production.

Table 2. Export intensities, factor intensities and value added shares

	Export trade patterns		Factor intensity and value-added shares									
			Share of total value added (row sums to 100%)									
	Export shares (%)	Export intensity (exports as share of output) (%)	Skilled labor (%)	Semi-skilled labor (%)	Unskilled labor (%)	*All labor (%)*	Agricultural land (%)	Livestock capital (%)	Agricultural capital (%)	Nonagricultural capital (%)	*All capital and land (%)*	Value added share of total output (%)
National	100.0	14.3										
Agriculture, forestry and fishing	27.4	20.2	5.1	1.4	24.3	*30.8*	48.9	8.7	11.5	0.0	*69.2*	68.7
Cereals	0.1	0.5	2.8	0.6	18.1	*21.5*	69.4		9.2		*78.5*	67.8
Roots	0.0	0.0	2.3	0.5	15.0	*17.8*	70.4		11.7		*82.2*	74.0
Pulses	0.8	6.4	2.7	0.5	17.4	*20.7*	69.4		9.9		*79.3*	74.5
Horticulture	2.5	10.9	3.1	0.6	19.6	*23.3*	65.7		11.1		*76.7*	71.7
Export crops	23.0	96.3	6.0	2.5	17.8	*26.3*	63.9		9.9		*73.7*	70.2
Livestock	0.1	0.3	10.6	2.7	45.1	*58.4*		41.6			*41.6*	58.5
Fishing	0.9	43.0	5.7	1.5	48.7	*55.9*			44.1		*44.1*	79.3
Forestry	0.0	0.1	4.8	1.2	20.3	*26.3*			73.7		*73.7*	89.4
Non-agriculture	72.6	12.9	25.2	15.4	4.5	*45.1*	0.0	0.0	0.0	54.9	*54.9*	47.6
Mining	2.1	38.2	4.8	14.9	4.8	*24.6*				75.4	*75.4*	49.6
Food processing	2.4	5.5	31.7	10.4	3.1	*45.2*				54.8	*54.8*	26.2
Other manufacturing	20.6	27.6	10.6	30.1	2.5	*43.3*				56.7	*56.7*	38.0
Other industry	0.0	0.0	15.3	23.1	13.1	*51.6*				48.4	*48.4*	30.7
Services	47.5	13.0	28.3	12.7	3.9	*44.8*				55.2	*55.2*	55.6

Source: Author's calculations using IFPRI Social Accounting Matrix (SAM) for Kenya (2007).

Table 3. Population distribution across urban-rural and farm-nonfarm households, by AEZ

		High-rainfall areas				Arid areas				Semi-arid areas			
	National	Rural farm	Rural nonfarm	Urban	Total	Rural farm	Rural nonfarm	Urban	Total	Rural farm	Rural nonfarm	Urban	Total
Population ('000)	35,417	10,444	1,434	3,796	15,674	3,352	673	411	4,437	13,052	700	1,554	15,306
Quintile 1 (%)	25.0	13.5	15.1	1.9	10.9	45.2	59.7	11.6	44.3	24.8	21.4	2.1	22.3
Quintile 2	25.0	21.5	20.5	4.0	17.2	26.7	15.8	13.5	23.8	24.3	15.4	2.8	21.8
Quintile 3	25.0	25.5	16.2	10.9	21.1	15.3	11.4	17.0	14.9	21.2	18.8	14.1	20.3
Quintile 4	25.0	23.5	23.4	18.8	22.3	8.3	7.9	26.3	9.9	19.9	19.5	27.7	20.6
Quintile 5	25.0	15.9	24.8	64.4	28.5	4.5	5.3	31.6	7.2	9.8	24.9	53.3	14.9
No.h'holds ('000)	6,954	1,981	392	1,038	3,411	501	128	90	719	2,271	171	382	2,823
Household size	5.1	5.3	3.7	3.7	4.6	6.7	5.3	4.6	6.2	5.7	4.1	4.1	5.4
Poverty rate (%)	46.7	38.4	36.7	26.5	35.4	74.7	77.1	56.5	73.3	52.9	36.3	37.0	50.5
Share of poor (%)	100.0	24.3	3.2	6.1	33.6	15.1	3.1	1.4	19.7	41.7	1.5	3.5	46.8
Share of pop (%)	100.0	29.5	4.0	10.7	44.3	9.5	1.9	1.2	12.5	36.9	2.0	4.4	43.2

Source: Authors' calculations using 2005/06 Kenya Integrated Household Budget Survey (KIHBS)

Note: The poverty rate is the poverty headcount based on rural and urban poverty lines

Table 4. Crop land distribution, yields and production (2007), by AEZ

	High-rainfall areas				Arid areas				Semi-arid areas				National	
	Crop land (ha) ('000)	Land share of national (%)	Yield (mt/ha)	Production share of national (%)	Crop land (ha) ('000)	Land share of national (%)	Yield (mt/ha)	Production share of national (%)	Crop land (ha) ('000)	Land share of national (%)	Yield (mt/ha)	Production share of national (%)	Crop land (ha) ('000)	Yield (mt/ha)
CEREALS														
Maize	1,000.9	61.5	2.30	78.7	47.7	2.9	0.57	0.9	579.8	35.6	1.03	20.4	1,628.5	1.79
Wheat	75.4	53.8	3.66	80.1	4.6	3.3	1.49	2.0	60.2	42.9	1.02	17.9	140.2	2.45
Rice	16.5	89.7	2.40	83.8	0.0	0.0	0.00	0.0	1.9	10.3	4.05	16.2	18.4	2.57
Sorghum	108.9	70.3	0.98	72.8	6.0	3.9	0.46	1.9	40.0	25.8	0.93	25.4	154.9	0.95
Millet	52.7	41.2	1.42	62.5	3.2	2.5	0.83	2.3	71.9	56.3	0.59	35.3	127.7	0.93
ROOTS														
Cassava	45.0	84.0	9.78	86.9	0.1	0.2	1.60	0.0	8.4	15.8	7.87	13.1	53.6	9.47
Other roots	181.9	94.0	8.39	93.7	0.0	0.0	5.46	0.0	11.6	6.0	8.87	6.3	193.5	8.42
PULSES														
Pulses	652.8	45.2	0.68	60.8	17.8	1.2	1.03	2.5	773.6	53.6	0.35	36.7	1,444.2	0.51
Oil seeds	135.1	82.3	1.00	81.8	0.0	0.0	0.00	0.0	29.1	17.7	1.04	18.2	164.2	1.01
HORTICULTURE														
Fruits	124.8	76.3	14.83	77.6	3.4	2.1	4.05	0.6	35.4	21.7	14.71	21.9	163.7	14.58
Vegetables	139.4	96.2	11.42	95.9	0.2	0.2	6.93	0.1	5.3	3.7	12.49	4.0	144.9	11.45
EXPORT CROPS														
Cotton	17.0	46.1	0.47	29.5	1.3	3.4	0.96	4.4	18.6	50.5	0.97	66.1	36.8	0.74
Sugarcane	59.2	100.0	70.87	100.0	0.0	0.0	0.00	0.0	0.0	0.0	0.00	0.0	59.2	70.87
Coffee	153.8	90.5	0.22	90.5	0.0	0.0	0.00	0.0	16.2	9.5	0.22	9.5	170.0	0.22
Tea	135.0	90.5	2.48	90.5	0.0	0.0	0.00	0.0	14.2	9.5	2.48	9.5	149.2	2.48
Tobacco	14.0	94.0	1.33	94.0	0.0	0.0	0.00	0.0	0.9	6.0	1.33	6.0	14.9	1.33
Cash crops	26.5	59.7	0.62	39.8	7.5	16.8	0.02	0.4	10.4	23.5	2.38	59.9	44.4	0.94

Source: Authors' calculations using Ministry of Agriculture district-level agricultural production data, FAOSTAT (FAO, 2008), and 2005/06 Kenya Integrated Household Budget Survey (KIHBS).

IV. MODEL AND RESULTS

Simulation setup

We use the CGE and micro-simulation model to examine the impact of Kenya's current growth path on growth and poverty reduction. This "business-as-usual" or baseline scenario draws on historical production trends for various agricultural and nonagricultural subsectors at the AEZ level. The baseline, which is solved for the period 2010–2020, therefore assumes, with some degree of freedom, a continuation of the trends observed during 1998–2008. Kenya experienced fairly rapid growth during 2002–2007, with national GDP growing at over five percent per year. The agricultural sector did not grow as rapidly, with an average growth rate of 3.5 percent per year (Thurlow and Benin 2008). Nonagricultural sectors performed well, with historical growth rates averaging 5–6 percent per year. As results below reflect, these broad sectoral growth trends are roughly replicated in our modeled baseline simulation, which is solved for the period 2010–2020.

At the agricultural subsector level, yield growth has been generally disappointing for many crops in Kenya. Some of the best-performing crops in the high-rainfall areas were maize, millet and cassava, for which we exogenously apply total factor productivity growth rates of 3.4, 4.0 and 7.4 percent respectively in the baseline scenario (see Table 4). The only well-performing crop in arid areas was vegetables, for which 5.1 percent increase in yields is observed historically. Wheat performed well in semi-arid areas, with yields growing at 2.7 percent per year. Thurlow and Benin (2008) point out that about 40 percent of agricultural growth during 1990–2007 was driven by land expansion, with the rest resulting from changes in cropping patterns and improvements in yields. Our own analysis of cropping data reveals a 1.4 percent average annual expansion in cultivated land in high-rainfall areas, compared to 4.8 and 2.3 percent in arid and semi-arid areas respectively. High-rainfall areas therefore experienced fairly rapid yield growth across a broad range of crops, but had a lower rate of land expansion than in the other areas. These land growth rates are assumed to continue over the 2010–2020 period, thus acting to some extent as an output growth-equalization factor across the different AEZ.

Table 5. Exogenous total factor productivity growth factors (agricultural sectors)

	Baseline scenario			CAADP scenario		
	High-rainfall areas (%)	Arid areas (%)	Semi-arid areas (%)	High-rainfall areas (%)	Arid areas (%)	Semi-arid areas (%)
Cereals						
Maize	3.4	0.0	0.0	4.5	3.0	3.5
Wheat	2.0	0.0	2.7	3.0	2.2	2.5
Rice	1.3	0.0	0.0	2.0	2.5	0.5
Sorghum	0.0	0.0	0.0	3.0	2.2	2.5
Millet	4.0	0.0	0.0	3.0	2.2	2.5
Root crops						
Cassava	7.4	0.0	0.0	5.0	3.0	3.4
Other roots	0.0	0.0	0.0	5.7	5.3	5.4
Pulses and nuts						
Pulses	2.5	0.0	0.0	3.0	2.3	2.5
Oilseed crops	0.0	0.0	0.0	3.0	2.3	2.5
Horticulture						
Fruits	0.0	0.0	0.0	4.5	3.1	3.9
Vegetables	1.0	5.1	1.5	2.0	0.8	1.8
Export crops						
Cotton	1.5	0.0	0.6	4.5	2.8	4.7
Sugarcane	2.8	0.0	0.0	3.0	0.0	0.0
Coffee	0.0	0.0	0.0	2.5	0.0	0.0
Tea	1.1	0.0	1.1	4.0	0.0	2.0
Tobacco	1.0	0.0	1.0	3.5	0.0	0.0
Other crops	3.4	3.4	3.4	5.0	3.4	3.4
Livestock						
Beef	0.0	0.0	0.0	4.0	3.0	3.5
Dairy	0.0	0.0	0.0	4.0	2.5	3.5
Poultry	0.0	0.0	0.0	3.5	1.5	2.5
Sheep, goat	0.0	0.0	0.0	3.6	3.8	5.4
Other livestock	0.0	0.0	0.0	6.9	1.2	5.0
Fishing	2.5	2.5	2.5	5.0	2.0	2.5
Forestry	0.0	0.0	0.0	2.5	2.5	2.5

Source: Author's calculations using Nzuma 2011

The accelerated agricultural growth scenario or CAADP scenario assumes more rapid and more broad-based agricultural growth, both across sectors and across regions. Crop yield projections performed as part of this study and based on expert panels (Nzuma 2011) point at a strong overall growth performance in high-rainfall areas. Productivity growth in semi-arid areas is somewhat lower, but higher than in arid areas. Details are shown in Table 4. We assume the same land expansion rates as in the baseline; hence, while yields grow less rapidly in arid and semi-arid areas, the higher land expansion rates in these areas still imply that they may achieve rapid output growth. Actual crop yield outcomes in the baseline and CAADP scenarios are shown in the appendix (see Table 17).

Results and discussion

We first focus on national GDP results. The agricultural sector contributes about one-quarter to Kenya's national GDP. In our baseline scenario agriculture grows at 3.7 percent per year during 2010–2020, which is comparable to the historical growth rate. Nonagricultural sectors, which account for three-quarters of the economy, grow more rapidly (for example, manufacturing grows by 6.2 percent and services by 5.5 percent). As a result, national GDP expands at a rate of 5.1 percent per year, despite the continued weak performance of the agricultural sector in this scenario.

Most of the agricultural subsectors grow at between 2 and 4 percent per year. Some of the better-performing subsectors include maize (4.4 percent) and cassava (6.0 percent), which are largely grown for own consumption, and sugarcane (4.7 percent), a fairly important export crop for Kenya. Growth in the better-performing subsectors is largely driven by rapid productivity growth especially in high-rainfall areas (compare Table 5 and Table 6). Maize has been a particularly important driver of growth given its large contribution to agricultural GDP (12.4 percent), while increased cassava production has resulted from the introduction of new improved varieties in the arid and semi-arid areas as well as increased productivity in downstream cassava processing.

In the CAADP scenario, agricultural growth improves across all subsectors. Growth in excess of 6 percent in large subsectors such as maize, other roots, pulses, fruits, and tea contribute significantly to the attainment of 6 percent agricultural growth in this scenario. Export crops in general also perform well, growing at 6.2 percent, which is more than double the rate achieved in the baseline scenario. The CAADP scenario also assumes increased productivity in the downstream agricultural processing sectors. This ensures higher value addition and a significant reduction in agricultural supply bottlenecks often associated with rapid agricultural productivity growth.

Table 6 also shows average percentage changes in the different components of GDP (national accounts). Exports grow significantly in the CAADP scenario (7.5 percent compared to 6.3 percent in the baseline). However, compared to private consumption in Kenya, exports are a rather small component of GDP, even after adjusting for imports. Growth in GDP under the CAADP scenario is therefore mostly driven by 5.8 percent average annual growth in private consumption, which is about one percentage point higher than in the baseline.

Table 6. GDP growth rates in the baseline and CAADP scenarios (2010–2020)

	Initial value of GDP: KSh billion (2010)	Percentage share of total (%)		Average annual growth rate (%)	
		Total GDP (2010)	Agricultural GDP (2010)	Baseline scenario (2010-2020)	CAADP scenario (2010-2020)
Total GDP	**1,851.2**	**100.0**		**5.1**	**6.0**
Agricultural subsectors	457.1	24.7	100.0	3.7	6.0
Cereals	79.9	4.3	17.5	4.2	5.8
Maize	56.6	3.1	12.4	4.4	6.1
Wheat	10.2	0.6	2.2	4.1	5.5
Rice	1.3	0.1	0.3	2.1	5.0
Sorghum	5.3	0.3	1.2	2.2	5.2
Millet	6.4	0.3	1.4	4.2	4.8
Root crops	44.9	2.4	9.8	3.8	6.3
Cassava	3.5	0.2	0.8	6.0	6.3
Other roots	41.5	2.2	9.1	3.6	6.3
Pulses and nuts	45.3	2.4	9.9	3.6	6.1
Pulses	34.9	1.9	7.6	4.0	6.3
Oilseed crops	10.5	0.6	2.3	1.8	5.4
Horticulture	79.8	4.3	17.5	3.7	6.3
Fruits	46.5	2.5	10.2	3.9	7.0
Vegetables	33.3	1.8	7.3	3.4	5.2
Export-oriented crops	81.6	4.4	17.8	3.3	6.2
Cotton	0.7	0.0	0.2	3.2	7.8
Sugarcane	7.2	0.4	1.6	4.7	5.4
Coffee	5.0	0.3	1.1	1.8	4.6
Tea	61.8	3.3	13.5	3.0	6.3
Tobacco	2.1	0.1	0.5	2.9	5.7
Other crops	4.6	0.3	1.0	5.8	7.2
Livestock	96.5	5.2	21.1	3.6	5.6
Cattle	37.6	2.0	8.2	3.9	5.5
Dairy	29.2	1.6	6.4	3.5	5.4
Poultry	6.9	0.4	1.5	3.5	6.1
Sheep & goats	16.3	0.9	3.6	3.4	5.9
Other livestock	6.4	0.3	1.4	3.3	6.3
Fisheries	8.4	0.5	1.8	4.0	5.9
Forestry	20.7	1.1	4.5	4.2	5.7
Manufacturing	209.5	11.3		6.2	7.1
Agric. processing	58.1	3.1		5.4	9.2
Services	1,053.5	56.9		5.5	5.8
National accounts					
Private consumption	1,385.9			4.8	5.8
Fixed investment	377.2			4.9	5.4
Government consumption	311.2			5.0	5.0
Exports	443.3			6.3	7.5
Imports	703.3			5.3	6.1

Source: Kenya CGE and microsimulation model.

Table 7 disaggregates the same growth results across different AEZ. Despite relatively stronger total factor productivity growth in high-rainfall areas, agricultural GDP in this region grows only 3.3 percent in the baseline scenario. This is largely due to the slow rate of land expansion (1.4 percent). The high land expansion rate in arid areas (4.8 percent) ensures rapid growth in crop agriculture (9.2 percent) off a very small base; however, the small size of this subsector means that it contributes little to overall agricultural growth in arid areas. Crop agriculture is much more important in semi-arid areas, contributing significantly to overall agricultural growth (4.6 percent). The semi-arid region as a whole also contributes significantly to national agricultural output. In the CAADP scenario, agricultural GDP grows much more rapidly in high-rainfall (6.1 percent) and semi-arid areas (6.0 percent), while the arid areas lag behind (4.7 percent). This has important implications for poverty reduction, as we shall explain below.

Table 7. GDP growth rates by AEZ, baseline and CAADP scenarios (2010–2020)

	Initial value of regional GDP: KSh billion (2010)	Percentage share of total (%)		Average annual growth rate (%)	
		Regional GDP (2010)	Regional agricultural GDP (2010)	Baseline scenario (2010-2020)	CAADP scenario (2010-2020)
High-rainfall areas					
Total GDP	**1,066.0**	**100.0**		**4.9**	**6.0**
Agricultural subsectors	301.8	28.3	100.0	3.3	6.1
Crop agriculture	271.7	25.5	90.0	3.2	6.1
Livestock	23.9	2.2	7.9	4.4	6.2
Forestry and fisheries	6.1	0.6	2.0	4.4	5.8
Industry	191.9	18.0		6.0	6.8
Services	572.3	53.7		5.4	5.6
Arid areas					
Total GDP	**98.3**	**100.0**		**4.9**	**5.8**
Agricultural subsectors	25.2	25.7	100.0	3.4	4.7
Crop agriculture	2.3	2.3	9.0	9.2	9.5
Livestock	21.1	21.5	83.7	2.6	3.9
Forestry and fisheries	1.9	1.9	7.3	3.4	5.5
Industry	10.5	10.7		5.1	6.4
Services	62.5	63.6		5.4	6.1
Semi-arid areas					
Total GDP	**686.9**	**100.0**		**5.5**	**6.0**
Agricultural subsectors	130.0	18.9	100.0	4.6	6.0
Crop agriculture	57.5	8.4	44.2	5.6	6.1
Livestock	51.4	7.5	39.5	3.6	6.0
Forestry and fisheries	21.1	3.1	16.3	4.1	5.8
Industry	138.2	20.1		5.7	6.4
Services	418.7	61.0		5.7	6.0

Source: Kenya CGE and microsimulation model.

We next turn to the poverty results. The initial national poverty rate in 2010 is 42.4 percent (Table 8). In the baseline scenario this declines by 14.2 percentage points to reach 28.2 percent by year 2020. Poverty rates decline by 10.4, 13.5, and 18.2 percentage points in high-rainfall, arid, and semi-arid areas respectively between 2010 and 2020. Semi-arid areas therefore see the largest reduction in poverty, both in absolute and relative terms. Although the percentage point reduction in poverty is higher in arid than high-rainfall areas, arid areas start out with a much higher poverty rate close to 70 percent. The poverty rate therefore declines by one-fifth, compared to a one-third reduction in high-rainfall areas (from 32.0 to 21.6 percent).

In the CAADP scenario, national poverty declines to 24 percent, which represents an additional 4.2-percentage-point poverty reduction between 2010 and 2020 as compared to the baseline scenario. Households in high-rainfall areas benefit the most from the CAADP scenario compared to the baseline, in relative terms, and see their poverty rate slashed by slightly more than half to 15.3 percent. Poverty in the arid areas drops to 50.2 percent, which, in relative terms, is the smallest reduction in poverty—although in absolute terms the reduction here is similar to that in semi-arid areas where a 20-percentage-point poverty reduction is observed. While the high rainfall areas have the lowest initial poverty rate, they experience the largest reduction in poverty under the CAADP scenario compared to the baseline, because productivity growth is largest in the high rainfall areas and the population is also highest in the high rainfall areas.

Table 8.Poverty headcount changes in the baseline and CAADP scenarios (2010–2020)

	Initial poverty rate (2010) (%)	Final poverty rate (2020)		Percentage point change in poverty (2010—2020)		
		Baseline scenario (%)	CAADP Scenario (%)	Baseline scenario (%)	CAADP Scenario (%)	Difference in Difference (%)
National	42.4	28.2	24.0	-14.2	-18.4	-4.2
Urban	29.0	17.5	14.6	-11.5	-14.4	-2.9
Rural	45.0	30.3	25.8	-14.7	-19.2	-4.5
Rural farm	42.8	32.6	27.0	-10.2	-15.8	-5.6
Rural nonfarm	45.3	30.1	25.7	-15.2	-19.6	-4.4
High rainfall areas	32.0	21.6	15.3	-10.4	-16.6	-6.2
Urban	24.8	15.2	13.0	-9.7	-11.8	-2.1
Rural farm	34.5	24.3	16.3	-10.3	-18.3	-8.0
Rural nonfarm	32.2	18.7	14.7	-13.4	-17.4	-4.0
Arid areas	69.7	56.2	50.2	-13.5	-19.5	-6.0
Urban	53.3	40.9	33.2	-12.4	-20.2	-7.8
Rural farm	70.8	55.9	50.3	-14.9	-20.5	-5.6
Rural nonfarm	74.3	66.8	60.3	-7.5	-14.0	-6.5
Semi-arid areas	45.2	27.0	25.2	-18.2	-20.0	-1.8
Urban	32.5	16.8	13.4	-15.7	-19.2	-3.5
Rural farm	34.4	28.0	20.1	-6.4	-14.3	-7.9
Rural nonfarm	47.3	28.1	26.9	-19.2	-20.4	-1.2

Source: Kenya CGE and microsimulation model.

Three additional CAADP scenarios are conducted in order to test the strength of the linkages between AEZ and also to determine to what extent regions benefit from spillover effects of growth in other regions. For example, in the high-rainfall areas growth scenario we assume that

accelerated growth (as specified in the national CAADP scenario) only benefits that region, while the other two regions grow at the same rate as in the baseline. This is repeated for each of the three regions. Results are compared against the baseline and national CAADP scenario results in order to measure the economywide effects of growth occurring only within a specific region. These results may also be used to measure the returns to investments within specific regions. In Table 9we focus on GDP and poverty outcomes, both at the national level and within regions.

In the national CAADP scenario, national GDP grows at 6 percent, which is 0.9 percentage points higher than in the baseline. When the modeled productivity gains are only realized in high-rainfall areas, national GDP growth is marginally lower at 5.7 percent, or 0.6 percentage points higher than in baseline. Thus, two-thirds (0.6/0.9) of the additional growth achieved under the CAADP scenario is directly attributed to the growth in high-rainfall areas. Growth in arid areas is 5.2 percent, compared to 4.9 percent in the base. This region therefore benefits from increased growth in high-rainfall areas. The same is not true for semi-arid areas, which experience the same GDP growth as in baseline (5.5 percent).

When agricultural productivity growth only occurs in the arid areas, national growth increases only marginally from 5.1 percent in the baseline to 5.2 percent. GDP growth in arid areas is also much weaker at 5.4 percent, compared to 5.8 percent in the national CAADP scenario. This relates to the strong linkages between arid areas and high-rainfall areas highlighted above. The spillover effects into high-rainfall and semi-arid areas are also very weak; for example, semi-arid areas experience no additional growth, while high-rainfall areas grow by 5 percent, compared to 4.9 percent in the base.

Finally, in the semi-arid areas scenario national GDP grows quite strongly at 5.5 percent relative to 5.1 percent achieved in the baseline scenario. Both high-rainfall and arid areas benefit from spillovers, with increases of 0.2 and 0.4 percentage points over their respective baseline growth rates. Interestingly, GDP in semi-arid areas grows more in this scenario than in the national CAADP scenario (that is, 6.3 versus 6 percent). This relates to the fact that this region attracts significant investments when it grows more rapidly than other regions. In the national CAADP scenario, these investments may have been directed at faster-growing agricultural sectors in high-rainfall areas. In this scenario investments raise production capacity levels in semi-arid regions over and above the levels achieved in the national CAADP scenario.

Table 9. Growth and poverty linkages and spillovers

	Baseline scenario	CAADP scenarios			
		National	High-rainfall areas	Arid areas	Semi-arid areas
Percentage change in GDP					
National	5.1	6.0	5.7	5.2	5.5
High rainfall areas	4.9	6.0	5.9	5.0	5.1
Arid areas	4.9	5.8	5.2	5.4	5.3
Semi-arid areas	5.5	6.0	5.5	5.5	6.3
Percentage point change in poverty					
National	-14.2	-18.4	-15.5	-15.0	-17.0
High rainfall areas	-10.4	-16.6	-16.7	-10.4	-9.1
Arid areas	-13.5	-19.5	-14.3	-20.9	-13.8
Semi-arid areas	-18.2	-20.0	-14.7	-18.0	-26.0

Source: Kenya CGE and microsimulation model.

The second part of the table summarizes the poverty results. In general, these reflect similar linkages and spillovers as observed for the GDP growth results. Also, in each of the regional scenarios poverty within that region declines by more than in the national CAADP scenario (for example, poverty in arid areas declines by 20.9 percentage points in the arid area scenario, compared to 19.5 percentage points in the national CAADP scenario). This reflects the increased demand for labor in those regions experiencing relative productivity increases, which cause wages to rise.

V. AGRICULTURAL SPENDING IN KENYA

Increased public expenditure on agriculture will be critical if Kenya is to make significant progress towards achieving the CAADP targets and Millennium Development Goals. Jointly important will be how spending on agriculture is allocated among multiple options, that is, which agricultural investments the government chooses to prioritize. In general, agricultural spending options can be thought of as the set of agricultural subsectors or activities (agricultural value chains, public goods, services, and programs, such as agricultural research and extension) that the government can choose to spend public funds on. This is closely related to the functions of agricultural ministries, so spending options in agriculture can be considered to be allocations to each ministry within the agricultural sector. Agricultural spending options could also be thought of in geographic terms as the AEZ where the agricultural activities take place (that is, how much to allocate among the AEZ). Typically, though, audited national expenditure accounts are reported in terms of recurrent and development expenditure, so agricultural spending options could also be considered in terms of how much to allocate between development and recurrent expenditures. Given that much of the available data are

reported in this manner, we provide some analysis of past public spending on agriculture along these lines.

Past public expenditure on agriculture

Historically, about two thirds of Kenyan public expenditure on agriculture has been allocated to recurrent expenditure, the majority of which has been dedicated to salaries and wages. Data on *actual* past public expenditures for the whole agricultural sector in Kenya are unfortunately not disaggregated in enough detail and statistics vary somewhat by source, making it difficult to provide a precise assessment of the relationship between past expenditure patterns and growth by subsector/activity in each AEZ. Nonetheless, the available data on recurrent and development spending at the national and ministerial levels provide a useful starting point of analysis. Table 10 shows development and recurrent agricultural public expenditures in Kenya between 2003 and 2008.

Table 10. Development and Recurrent Expenditure on Agriculture in Kenya

Year	Development expenditure on agriculture in Ksh billion (% of expenditure on agriculture)	Recurrent expenditure on agriculture in Ksh billion (% of expenditure on agriculture)	Public expenditure on agriculture in Ksh billion (% of total public expenditure)	Total Public Expenditure
2003/4	5.31	11.15	16.46	376.3
	(32.3)	(67.7)	(4.4)	
2004/5	4.69	10.54	15.23	379.8
	(30.8)	(69.2)	(4.0)	
2005/6	4.64	11.95	16.59	432.6
	(28.0)	(72.0)	(3.8)	
2006/7	6.23	13.85	20.08	508.8
	(31.0)	(69.0)	(3.9)	
2007/8	7.89	14.48	22.37	658.1
	(35.3)	(64.7)	(3.4)	

Source: Ministry of State for Planning, National Development and Vision 2030: Public Expenditure Review 2010

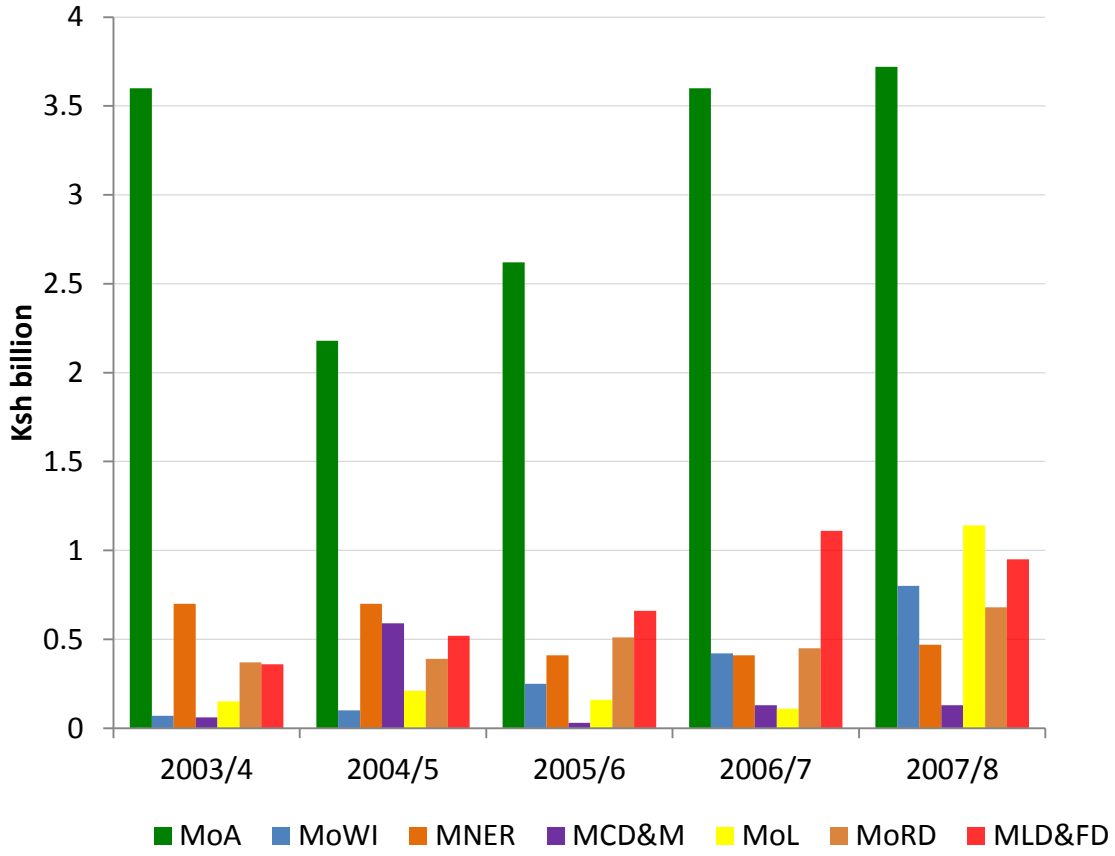
Between 2003 and 2006 the proportion of agricultural public spending allocated to development declined slightly from 32.3 percent to 28 percent, but has since rebounded to 35.3 percent in2007–2008. In absolute terms, the value of development expenditure followed the same pattern, decreasing between 2003 and 2006 and increasing sharply in 2007 and 2008. While more recent audited data are not yet available, it is estimated that the trend of increased development spending has continued, particularly in 2009–10, mainly because of the Ksh

22billion economic stimulus program that was introduced to mitigate the adverse effects of post-election violence, the global economic crisis, and the food price crisis. Judging by the MTIP's outlays, continued increases in development expenditure are expected for 2011–2015.

Total public expenditure on agriculture has also increased in recent years, but as a proportion of total public expenditure has declined from 4.4 percent in 2003–4 to 3.4 percent in 2007–8, remaining much lower than the stated CAADP target of 10 percent. These statistics imply that while public spending on agriculture is generally on the rise in Kenya, there is still substantial room for increased agricultural spending, which could further accelerate growth in the near term. This calls for further government commitment to sustain increased spending on agriculture, particularly development spending.

Ministerial estimates documented in the Economic Review of Agriculture 2010 show that the MoA has historically received the bulk of funding under the agriculture sector (MoA, 2010). Of note is that the estimates in the Economic Review of Agriculture 2010 (Table 11) are different from those published in the Public Expenditure Review 2010 (Table 12). Nevertheless, these figures both show a preponderance of recurrent spending, averaging about two thirds. Estimates based on the Public Expenditure Review 2010 also show that in the case of the Ministry of Water and Irrigation (MoWI) and Ministry of Lands (MoL), more funding has recently been allocated to development (see Figure 2 and Table 12).

Figure 2.Development spending on Agriculture by Line Ministries



Source: Authors' illustration using data from Public Expenditure Review, 2010

Note: MNER includes Ministry of Environment and Mineral Resources and Ministry of Forestry and Wildlife; MCD&M = Ministry of Cooperative Development and Marketing; MoRD = Ministries of Regional Development, which includes the Ministry of State for Northern Kenya and Other Arid Lands as well as Ministry of Regional Development Authorities; MLD&FD includes Ministry of Livestock Development and Ministry of Fisheries Development

Table 11. Public expenditure allocated to the Ministry of Agriculture (Ksh billion)

Year	Development (%)	Recurrent (%)	Total
2002/3	0.93	3.13	4.06
	(22.9)	(77.1)	
2003/4	1.78	3.26	5.04
	(35.4)	(64.6)	
2004/5	1.76	3.36	5.12
	(34.3)	(65.7)	
2005/6	2.22	5.05	7.27
	(30.5)	(69.5)	
2006/7	3.72	5.46	9.18
	(40.5)	(59.5)	
2007/8	4.04	9.51	13.56
	(29.8)	(70.2)	
2008/9	5.61	7.53	13.14
	(42.7)	(57.3)	
2009/ 10*	5.67	7.8	13.47
	(42.1)	(57.9)	

Source: Ministry of Agriculture (MoA)—Economic Review of Agriculture, 2010

* The 2010 figure is provisional; Development or recurrent spending as a percentage of total annual spending is shown in parentheses

Table 12.Public Expenditure on Agriculture by Ministry (Ksh billion)

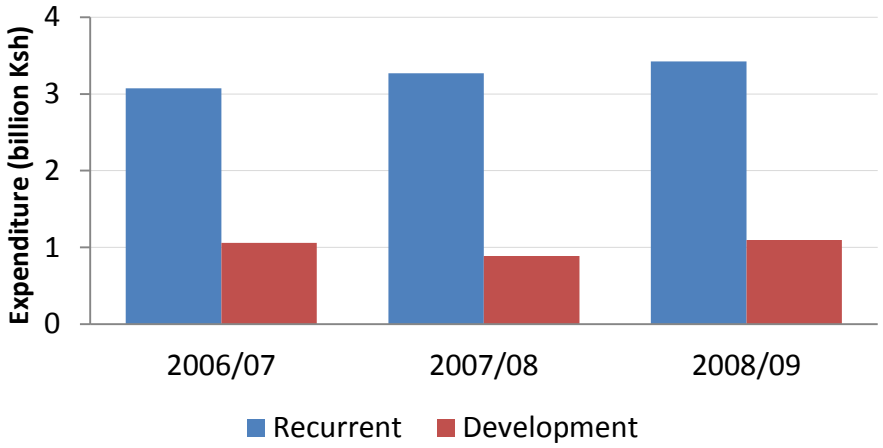
	2003/4	2004/5	2005/6	2006/7	2007/8
Recurrent					
MoA	3.39	3.71	4.93	5.8	7.56
MoWI	0.17	0.15	0.16	0.18	0.26
MNER	2.45	2.11	2.25	2.53	0.87
MCD&M	0.61	0.52	0.51	0.61	0.68
MoL	1.44	1.24	1.3	1.6	1.43
MoRD	0.62	0.58	0.47	0.48	0.5
MLD&FD	2.47	2.24	2.32	2.65	3.19
Total	11.15	10.54	11.95	13.85	14.48
Development					
MoA	3.6	2.18	2.62	3.6	3.72
MoWI	0.07	0.10	0.25	0.42	0.8
MNER	0.70	0.70	0.41	0.41	0.47
MCD&M	0.06	0.59	0.03	0.13	0.13
MoL	0.15	0.21	0.16	0.11	1.14

MoRD	0.37	0.39	0.51	0.45	0.68
MLD&FD	0.36	0.52	0.66	1.11	0.95
Total	5.31	4.69	4.64	6.23	7.89
Total Ministerial Expenditures					
MoA	6.99	5.89	7.55	9.4	11.28
MoWI	0.24	0.25	0.41	0.6	1.06
MNER	3.15	2.81	2.66	2.94	1.34
MCD&M	0.67	1.11	0.54	0.74	0.81
MoL	1.59	1.45	1.46	1.71	2.57
MoRD	0.99	0.97	0.98	0.93	1.18
MLD&FD	2.83	2.76	2.98	3.76	4.14
Total Expenditure on Agriculture	16.46	15.23	16.59	20.08	22.37
Total Government Expenditure	330.23	350.14	405.52	472.28	619.54

Source: Public Expenditure Review, 2010 and several Reports of the Controller and Auditor General's Office

Data from MoLD also show the majority of public funds (over 75 percent) going to recurrent rather than development activities (Figure 3). The pattern of low development spending is replicated in a number of ministries in the agricultural sector and at various levels of government. Efforts to increase development spending could help increase growth, consistent with previous research that suggests a positive relationship between development spending and growth (Agenor, Bayraktar and Aynaoui 2008).

Figure 3. Recurrent and development public spending under the Ministry of Livestock Development



Source: Authors' representation using data obtained from MoLD (2011)

Thus regardless of the data analyzed, results suggest that on average about a third of public spending on agriculture has been allocated to development activities, and the proportion of

total public spending dedicated to agriculture has consistently been close to 4 percent. Unfortunately, we are unable to compare the previous statistics on development versus recurrent spending with the MTIP planned spending, because the MTIP does not provide enough detail on planned allocation between recurrent and development spending (see Table 18; ASCU, 2010). Ministerial strategic plans offer some insight, however limited, and suggest that the spending structure will remain the same. A consolation is that a majority of public funds under the MTIP are allocated to infrastructure and irrigation development and in this regard some increases in development spending can be expected for the next five years (2011–2015).

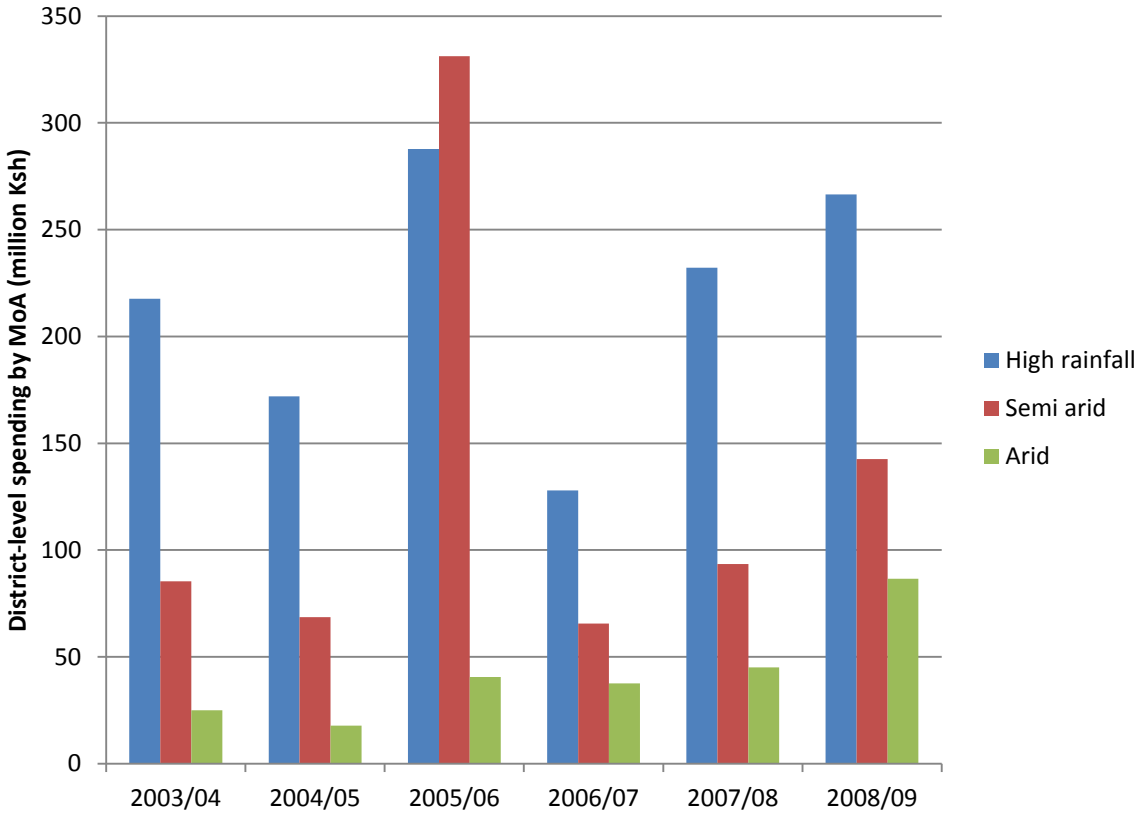
To get a sense of how public expenditures may have been allocated across AEZ in the past, we analyze district allocations data obtained from the audited reports of the Ministry of Finance's Printed Budget Estimates of the district budget books. These data were compiled by an officer from the budget coordination unit of MoA using head and identifier codes (AIE and holder codes) to match and aggregate the figures for each AEZ. It is important to note that these data do not represent total public expenditure allocated to the whole agricultural sector in Kenya; hence the data are not useable to analyze the efficiency of public spending at the AEZ-level or for predicting the impact of planned MTIP spending in each AEZ. In some cases the accuracy of the data may also be uncertain because figures are primarily for spending at the district/field office levels in MoA and MoLD. According to the officer who compiled the data, the figures do not reflect votes to parastatals under these ministries, nor do they include transfers to agricultural research and training institutions. Nonetheless, these limited estimates give some indication of budget allocation trends, which can be particularly useful for informing district-level allocations.

Based on these data, Figure 4 shows that the annual allocations to the district levels under the Ministry of Agriculture have ranged between 231 million and 660 million Kenyan shillings in the period 2003–2009. This represents between 2.5 and 9.1 percent of total spending under the Ministry of Agriculture, based on the aggregate statistics from the Economic Review of Agriculture (2010). This implies that public spending under MoA is relatively centralized with limited funding being disbursed to implementing district-level offices, suggesting that almost all of public spending under MoA was spent at the central government level (for example for salaries and wages) and channeled through parastatals and research-education institutions, whose spending is not reflected in Figure 4.

Most of the district-level spending reflected in Figure 4 under MoA was allocated to high-rainfall and semi-arid areas, while arid areas consistently received the least funding. In most

cases, funding levels have generally increased in absolute terms between 2006–7 and 2008–9[1]. This implies that the funding disparities between high rainfall, semi-arid and arid areas have remained relatively the same in recent years, and that the currently proposed budget in the MTIP, which is expected to significantly increase funding allocation to the semi-arid areas, represents a major shift in allocation of public finances among AEZ in the agricultural sector.

Figure 4. Public spending by Ministry of Agriculture in each AEZ, based on district-level data



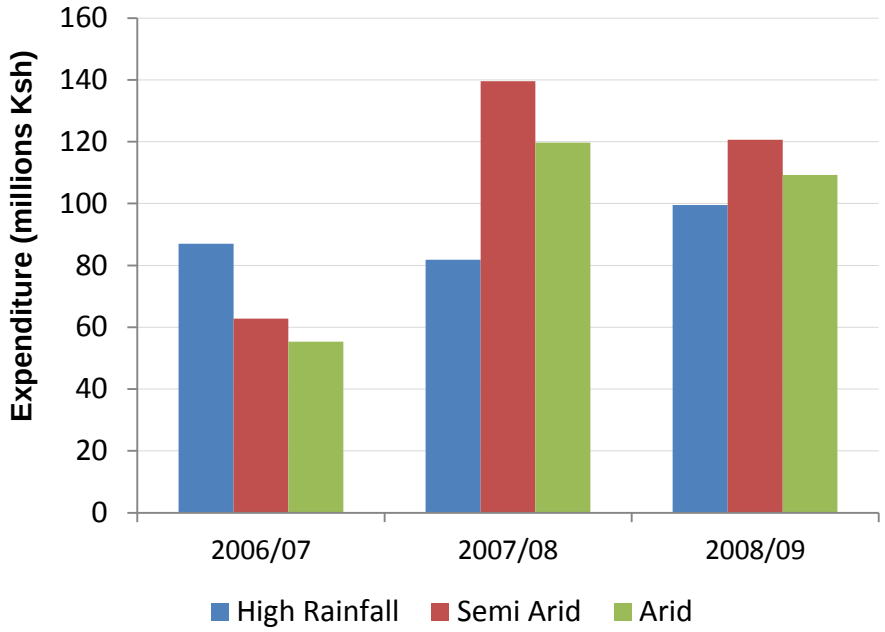
Source: Authors' calculation based on data files obtained from MoA (2011)

Figure 5 shows district-level public spending devoted to development activities under MoLD. It would have been expected that more funding would be allocated to the arid areas, since livestock production is predominant in this area. However, the figures show this has not always been the case. While funding levels have increased between 2006–7 and 2007–9, the

[1] Important to note is that in 2008 several activities previously carried out under MoA were divided among several ministries formed in 2008, including the MoLD, Ministry of Fisheries Development and the Ministry of State for the Development of Northern Kenya and other Arid Lands plus the current existing MoA. Therefore, district-level spending under MoA after 2008 may not be comparable with previous allocations because previous funding covered activities now carried out by multiple ministries.

proportion of district-level funding for arid and semi-arid areas actually dropped in 2008–9. Instead, district-level allocations to HRA increased, though remaining below the levels of the arid and semi-arid areas. A possible explanation is that the arid areas may have received the majority of spending for livestock development through centralized channels and therefore funds were not reflected in the district-level statistics shown in Figure 5. In this respect, it is worth assessing why this was and whether the ratio of devolved versus centralized funds affected performance in the subsector in each AEZ. A possible explanation for less devolved spending in the arid areas might be these areas' lower capacity to manage and implement programs at the district level, necessitating centralization of funding and implementation of livestock development activities. Regardless, there is insufficient data to analyze these issues.

Figure 5. Development spending under the Ministry of Livestock Development by AEZ, based on district-level data



Source: Authors' representation using data files obtained from MoA (2011)

Overall, the district-level data suggest that a relatively small proportion of total public agricultural spending has been allocated to district-level offices. As such, the data are not sufficient to analyze effects of spending by AEZ on agriculture growth and reduction of poverty and malnutrition. There is, therefore, a need for the government of Kenya to significantly improve tracking of both central and district-level spending in the agriculture sector by AEZ and to report detailed disaggregated data on spending in the sector. In this regard, coordination among the agriculture-sector ministries, the Ministry of Finance, and the Kenya Bureau of Statistics would be critical. Investing in technologies and data management systems as well as

capacity building that allow for efficient collection and reporting of detailed public spending data is recommended.

Planned MTIP spending by AEZ

To review the MTIP's planned spending by AEZ, we first reclassify the figures shown in the MTIPAEZ budgets into broader activities as shown in Table 13. Part of the reason for doing this is that the planned AEZ budgets, as outlined in the MTIP, do not entirely separate the allocations by AEZ. For instance, the budget for the HRA includes planned spending on irrigation and drainage, and fisheries for the other two AEZ[2]. After re-categorization, based on the authors' assessment, the semi-arid areas are projected to receive the highest allocation (46.6 percent), while the arid areas receive the least (18.7 percent).

Table 13. Kenya's planned agricultural public investments by AEZ

	Agroeconomic Zone (AEZ)			
Activity	High rainfall areas (Millions of KSh)	Semi-arid areas (Millions of KSh)	Arid areas (Millions of KSh)	Total (Millions of KSh)
Livestock development	4,050	7,506	15,875	27,431
	(4.7)	(6.5)	(33.1)	(11.1)
Crop productivity and technology adoption	25,600	1,321	0	26,921
	(29.8)	(1.1)	(0)	(10.9)
Irrigation, dams and water infrastructure	25,400	70,359	18,922	114,717
	(29.6)	(61.0)	(41.5)	(46.3)
Value chain, markets and road infrastructure	20,570	29,991	7,993	58,555
	(24.0)	(26.0)	(17.5)	(23.6)
Enabling environment (Research, Policy, Capacity building and Legal framework)	5,900	4,359	1,762	12,022
	(6.9)	(3.8)	(3.9)	(4.9)
Fisheries Development	4,333	1,833	1,833	8,000
	(5.0)	(1.6)	(4.0)	(3.2)
Total	85,853	115,406	46,386	247,645

[2]Table 21 in the appendix shows the detailed planned public investments in agriculture for the high rainfall areas as shown in the MTIP and indicates that some of the high rainfall area's budget allocations also cater for the semi-arid and arid areas.

	[34.7]	[46.6]	[18.7]	[100.0]

Source: Author's calculation based on the Government of Kenya's Agricultural Sector Development Strategy Medium Term Investment Plan (MTIP), 2010-2015
Note: Figures in parentheses are column percentages while figures in square brackets are row percentages

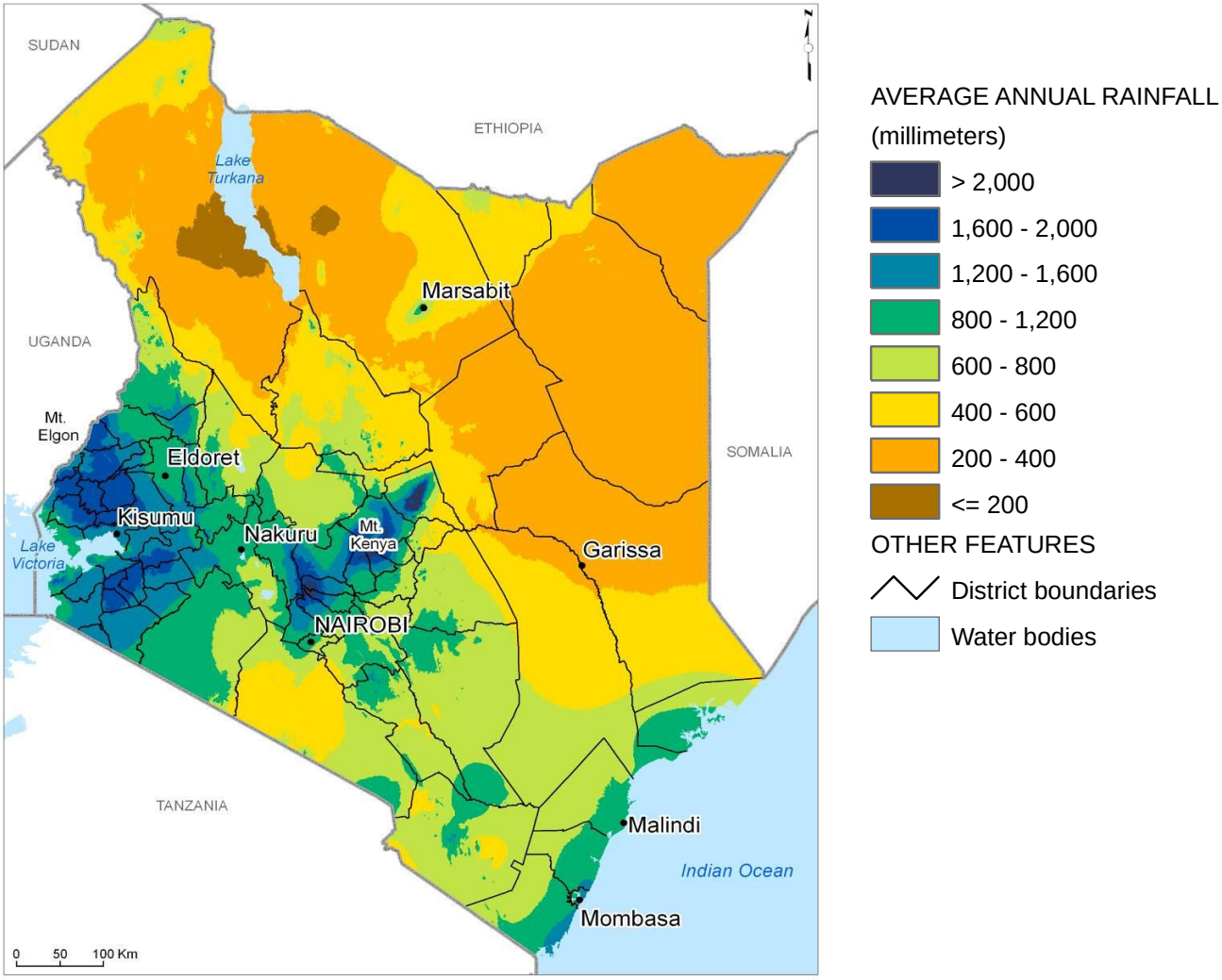
Significant spending on water resources and infrastructure

Having re-categorized the budget line items, we find that significant public spending is slated for water resources development—irrigation, dams, infrastructure, and water harvesting and storage. The MTIP dedicates nearly 115 billion Kenyan shillings to water resources development, which is over 46 percent of the total national MTIP budget. Also, the majority of public spending on irrigation infrastructure will be directed to semi-arid areas (61.0 percent). This level of investment in water resources and infrastructure, particularly in the semi-arid areas, should significantly boost agricultural growth, consistent with the evidence on high returns[3] to public investments in rural infrastructure and irrigation (Fan, Hazell and Thorat 2000; Fan and Zhang 2004; Fan and Chan-Kang 2004; Fan, Zhang and Rao 2004). The irrigation and infrastructure investments are somewhat aligned with the recommendations of Thurlow and Benin (2008) that the Kenyan government allocate 60 to 70 percent of its additional public spending to infrastructure and improvement of market access (feeder roads and market information services). In addition, the high concentration of investments in the semi-arid areas is aligned with the results of the current economywide growth options analysis in section IV, which shows semi-arid areas as having the greatest potential to achieve broad-based poverty reduction at the national level. Given the high population density and scarcity of land in the HRA contrasted with the volatility in agricultural output in the arid and semi-arid areas, largely due to erratic rainfall patterns, investing in irrigation and water resources in the semi-arid and arid areas has the potential to simultaneously increase agricultural production and reduce volatility in agricultural production, thereby transforming Kenyan agriculture (You et al. 2011). As documented in the recent study by You et al. (2011), the potential for investment in small-scale irrigation projects in Kenya ranges from 54,000 ha to 241,000 hectares, depending on the assumptions made about the estimated investment costs, period of reinvestment cycle, and travel time to produce markets. Significant potential is found to be located in both the high rainfall and semi-arid areas, while the potential for irrigation in the arid areas is found to be very limited and largely economically infeasible.

To further explore the significance of prioritizing irrigation investments and water resources development in the semi-arid areas, we turn to comparative mapping and geographic analysis. Figure 6 is a map of Kenya showing the distribution of average annual precipitation by AEZ, while Figure 7 shows the geographic distribution of past investments in irrigation infrastructure.

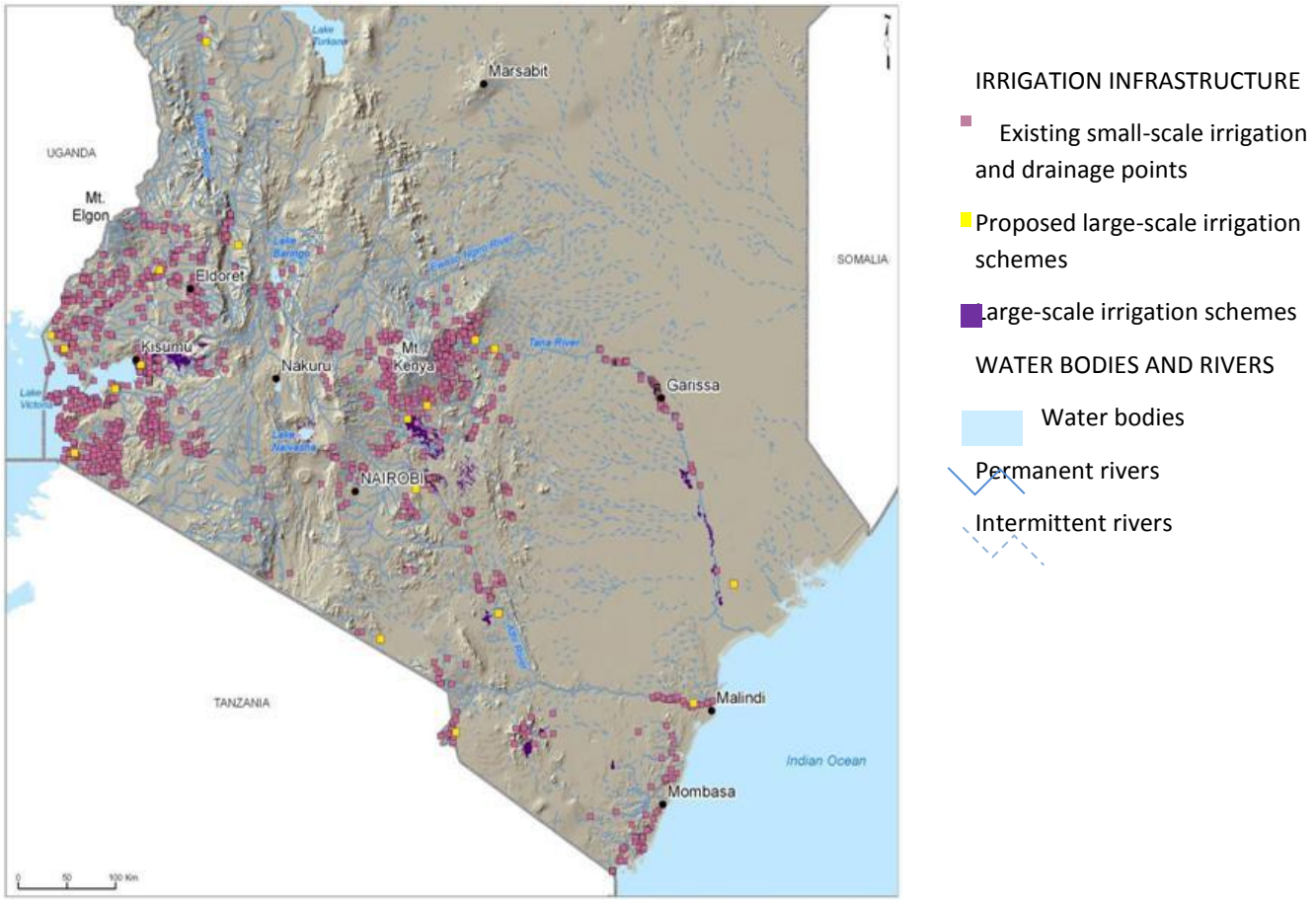
[3] Returns being measured in terms of capital formation as well as resultant agricultural growth

Figure 6. Average annual rainfall in Kenya



Source: World Resources Institute (WRI) et al. (2007): http://www.wri.org/publication/content/9506#ch3

Figure 7. Water irrigation infrastructure in Kenya



Source: World Resources Institute (WRI) et al. (2007) http://www.wri.org/publication/content/9506#ch3

Comparison of the two maps shows that most irrigation investments in the past were directed to the HRA. This was likely driven by the potential at the time in terms of precipitation, available surface water, opportunities for agricultural land expansion, accelerated broad-based growth and poverty reduction. Unfortunately, the potential for land expansion in HRA has since become limited, and if accelerated agricultural growth is to be sustained, significant improvements will have to come from intensified agricultural production in the HRA and land expansion in the semi-arid and arid areas, especially the semi-arid areas where irrigation potential[4] is relatively high for both crop and animal (livestock and fisheries) production. Critical to note is that, both maps do not show the distribution of drainage infrastructure and water

[4]Comparison of the water balance in each AEZ, which accounts for both underground and surface water distribution as well as water demand, suggests that semi arid areas have high irrigation potential (World Resources Institute, 2011), while arid areas are better suited for improved water management (conservation and storage) investments. Some parts of arid areas may also have irrigation potential but the majority has surface water bodies that dry up in the dry seasons - http://docs.wri.org/ke_water-balance.zip.

transportation networks (for example underground storm drains, pipes, and canal networks), nor do they show soil quality or use of fertilizer (and other inputs) in each AEZ. These factors are important to consider when determining the potential impact of the proposed irrigation investments with respect to productivity growth. One such consideration is the fact that several of the irrigation infrastructures, depicted in Figure 7, are no longer functional as they have not been maintained. As pointed out in You et al. (2011), it is important to consider the period of reinvestment cycle required to maintain the infrastructure.

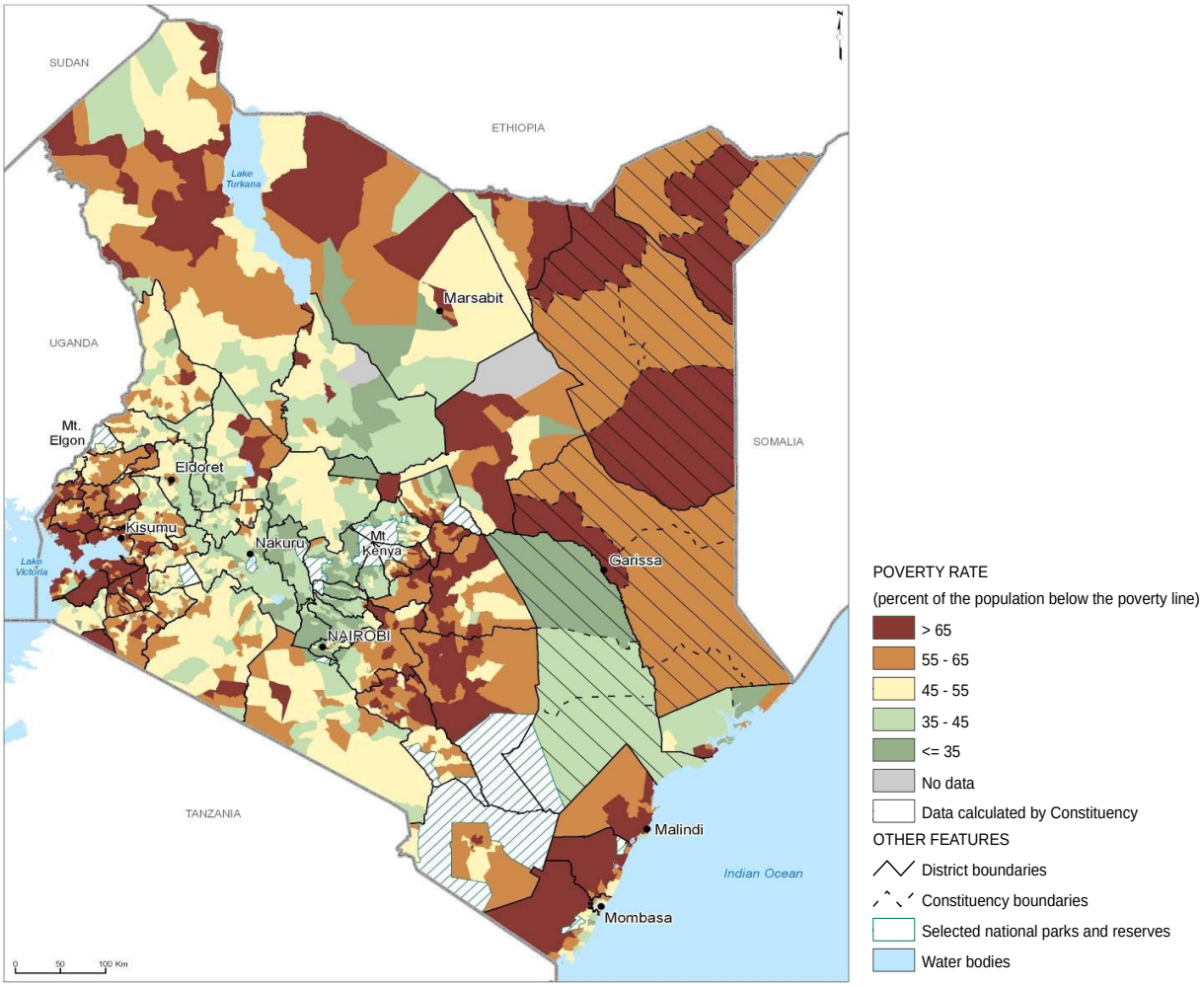
Although an assessment of these factors would provide an even more precise analysis, the general assessment is that past investments in irrigation in the semi-arid areas have not been nearly sufficient to maximize productivity potential. Therefore, allocating significant spending to improve water infrastructure and water resources, as proposed in the MTIP, is justified, and should likely be transformational, provided the MTIP irrigation investments are efficiently and fully implemented.

It is also important to bear in mind that a majority of returns to irrigation infrastructure do not materialize in the short run. In fact, most benefits will likely not accrue during the next five years (2011–2015) since there is a general time lag associated with irrigation and infrastructural investments. On the one hand, construction takes time, and on the other hand, bureaucratic/implementation bottlenecks and red tape can additionally hamper progress. Implementation of some infrastructure investments in Kenya has taken between two to six years to complete in the past. For example, the Kimira-Oluch smallholder irrigation development project, financed by the African Development Bank (US$ 35 million) to develop smallholder irrigation schemes along the shores of Lake Victoria in Rachounyo and Homa Bay districts, was approved in 2006 and is still not completed in 2012. Similarly, the Bura irrigation rehabilitation project in Tana River was approved in 2007 but has not been fully implemented largely because of a delay in the disbursement of funds (NIB 2011; AidData 2011).Therefore, it will be critical to understand and avoid the challenges that have stalled previous and current infrastructure developments and to create opportunities for fast-tracking construction and rehabilitation of infrastructure while not compromising on quality. It is also important to recognize that a number of proposed investments under the MTIP are for rehabilitative construction of previously developed infrastructure[5], (for example, the Bura irrigation project). Therefore the problems that led to previous failures in these investments need to be carefully analyzed and taken into account if the planned rehabilitative investments are to make a sustainable impact on agricultural growth, hunger, and poverty.

[5] The MTIP budget contains line items that specifically use the word rehabilitate in describing the investments of irrigation infrastructure surmounting to 29.9 billion Ksh. This represents about 26.1 percent of the total amount allocated to water resources development and irrigation.

For additional comparison, we show a poverty map of Kenya (Figure 8) to highlight that the same semi-arid and arid areas with modest irrigation investments but sizeable potential (for example, near Tana River and Lake Turkana) have relatively high levels of poverty. While this does not necessarily imply causality or preclude other factors, t certainly points to the potential role that increased irrigation investments could play in these areas in reducing poverty and enhancing food security.

Figure 8. Poverty Map of Kenya (Percentage of people below poverty line in 1999)



Source: World Resources Institute (WRI) et al., (2007):http://www.wri.org/publication/content/9506#ch3

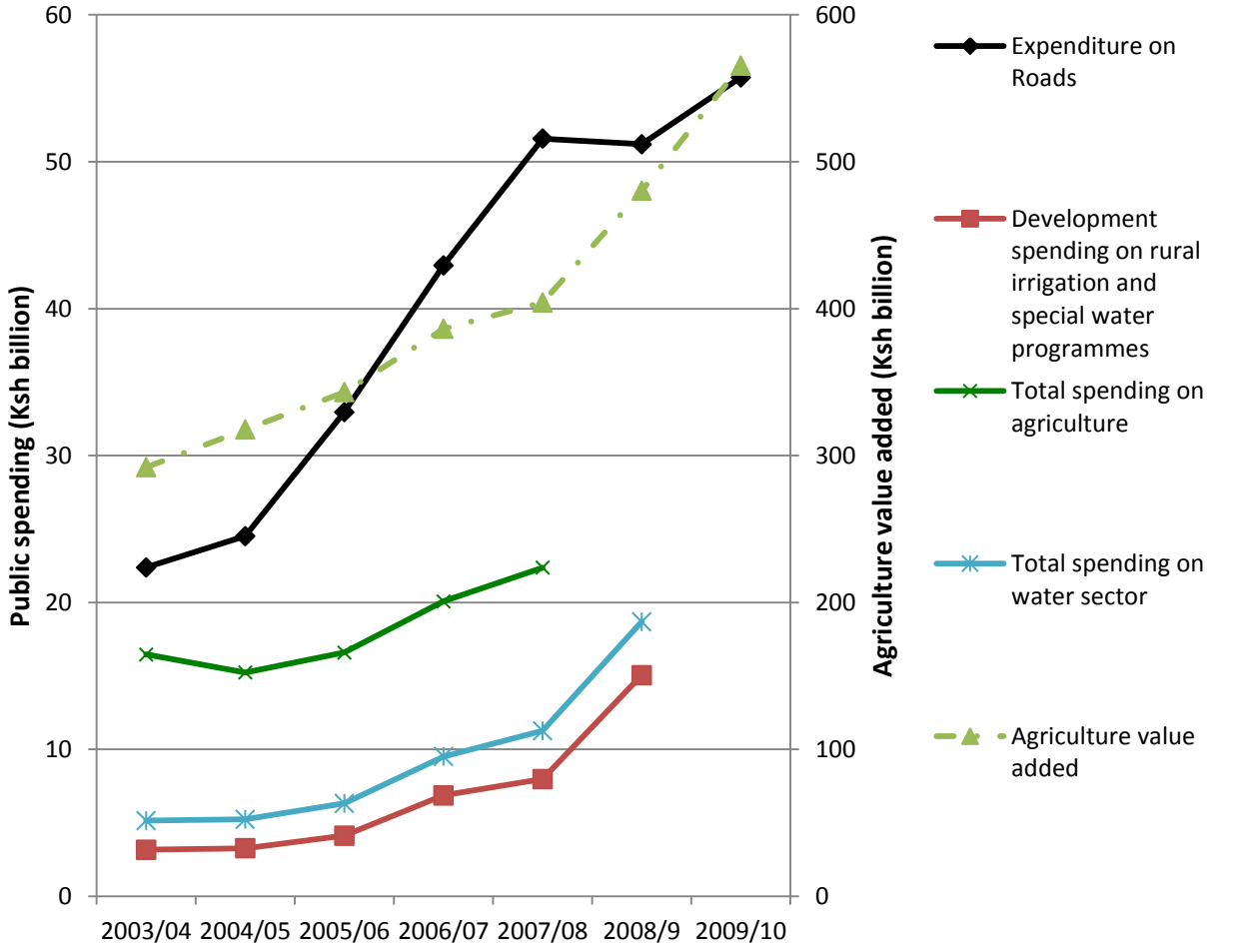
Spending on market access improvements and value chains

Market access, road infrastructure and value chain developments receive the second largest share of total planned spending on agriculture, as shown in Figure 9. Approximately 58.5 billion

Kenyan shillings (23.6 percent of the total spending on agriculture) will be allocated to this category, with, again, the semi-arid areas receiving the lion's share (nearly 30 billion Ksh, which is approximately 51.2 percent of the planned spending on the category). About 28.7 billion Ksh (11.6 percent of total MTIP spending) is allocated specifically for road construction and development. As the analysis by Thurlow and Benin (2008) has previously shown, investing in market access improvements, especially market information services and feeder roads, "is often ranked among the top two public spending sources of overall growth and poverty reduction" and can result in considerable gains in agricultural growth in Kenya. It is noteworthy that within this category, 12.2 percent of spending is dedicated to market information service provision. Given the empirical evidence on the importance of market information services in agriculture, and Kenya's potential to leverage recent investments in information and communications technology (ICT) and make them sustainable, for example the National Farmers Information Service (NAFIS) (Gakuru and Tucker 2009; Gakuru, Winters and Stepman 2009), it is important that a sizeable amount of funding has been allocated to this area.

Figure 9 shows past public spending on road infrastructure together with spending on rural irrigation infrastructure and agricultural value added, as documented in the records of Kenya National Audit Office (KENAO 2010) and the World Bank's World Development Indicators (World Bank 2010).

Figure 9. Comparison of public spending on roads and water infrastructure in Kenya



Source: Author's representation based on data from KENAO, Audited Appropriations Accounts (various issues) for water expenditures; Agriculture value added data are from the World Bank's World Development Indicators (WDI).

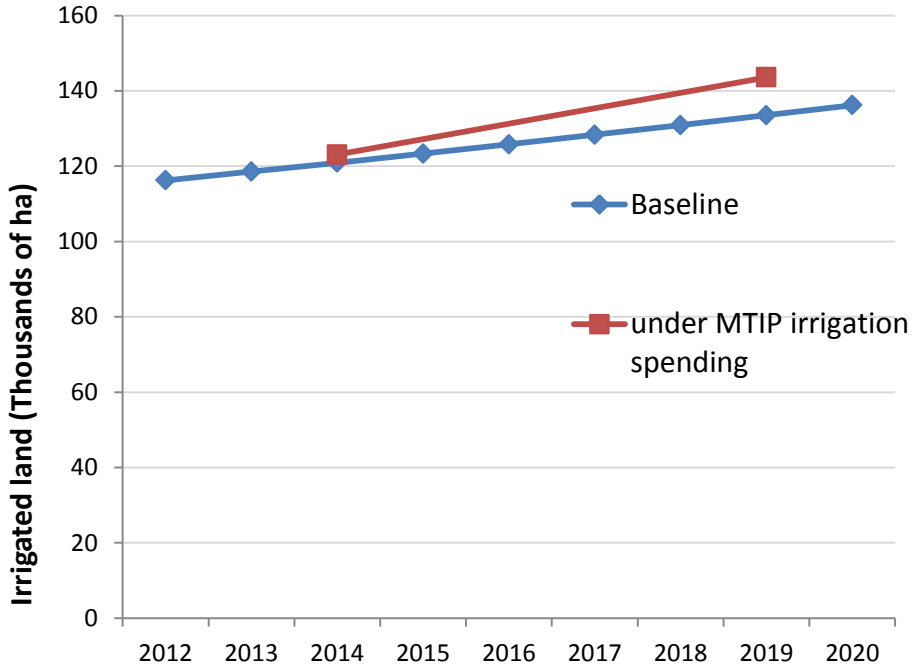
Note: All the public spending series are read off the vertical axis on the left while the agriculture value added series is read off the vertical axis on the right

Previous studies in India and Ethiopia have shown that the elasticities of public spending on agricultural capital formation (growth-capital elasticities) range from 0.23 to 1.74 for road investments (Fan, Hazell and Thorat 2000; Mogues et al. 2007) and 0.25 to 0.87 for irrigation investments (Fan and Zhang 2004). If we assume that these elasticity estimates and associated lag periods (3–8 years) apply to Kenya's situation and that the 28.7 billion Ksh road investments under the MTIP will be additional to current levels of spending under the Ministry of Roads (55.7 billion Ksh), we can roughly predict that the 51 percent increase in public spending on roads, attributable to the MTIP, would lead to road infrastructure growth of anywhere between 12 percent and 88 percent sometime between 2014 and 2019. Given that the current road

density is 0.112 km per km^2, this would translate to a projected increase in road density of between 0.125 and 0.211 km per km^2 by 2014 to 2019. However, based on recent history in road developments in Kenya and the fact that part of the 28.7 billion Ksh MTIP road investments are dedicated to road rehabilitation works, an estimate within the range but closer to the lower bound estimate of 0.125 km per km^2 seems more appropriate.

A similar exercise can be performed for irrigation capital stock, and results show that this can be expected to rise by 8 to 26 percent by 2014–2019. If we take the World Bank's World Development Indicators estimate for Kenya's irrigated area in 2006 (103,203 ha), and use this as a baseline proxy of irrigation capital stock, we can extrapolate this figure using the baseline annual growth rate of 2 percent (World Bank 2011) as shown in Figure 10. We can also calculate irrigation capital formation using the elasticities from Fan and Thorat (2004) to project an irrigated area of between 123,060 ha and 143,570 ha by 2014 to 2019—significantly greater than would be projected if using the constant growth rate of 2 percent per year, which is the current growth rate in Kenya according to the World Bank (2011).

Figure 10. Projected irrigation capital formation, measured in terms of area irrigated (ha)



Source: Authors' calculations using baseline data from the World Bank's World Databank (2011) and capital formation elasticity estimates from Fan and Zhang (2004)

Because these estimates are based on elasticities from other countries that are not specific to Kenyan AEZ and do not differentiate between infrastructure investments in urban and rural

areas, these projections must be cautiously interpreted. For this reason, we do not attempt to attribute agricultural growth that may arise from the road and irrigation investments. Instead we refer the reader to the growth options analysis in section IV, which uses total factor productivity growth estimates based on expert panel sessions held in Nairobi, Kenya, in February 2011. Because the expert panels were asked to incorporate information on the MTIP's planned investments in agriculture and infrastructure in estimating the potential productivity growth, we deem the analysis based on their projections more reliable.

In general, no matter which analytic method is used, there is a positive correlation between all types of rural infrastructure investments and agriculture value added as illustrated in Figure 9. However, because of limited data, it is not possible to establish specific relationships or infer which investments have the highest benefit-cost ratio in each AEZ. Also, without longer time-series data, we cannot adequately account for time lags of each investment, nor, without AEZ-level data, can we estimate growth and poverty reduction resulting from AEZ-level infrastructure investments. Therefore, our recommendation to invest in market access and road infrastructure is based on the mapping analysis as well as evidence from previous studies in other developing countries.

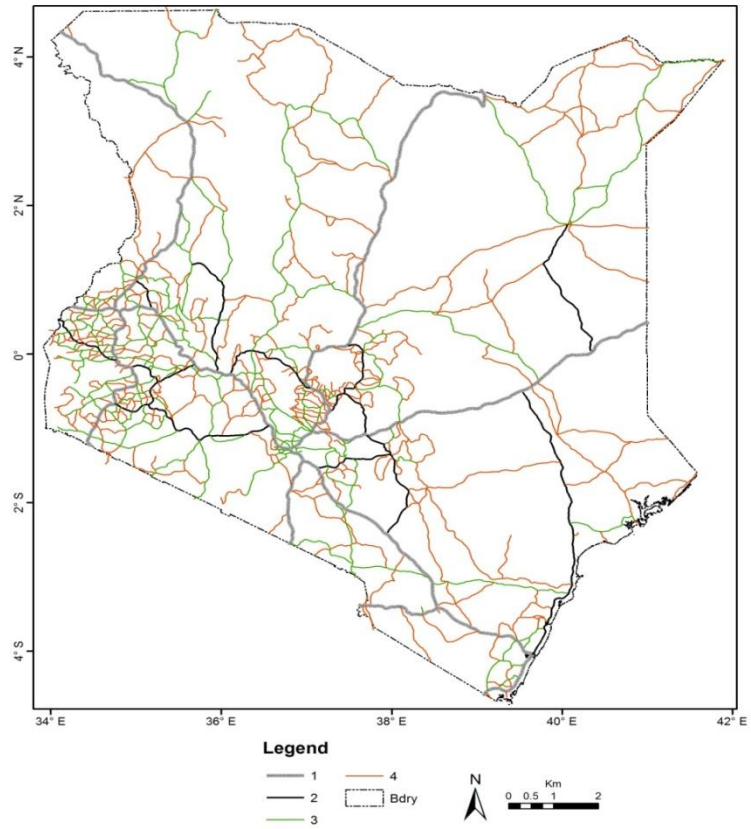
Figure 11 maps the road network in Kenya and roughly shows that the road density (calculated in km per km^2) is highest in the HRA followed by the semi-arid areas. Quality of roads would seem to follow the same pattern, but it is not quite possible to establish exact quality levels by AEZ; only national-level data on types of roads were available to the authors, and at one time point (Table 14).

Table 14. Classification of Road Network in Kenya

	Length by Surface Type (km)				
Road class	Premix	Surface dressing	Gravel	Earth	Total
International Trunk Roads (A)	1244.91	1563.81	715.11	94.48	3618.31
National Roads (B)	350.21	1166.26	819.29	346.14	2681.9
Primary Roads (C)	642.89	2198.16	3601.64	1552.9	7995.59
Secondary Roads (D)	76.63	1183.1	5701.93	4087.73	11049.39
Minor Roads (E)	165.81	542.04	8215.89	17982.57	26906.31
Special Purpose Roads	24.88	114.63	4929.69	6253.78	11322.98
All classes	2505.33	6768	23983.55	30317.6	63574.4

Source: Ministry of Roads, Republic of Kenya - http://www.roads.go.ke/index.php?option=com_content&view=article&id=46&Itemid=57

Figure 11. Road infrastructure map of Kenya



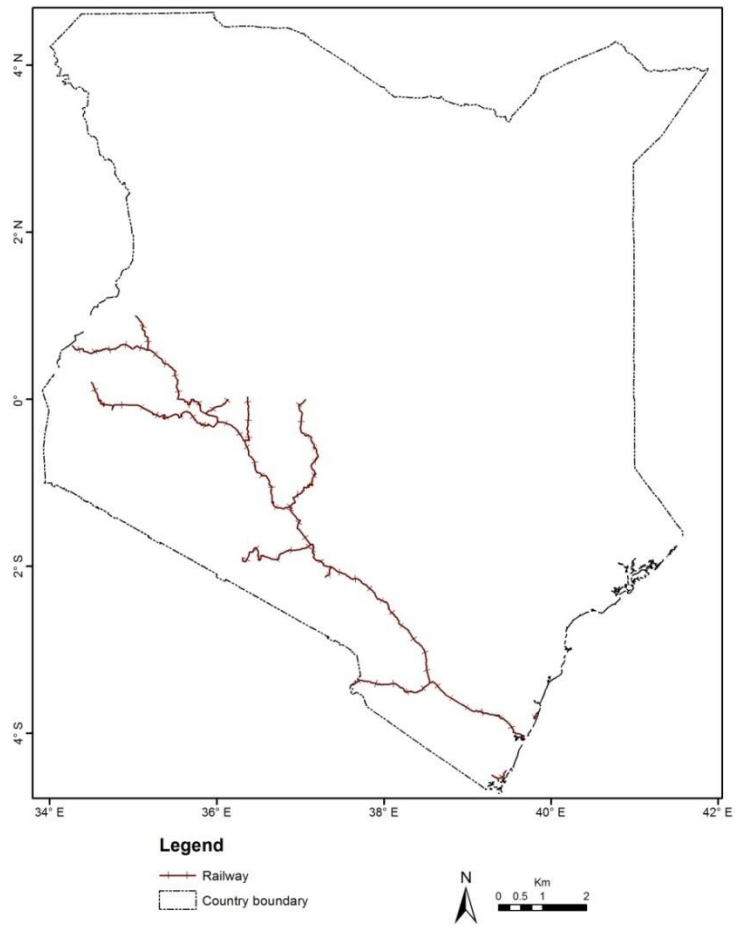
Source: ILRI (2011); GIS Services.

If we also account for population and measure road density in terms of km per km^2 per million people in each AEZ, we estimate that HRA would still have the highest road density, while semi-arid and arid areas may have comparable but lower road density. To inform the MTIP's prioritization of spending on transport infrastructure in general, we can also assess the status of railroad access in each AEZ. Based on Figure 12, we find that the majority of railroad access is in the HRA and semi-arid areas, while it is virtually nonexistent in the arid areas. Thus not only have past road investments been low in the arid areas, but rail investments as well, implying that planned road investments in the arid areas would be important for improving agriculture and economic growth in the arid areas. Worth noting is that Kenya's proposed railroad investments by Kenya Railways Corporation and Rift Valley Railways focus on urban railway infrastructure to alleviate congestion in Nairobi and do not address rural railroads or their potential in the agriculture sector, except for longer-term plans such as the Lamu-Juba (Sudan) railway line, which is part of the 2030 vision. Therefore, the short- to medium-term investments in roads in semi-arid and arid areas will be crucial for improved agricultural marketing, growth and poverty reduction in the long run.

General assessment suggests that combining different types of infrastructure investments in the semi-arid areas, for example irrigation plus road investments as planned for in the MTIP, makes the most sense for three reasons: (i) semi-arid areas have the greatest potential for agricultural growth and poverty reduction (see growth options analysis of section IV); (ii) combining different types of infrastructure investments in the same area yields synergies, thus potentially increasing the impact on development outcomes; and (iii) some of the benefits in the semi-arid areas would spill over to other regions, as shown by the analysis in section IV, which shows that productivity increases in the semi-arid areas have the highest spillover benefits for the other AEZ.

Thus, while the arid areas appear to have the lowest road density, they also have the lowest agricultural growth and poverty reduction potential at the national level, implying that spending more on rural roads in the arid areas, while important, may be less efficient compared to the semi-arid areas. However, some spending on rural roads in the arid areas is justified on the grounds of equity and/or the potential benefits accruing at the regional level in the East African Community (particularly via major roads that connect multiple countries). In this regard, it may make more sense to leverage regional investments such as the Northern Corridor Transport Improvement Project (NCTIP) to improve agricultural returns in the arid areas and potentially dovetail these regional investments on trunk roads with investments on rural connector and feeder roads that link remote areas to major roads constructed under the NTCIP. Therefore, allocating most of the public spending on road infrastructure in the arid areas on feeder and connector roads seems most beneficial at this point. In sum, public spending on rural road infrastructure and market access has been increasing over the past few years in Kenya, and the MTIP's further increased spending on rural road market access should contribute to accelerated agricultural growth and poverty reduction.

Figure 12. Railway system in Kenya



Source: ILRI (2011); GIS Services.

Livestock subsector spending

Planned investments in the livestock subsector equal approximately Ksh 27.4 billion, slightly more than the investments slated for crop production and technology adoption (Ksh 26.9 billion). Given crop production's importance relative to livestock in terms of its potential to contribute to national agricultural growth and poverty reduction, as shown by the analysis in section IV, it may first appear questionable why a greater expenditure share is dedicated to the livestock sector. However, most of the irrigation and road infrastructure investments that constitute the majority of public spending will be allocated to crop producing areas rather than livestock producing areas. Therefore, the allocation of 11 percent of total agricultural spending to the livestock subsector seems amenable. Most of the spending on the livestock subsector will be devoted to animal disease control and livestock health (Ksh21.1 billion, which is approximately 80.7 percent of the total spending on this category and 8.9 percent of the total

MTIP budget). In terms of AEZ, the arid areas receive most of this funding (over 15 billion Ksh). This structure of spending allocation is practical in that the arid areas are predominantly livestock-oriented, while some dairy production and small ruminant production take place in parts of the semi-arid and HRA through mixed farming systems. Given the significant potential to increase livestock production in arid areas and that the major constraint in the past has been animal diseases and value chain constraints such as poor quality, particularly for export, the MTIP seems to allocate funding to this category appropriately. Specific details on how these investments are coordinated at a regional level would be helpful in harmonizing the efforts to improve the livestock sector in the region, particularly given its implications for enhancing resilience to drought and improving the livelihood options in arid areas.

Crop production and technology adoption

One of the most striking aspects of the proposed MTIP budget allocation to improving crop production is the disproportionate amount set aside for HRA (25.6 billion Ksh). This is particularly unexpected since most of the infrastructural investments are set for semi-arid areas. It might be better to couple increased investments in infrastructure with increased crop production investments in the same semi-arid areas. However, only Ksh1.3 billion will be spent on increasing crop production in the semi-arid areas for improving delivery of extension services, adoption of high yielding seed varieties, etc. Thus there may be a need to reconsider how much spending is allotted to the semi-arid areas. Here we recommend gradually increasing the amount of spending on semi-arid crop production, especially since HRA still constitute the bulk of crop production and since infrastructure investments in arid areas will have a lag. However, progressively increasing the amount allocated to crop productivity activities in the semi-arid areas may make sense.

Public spending on fisheries

Another area of investment that features in the MTIP is fisheries development. Although the fisheries subsector only accounts for about 0.5 percent of total GDP, with freshwater fisheries contributing most of the fish landed (about 93 percent; see Table 15), there are significant opportunities for expansion (KNBS, 2009). According to the authors' categorization of the MTIP budget (Table 13), HRA will receive most of the fisheries development investments (4.3 billion Kenyan shillings)[6], and based on the details in the MTIP, most of these investments will be for

[6] To obtain these figures we assumed that the investment amount described under the high rainfall areas budget but indicating that these funds will also be spent in the arid and semi-arid areas would be allocated evenly across the three AEZs (See Table 18 in the appendix).

productivity enhancements at the fish farm and marine levels (that is, for fingerlings, fish feed, and development of marine capture fisheries). It is debatable whether increased fisheries production will be matched by complementary downstream value chain investments and increased domestic market demand, especially given that the Kenyan diet does not currently include significant amounts of fish. Alternatively, if the increased investments in fisheries are targeted at export markets, adequate value- and cold-chain investments must be made to facilitate increased exports. As it stands, 1 billion Ksh is allocated to fish safety and quality for all three regions over the five-year period, and it is not clear how these investments will be apportioned. Currently, the Competent Authority, which carries the mandate of fish inspection and quality assurance, has 29 fish inspectors trained in HACCP implying that increased institutional capacity may be necessary to complement planned increased production. Thus, careful retooling of the fisheries section of the MTIP budget is recommended.

Moreover, there is no clear indication in the MTIP on whether the focus will be fresh fish production or processed fish products or high value seafood (for example lobsters, prawns, crabs, oysters, octopus, and squid). What is apparent is that significant investment will be devoted to marine fish capture (2.5 billion Ksh). This area has received little investment in the past, yet could contribute to the subsector's growth. According to the strategic plan of the Ministry of Fisheries Development, its main emphasis is on the traditional mainstay of Kenyan fisheries, warm freshwater production and domestic consumption of tilapia and African catfish, which seems to be a different focus from the MTIP. Perhaps a more focused and coordinated plan within government could help improve the impact of the fisheries investment plan in Kenya.

Given the limited size of the fisheries investment budget, strategically harmonizing and leveraging public investments in fisheries with private sector investments, for example through the Kenya Fish Processors and Export Association (AFIPEK), may be a practical option to explore. Currently, the MTIP does not provide a description of how public and private sector fisheries investments will be harmonized. Thus, while there may be potential to expand fish production in Kenya, a clearer and more specific budget that leverages and complements private sector investments could exploit opportunities of synergy for significant impact on growth and poverty reduction.

Table 15. Value of fish landed in Kenya, 2004–2008 (Ksh million)

	2004	2005	2006	2007	2008
Freshwater fish	7,182	7,208	8,071	7,984	8,383
	(92.5)	(94.2)	(94.2)	(92.9)	(92.9)
Marine fish	328	306	335	422	443
	(4.2)	(4.0)	(3.9)	(4.9)	(4.9)
Crustaceans	221	99	123	145	153
	(2.8)	(1.3)	(1.4)	(1.7)	(1.7)
Other marine products	30	39	38	43	46
	(0.4)	(0.5)	(0.4)	(0.5)	(0.5)
Total	7,761	7,652	8,567	8,594	9,024

Source: Ministry of Fisheries Development (2011); Percentages are shown in parentheses

Multi-sectoral synergy in public investments

The MTIP does relatively well to link investments across ministries within the agricultural sector, but there appear to be limited links and coordination between agricultural investments and nonagricultural investments, particularly those that are related to industry and trade or nutrition, health, and education sectors. This calls for a careful analysis of the proposed MTIP as well as other sector budgets to find opportunities of improving multi-sector coordination, which could yield even greater impact on growth, poverty reduction, and nutrition. Possibly, the current MTIP can leverage investments in the trade sector and, likewise, investments in the education and health sectors could leverage those in agriculture to enhance impact on a variety of development outcomes.

Development partner and civil society investments in agriculture

To assess the links between the MTIP and development partner/NGO investments in agriculture, we collected data on past agricultural investments and activities carried out by development partners in Kenya from the AidData website (http://www.aiddata.org/home/index) (Findley et al, 2009). We also collected data from the OECD database (Creditor Reporting System) and individual donor reports (for example World Bank projects and African Development Bank reports). Unfortunately, the data compiled were incomplete as they lacked disaggregated data from several development partners (see Table 22

in the appendix and Figure 13 for the data obtained). The aggregate figures show that official development assistance (ODA) to Kenya has disfavored the agriculture sector; for example, in 2009 only 4.7 percent of total ODA to Kenya was dedicated to the agricultural sector. More ODA was targeted at population policy/programs, reproductive health, and humanitarian aid. In fact, most of the increase in ODA in the last decade under the category population policy/programs and reproductive health was for HIV/AIDS related activities. ODA funding on HIV/AIDS and sexually transmitted disease control increased from US$ 20.8 million in 2002 to US$ 377.1 million in 2009. Funding allocated to economic infrastructure and services also increased. In general, spending by development partners has increased significantly and has become more aligned with government investment plans–this is expected to enhance spending efficiency overall.

Figure 13. Official Development Assistance to Kenya (million US$)

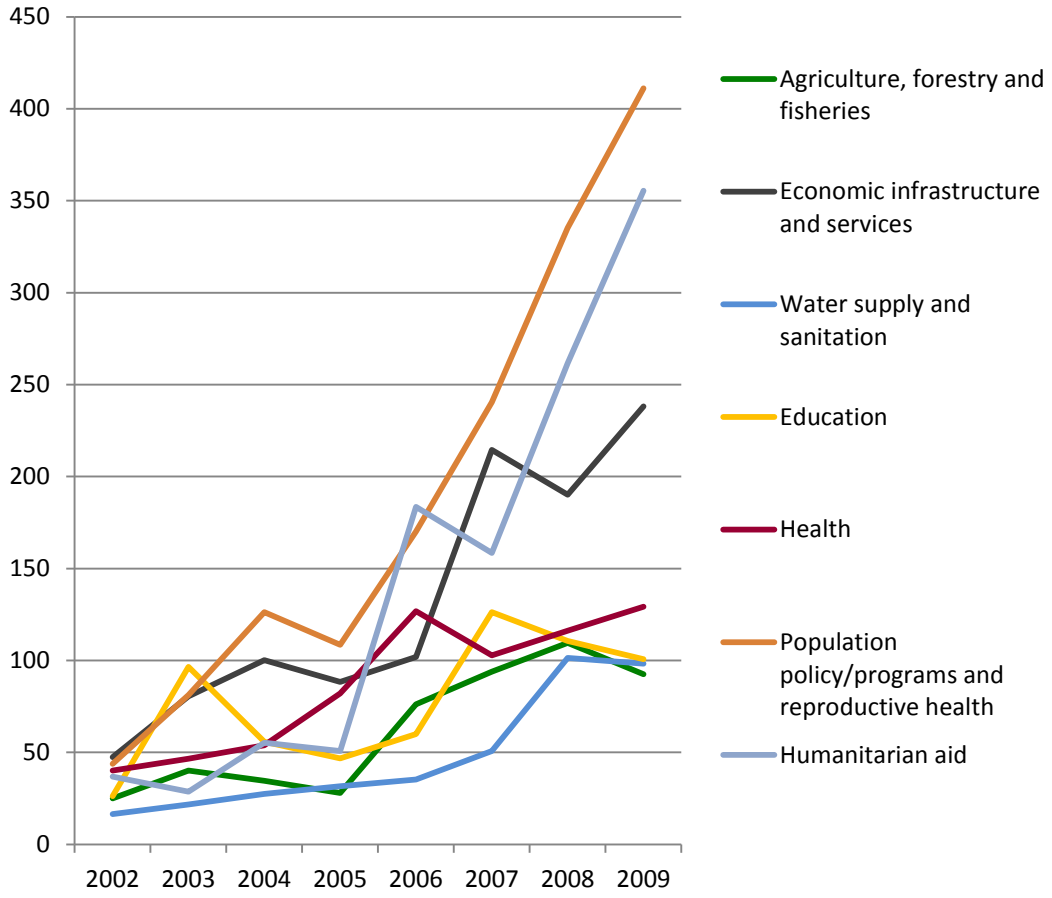


Table 16. Proportion of agriculture investments to Kenya by development partner in 2005/6-2007/8

Development partner	Proportion (%)
European Union	26.5
World Bank, International Development Association	21.2
African Development Bank	18.5
International Fund for Agricultural Development (IFAD)	11.9
SIDA	6.9
United States Agency for International Development (USAID)	5.8
Japan International Cooperation Agency (JICA)	2.7
Ministry of Foreign Affairs of Denmark - Danish Agency for International Development and Aid (DANIDA)	2.7
Germany	1.5
United Nations Food and Agriculture Organizations (FAO)	1.2
Italy	1.2

Source: African Development Bank (2009) Project Appraisal Report.

Private sector investments, public-private partnerships and parastatals

The private sector can help accelerate agricultural growth in Kenya. Over the last decade, several major private sector investments have helped increase agricultural value added, particularly in the horticultural export value chains through export processing zones (EPZs) that predominantly draw from agricultural production in the HRA. Private sector investments have typically come from multi-nationals as well as domestic firms organized under trade associations such as the Fresh Produce Exporters Association of Kenya (FPEAK). In relation to the MTIP, it is important that over 12 billion Ksh will be spent on enabling a conducing economic environment, which is critical in getting the private sector to invest in agricultural ventures that are considered riskier by investors (Poulton and Macartney 2012). However, a close look at the MTIP reveals that most of the funding under this category is for land policy related activities and it is not quite clear to what extent this spending will attract (crowd in)

private sector investments in agriculture. Property rights and an enforceable land tenure and land use legal framework are essential for private sector involvement in agriculture and in that regard this spending could play an important role.

Recently there has been growing interest in finding effective ways of leveraging public sector spending to crowd in private sector financial capital into smallholder agriculture. A variety of incentive structures and mechanism designs have been documented as levers for encouraging private sector investments in smallholder agriculture (Poulton and Macartney 2012). Such levers include a gamut of public-private partnership arrangements which have emerged under a variety of conducive settings in Kenya, such as the long-standing partnership between SC Johnson and the Pyrethrum Board of Kenya, which has evolved over time to include Appropriate Technologies for Enterprise Creation (ApproTEC) and the integration of over 200,000 smallholder farmers in the pyrethrum value chain (PBK, 2011). Other examples of PPP levers worth considering within the MTIP framework include guarantee funds to enable credit provision to agro-dealers and smallholder farmers (for example AGRA's microcredit programs and commercial lending program with Equity Bank) as well as challenge grant funds such as those employed by the United Kingdom's Department for International Development (DFID) to support the establishment of the MPESA mobile phone money transfer system. Traditionally, a considerable amount of public spending has been allocated to parastatals with limited consideration of how to enhance their efficiency and possibly link parastatals' spending and activities with those of the private and non-governmental sectors; this may be worth exploring as well.

VI. SUMMARY OF MAJOR FINDINGS

The dynamic CGE model for Kenya was updated by revising the Social Accounting Matrix (SAM) so that productive activities and households were disaggregated by agroeconomic zones using 2007 disaggregated data. Following the SAM revision, CGE growth options and poverty reduction simulations were run in similar fashion to the previous work of Thurlow and Benin (2008), to identify priority subsectors and commodities within each agronomic region. The simulations were based on subsector- and region-specific total factor productivity growth criteria that were jointly established by the task team and stakeholders in Kenya during expert panel sessions conducted in February 2011. Thus, the analysis accounted for the relative importance or weighting of regional versus national poverty or of different subsector-led growth scenarios in light of the proposed public expenditure under the MTIP. While the available public expenditure data did not allow for comprehensive quantitative investment analysis by agronomic region (AEZ) or by investment category as reflected in the MTIP, qualitative and mapping analysis were employed to help review planned investments under the

MTIP. This was done in relation to previous studies, targeted agricultural growth and related development outcomes associated with different investment options within the different AEZ. The major findings of this study are summarized below.

Six percent agricultural growth is highly ambitious but achievable

Results of the CGE modeling suggest that for Kenya to achieve a 6 percent agriculture GDP growth rate, as delineated in the CAADP goals, subsector growth would have to improve significantly across the board with maize, other roots, pulses, fruits, and tea all being important drivers of growth; each would have to attain growth rates greater than 6 percent. Export crops would also have to perform exceedingly well, growing at 6.2 percent, which is more than double the rate achieved in the baseline scenario. The CAADP scenario would also require increased productivity in downstream agricultural processing sectors. This would be necessary to ensure higher value addition and a significant reduction in agricultural demand-side bottlenecks often associated with rapid agricultural productivity growth. Given these minimum requirements, a six percent agriculture GDP growth rate seems highly ambitious though not totally out of reach for Kenya.

The composition of agricultural growth matters

Comparing the effectiveness of growth driven by different subsectors in different AEZ, maize and traditional export crop production in the semi-arid and HRA have larger impacts on national poverty reduction. This is because these sectors and AEZ are already large in scale and population size and so can contribute substantially to achieving broad-based agricultural growth. Yield improvements in maize and root crops not only benefit households directly, by increasing incomes from agricultural production, but also by allowing farmers to diversify their land allocation towards other higher-value crops. Maize and traditional export crops are also effective at raising rural real incomes and reducing poverty. Cereals are particularly effective at reducing poverty amongst Kenya's poorest households. Thus, high priority should be afforded to improving maize and root crop yields and increasing production and domestic value-addition of traditional exports.

Increasing agricultural spending and improving efficiency in allocation across regions and subsectors will be critical

Increasing agricultural growth to meet the CAADP growth target will require additional investment in the sector as well as improvements in how public spending is allocated across

subsectors and AEZ. Previous investment analysis of Thurlow and Benin (2008) indicates that government spending on agriculture would have to grow by about 14 percent per year in order to achieve and sustain the targeted 6 percent agricultural growth under the CAADP agenda as well as meeting the first Millennium Development Goal of reducing the poverty rate by half. This implies that the government would need to allocate 8–11 percent of its total budgetary resources to agriculture by 2015. In addition, our current analysis suggests that the MTIP's focus on rural infrastructure development (irrigation and roads) is apposite and would need to be implemented efficiently and fully to maximize potential gains. This would assist Kenya in achieving the CAADP target, which will substantially reduce the number of poor people living below the poverty line by 2015 and significantly improve the well-being of both rural and urban households.

Semi-arid areas and infrastructure developments could contribute increasingly more

With the largest portion of the MTIP budget dedicated to the semi-arid areas and for potentially transformational improvements in irrigation and road infrastructure as well as market/value chain developments, significant growth is expected to result from the proposed investments. While continued growth in the HRA will be necessary to contribute to agricultural growth and reduction of poverty and malnutrition, significant gains will also necessarily have to come from the other regions, especially the semi-arid areas. As shown in the growth options analysis, poverty reduction spillover effects will be largest in the semi-arid areas, implying that the semi-arid areas will also become a major engine for growth and poverty reduction. Investments in rural infrastructure are not likely to lead to immediate gains however, given the lag associated with these kinds of investments. In the long run these investments should reap major benefits for Kenyan agriculture and citizens as a whole, provided the rural infrastructure developments are efficiently and fully implemented.

Multi-sector and Private sector Considerations may be worth exploring

While the MTIP has strong linkages between various agricultural subsectors investments, weaknesses are evident in terms of incorporating other nonagricultural sectors and private sector investments. There may be opportunities to leverage the MTIP's spending to crowd in private sector investments in agriculture and to enhance the impact of other sectors' spending on agriculture-related outcomes. Similarly, outcomes such as health, nutrition and education, which are typically considered as nonagricultural may benefit from the MTIP investments as backward–forward synergies could be realized across sectors. Thus, it is important for the

government to consider a holistic systems perspective in the execution of the MTIP agricultural investments to capitalize on opportunities for synergy.

VII. REFERENCES

African Development Bank. 2009. Project Appraisal Report 2009. Tunis, Tunisia.

Agenor, P. R., Bayraktar, N. & El Aynaoui, K. 2008. Roads out of poverty? Assessing the links between aid, public investment, growth and poverty reduction. *Journal of Development Economics* 86(2): 277–295.

ALRMP. 2011. Districts covered by Arid Lands Resource Management Project (ALRMP) (Figure), available online at http://www.aridland.go.ke (last accessed May 2011).

AidData. 2011. Tracking Development Finance. Available at: http://www.aiddata.org/home/index

ASCU (Agricultural Sector Coordination Unit). 2010. Agricultural Sectoral Development Strategy (ASDS) Medium Term Investment Plan (MTIP): 2010-2015, Kenya.

Fan, S. and Zhang,X. 2004. Investment, Reforms and Poverty in Rural China. *Economic Development and Cultural Change* 52(2):395-422.

Fan, S., Zhang, X. and Rao, N. 2004. Public expenditure, growth and poverty reduction in rural Uganda .Development Strategy and Governance Division Discussion Paper 4, IFPRI, Washington D.C.

Fan, S. and Chan-Kang, C. 2004. Returns to investment in less-favored areas in developing countries: a synthesis of evidence and implications for Africa. *Food Policy* 29(4):431-444.

Fan, S., Hazell, P. and Thorat, S. 2000. Government spending, agricultural growth and poverty in rural India. *American Journal of Agricultural Economics* 82(4):1038-51.

Findley, M.G., Hawkins, D., Hicks, R.L., Nielson, D.L., Parks, B.C., Powers, R.M., Roberts, J.T., Tierney, M.J and Wilson, S. September 2009. AidData: Tracking Development Finance," presented at the PLAID Data Vetting Workshop, Washington, DC.

Gakuru, M. and Tucker, R.C.F. 2009. Sustainability of Research and Development: A case of successful technology transfer in spoken language technology. CHI workshop on human-centered computing in international development, Boston, MA. Available at: http://llsti.org/pubs/CHI_2009_GakuruTucker.pdf

Gakuru, M., Winters, K. and Stepman, F. 2009. Innovative farmer advisory services using ICT.IST-Africa 2009 Conference Proceedings, Kampala, Uganda. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.170.5628&rep=rep1&type=pdf

Government of Kenya.2010. Agricultural Sector Development Strategy Medium-Term Investment Plan 2010—2015. Nairobi, Republic of Kenya

ILRI (International Livestock Research Institute). 2011. GIS Services. Nairobi, Kenya. Available online at: http://192.156.137.110/gis/

KENOA (Kenya National Audit Office). (various years). Summary of the report of the Auditor General's on the appropriation accounts other public accounts and the accounts of the funds of the Republic of Kenya for the year ending (various years: 2000/2001–2009/2010).

KENOA (Kenya National Audit Office). (various years). Report of the controller and auditor general on the appropriations accounts of the funds of the Republic of Kenya. Nairobi, Kenya for the year ended30 June, (various years: 2000–2009).

KNBS (Kenya National Bureau of Statistics). 2007. Kenya Integrated Household Budget Survey (KIHBS) 2005/06. Nairobi, Kenya

KNBS (Kenya National Bureau of Statistics). 2009. Economic Survey 2009. Nairobi, Kenya

Kiringai, J., Thurlow, J. and Wanjala, B. 2006."A 2003 Social Accounting Matrix (SAM) For Kenya", International Food Policy Research Institute, Washington DC, and Kenya Institute for Public Policy Research and Analysis, Nairobi.

Ministry of Fisheries Development. 2011. Fish landing statistics. Nairobi, Kenya. Available online at: http://www.fisheries.go.ke/

Ministry of State for Planning, National Development and Vision 2030. 2010. Public Expenditure Review 2010: Policy for prosperity 2010. Nairobi, Kenya.

MoA (Ministry of Agriculture). 2010. Economic Review of Agriculture 2010. Nairobi, Kenya.

MoA (Ministry of Agriculture). 2011. Ministry of Agriculture financial data files. Nairobi, Kenya.

Mogues, T., Ayele, G., and Paulos, Z. 2007. The bang for the Birr: public expenditures and rural welfare in Ethiopia. IFPRI Discussion Paper 702. IFPRI, Washington D.C.

MoLD (Ministry of Livestock Development). 2011. Ministry of Livestock Development financial data files. Nairobi, Kenya.

NIB (National Irrigation Board). 2011. National Irrigation Board Schemes and Stations. www.nib.or.ke

Nzuma, J.M., A. 2011. Kenya's Agricultural Productivity and Investment Growth Projections into 2020.Notes from a meeting with a panel of experts. Nairobi, 2011.

OECD. 2011. Organization for Economic Co-operation and Development Creditor Reporting System Database. Paris: OECD. Available online at: http://stats.oecd.org/Index.aspx?datasetcode=CRS1

PBK (Pyrethrum Board of Kenya). 2011. Growing: Socio-economic benefits. Available online at: http://www.kenya-pyrethrum.com/

Poulton, C. and Macartney, J. 2012. Can Public-Private Partnerships leverage private investment in agricultural value chains in Africa? A preliminary review. *World Development*, 40(1): 96-109.

Thurlow, J. and Benin, S. 2008. Agricultural Growth and Investment Options for Poverty Reduction in Kenya. Preliminary report prepared for Kenya's Comprehensive Africa Agricultural Development Programme (CAADP) Roundtable Discussion, International Food Policy Research Institute.

Thurlow, J., Kiringai, J., and Gautam, M. 2007. Rural Investments to Accelerate Growth and Poverty Reduction in Kenya. Discussion Paper No. 723, International Food Policy Research Institute.

World Bank. 2010. World Databank: World Development Indicators and Global Development Finance. Available at: http://databank.worldbank.org/ddp/home.do

World Resources Institute (WRI). 2007. Department of Resources Surveys and Remote Sensing; Ministry of Environment and Natural Resources, Kenya; Central Bureau of Statistics—Ministry of Planning and national Development, Kenya; International Livestock Research Institute (ILRI). *Nature's benefits in Kenya: an atlas of ecosystems and human well-being.* WRI, Nairobi, Kenya. Available online at: http://www.wri.org/publication/content/9506#ch3

You, L., Wood-Sichra, U., Xie, H. and Guo, Z. April, 2011. Prioritize Irrigation Investment in Kenya. IFPRI Unpublished report submitted to the World Bank: Strategic Analysis of Water Resources Investment in Kenya, Africa Region. Washington, DC.

VIII. APPENDIX

Table 17. Crop yields in baseline and CAADP scenarios, by AEZ (2010-2020)

	High rainfall areas			Arid areas			Semi-arid areas			National average		
	Initial yield (2010)	Final yield (2020)		Initial yield (2010)	Final yield (2020)		Initial yield (2010)	Final yield (2020)		Initial yield (2010)	Final yield (2020)	
		Baseline	CAADP		Baseline	CAADP		Baseline	CAADP		Baseline	CAADP
Cereals												
Maize	2.57	3.76	4.00	0.53	0.47	0.63	0.99	0.91	1.33	1.97	2.87	2.97
Wheat	3.92	4.94	5.36	1.46	1.38	1.64	1.11	1.47	1.40	2.61	3.21	3.35
Rice	2.55	3.15	3.07				3.89	3.46	3.97	2.71	3.21	3.16
Sorghum	1.01	1.13	1.36	0.42	0.37	0.47	0.88	0.78	1.09	0.93	0.83	1.18
Millet	1.60	2.45	2.18	0.81	0.79	0.89	0.58	0.59	0.71	1.05	1.73	1.31
Root crops												
Cassava	12.35	27.38	20.36	1.66	2.43	2.03	8.36	13.10	11.71	11.95	27.08	19.66
Other roots	8.46	8.83	15.15	4.96	4.09	7.44	8.26	6.96	13.43	8.44	8.37	14.97
Pulses and nuts												
Pulses	0.74	0.98	1.00	0.96	0.84	1.05	0.33	0.30	0.40	0.52	0.61	0.65
Oilseed crops	1.02	1.05	1.39				1.04	1.05	1.30	1.02	1.05	1.37
Horticulture												
Fruits	15.05	16.06	23.33	3.70	3.06	4.49	13.78	11.68	19.03	14.37	12.90	21.30
Vegetables	12.05	14.33	14.53	6.86	8.50	6.43	12.00	11.06	13.03	12.03	13.36	14.37
Export crops												
Cotton	0.50	0.61	0.80	0.93	0.86	1.06	0.99	1.06	1.53	0.77	0.86	1.20
Sugarcane	77.89	107.44	107.04							77.89	107.44	107.04
Coffee	0.22	0.23	0.29				0.22	0.22	0.21	0.22	0.23	0.28
Tea	2.59	3.01	3.92				2.57	2.88	3.03	2.59	2.99	3.82
Tobacco	1.39	1.61	2.01				1.38	1.54	1.33	1.39	1.61	1.96
Other crops	0.70	1.03	1.18	0.02	0.03	0.03	2.64	3.78	3.64	1.03	1.44	1.46

Source: Kenya CGE and microsimulation model.
Note: units are measured in metric tons per hectare (MT/HA).

Table 18: MTIP 2010–2015, Kenya

Strategic Thrust	Activity	Annual budget '000 Kenyan Shillings (at 2010 constant prices)					Total
		Year 1 (2010/11)	Year 2 (2011/12)	Year 3 (2012/13)	Year 4 (2013/14)	Year 5 (2014/15)	
1. Increase productivity and promote commercialization and competitiveness of all crops, livestock, marine and fisheries, and forestry.		13,362,793	16,879,820	17,915,368	19,747,741	21,833,325	89,739,047
1.1 Livestock development in arid areas.	1.1.1 Undertake disease control and livestock health measures	2,400,000	2,500,000	2,750,000	3,200,000	3,600,000	14,450,000
	1.1.2 Establish and manage disease-free zones.	140,000	150,000	150,000	150,000	200,000	790
	1.1.3 Undertake proper range management practices	6,005	80,800	110,990	120,595	150,625	469,015
	1.1.4 Undertake livestock restocking.	2,487	15,000	23,760	24,750	29,980	95,977
	1.1.5 Breed livestock for productivity.	10,000	12,000	15,000	16,000	17,000	70,000
1.2 Livestock development in Semi-Arid Areas	1.2.1 Disease control.	341,000	358,050	375,952	394,750	414,488	1,884,240
	1.2.2 Disease-free zones.	542,924	570,071	598,574	628,503	659,928	3,000,000
	1.2.3 Water provision.	50,000	52,500	55,125	57,881	60,775	276,281
	1.2.4 Range management.	156,005	163,805	171,995	180,595	189,625	862,025
	1.2.5 Forage production and conservation.	100,000	105,000	110,250	115,762	121,551	552,563
	1.2.6 Undertake livestock restocking.	90,487	95,012	99,762	104,750	109,988	499,999
	1.2.7 Breeding for productivity.	78,002	81,903	85,998	90,298	94,813	431,014
	1.2.8 Early warning systems.	14,840	15,582	16,361	17,179	18,038	82,000
	1.2.9 Marketing.	39,001	40,951	42,999	45,149	47,406	215,506
	1.2.10 Processing and value addition.	48,362	50,780	53,319	55,985	58,784	267,230
	1.2.11 Capacity building.	100,000	105,000	110,250	115,762	121,551	552,563
1.3 Conservation agriculture in the semi- arid areas.	1.3.1 Capacity building on conservation tillage.	50,000	52,500	55,125	57,881	60,775	276,281
	1.3.2 Developing land under conservation tillage.	189,001	198,451	208,374	218,793	229,732	1,044,351

1.4 Increase the productivity of the HRA agricultural land.	*Improve access to and affordability of qualtty inputs:*						
	1.4.1 Fertilizer.	452,437	475,059	498,812	523,752	549,940	2,500,000
	1.4.2 Seeds.	180,975	190,024	199,525	209,501	219,976	1,000,001
	1.4.3 Pesticides.	90,487	95,012	99,762	104,750	109,988	499,999
	1.4.4 Animal nutrition.	135,731	142,518	149,644	157,126	164,982	750,001
	1.4.5 Disease and pest control.	361,950	380,047	399,049	419,002	439,952	2,000,000
	1.4.6 Artificial insemination.	90,487	95,012	99,762	104,750	109,988	499,999
	1.4.7 Breeding Stock.	54,292	57,007	59,857	62,850	65,993	299,999
	1.4.8 Establish bulking sites and fodder banks.	90,487	95,012	99,762	104,750	109,988	499,999
	1.4.9 Fingerlings and fish feed.	452,437	475,059	498,812	523,752	549,940	2,500,000
	Build capacity of:						
	1.4.10 Farmers / producers (all subsectors) to develop and promote intensive and profitable farming on a conservational and sustained basis.	633,412	665,082	698,337	733,253	769,916	3,500,000
	1.4.11 Extension service providers to develop and promote intensive and profitable farming on conservation and sustained basis.	1,284,921	1,349,167	1,416,625	1,487,457	1,561,830	7,100,000
	1.4.12 Other service providers and actors along the value chain.	555,593	583,372	612,541	643,168	675,326	3,070,000
	Exploit opportunities for larger land units to achieve economies of scale.						
	1.4.13 Address the physical constraints along the value chain (build and maintain roads provide water cooling plants, build physical markets).	1,809,748	1,900,235	1,995,247	2,095,010	2,199,760	10,000,000
	1.4.14 Construct multipurpose dams.	200,000	3,000,000	3,200,000	4,000,000	5,000,000	15,400,000
	Address the non-physical constraints along the value chain (organizations and distribution channels / routes to market).						

	1.4.15 Access to information for farmers / producers and other stakeholders.	452,437	475,059	498,812	523,752	549,940	2,500,000
	1.4.16 Promote farmer / producers organizations to facilitate access to inputs information, credit, storage and handling facilities and markets.	904,874	950,118	997,624	1,047,505	1,099,880	5,000,001
	1.4.17 Appropriate technology transfer and innovation (technology information incubation centres).	180,975	190,024	199,525	209,501	219,976	1,000,001
1.5 Use every possible agricultural land available for production in the HRA (trust land held for speculative purposes).	1.5.1 Develop a policy on urban and peri-urban agriculture.	9,049	9,501	9,976	10,475	10,999	50,000
	1.5.2 Implement a national land use policy.	50,000	50,000	50,000	50,000	50,000	250,000
1.6 Increase production of capture fisheries.	1.6.1 Develop marine capture fisheries.	452,437	475,059	498,812	523,752	549,940	2,500,000
	1.6.2 Development and management of inland fisheries resources.	180,975	190,024	199,525	209,501	219,976	1,000,001
	1.6.3 Ensure fish safety and quality.	180,975	190,024	199,525	209,501	219,976	1,000,001
	1.6.4 Provide fingerlings and fish feeds.	200,000	200,000	200,000	200,000	200,000	1,000,000
2. Promote private sector participation in all aspects of agricultural development.		5,189,530	6,538,421	6,805,007	7,057,297	7,325,825	32,916,080
2.1 Capacity building	2.1.1 Strengthen research and extension systems relevant to dry lands - existing services.	30,000	150,000	150,000	150,000	150,000	630,000
	2.1.2 Strengthen delivery of extension services in Arid Areas.	17,000	22,500	35,000	40,000	50,000	164,500
	2.1.3 Promote private sector participation in service delivery - contracted services.	15,500	20,000	35,000	47,500	50,000	168,000
	2.1.4 Promote research activities in arid areas - infrastructure.	5,000	20,000	45,000	55,000	75,000	200,000
2.2 Promotion of value addition.	2.2.1 Promote primary processing and storage.	50,000	52,500	55,125	57,881	60,775	276,281
	2.2.2 Promote value-addition processing initiatives in cooperatives.	44,205	44,205	44,205	44,205	44,205	221,025
	2.2.3 Promote the development of joint ventures, linkages and partnerships for value addition in cooperatives.	50,000	52,500	55,125	57,881	60,775	276,281

	2.2.4 Promote agribusiness and investments in cottage industries.	39,001	40,951	42,999	45,149	47,406	215,506
	2.2.5 Promote establishment of Cooperatives and farmer organizations.	50,000	52,500	55,125	57,881	60,775	276,281
	2.2.6 Promote internal and external trade.	90,000	94,500	99,225	104,186	109,396	497,307
	2.2.7 Empower farmer organizations.	20,000	21,000	22,050	23,153	24,310	110,513
	2.2.8 Strengthen capacity of private sector to process farm produce and store strategic grain reserves, training and credit.	0	1,000,000	1,000,000	1,000,000	1,000,000	4,000,000
	2.2.9 Strengthen capacity of private sector to process livestock produce and store strategic livestock products, training and credit.	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	5,000,000
2.3 Development of support infrastructure.	2.3.1 Invest in construction of access roads.	3,003,710	3,153,896	3,311,590	3,477,170	3,651,028	16,597,394
	2.3.2 Promote renewable sources of energy to facilitate production and agro processing.	150,000	157,500	165,375	173,644	182,326	828,845
2.4 Capacity building in semi-arid areas.	2.4.1 Develop appropriate capacity of primary producers in semi-arid areas to undertake the above activities.	95,114	99,869	104,863	110,106	115,611	525,563
	2.4.2 Strengthen delivery of extension service in semi- arid areas.	300,000	315,000	330,750	347,287	364,652	1,657,689
	2.4.3 Promote private sector participation in service delivery.	30,000	31,500	33,075	34,729	36,465	165,769
	2.4.4 Promote research activities in semi-arid areas.	200,000	210,000	220,500	231,525	243,101	1,105,126
3. Develop and manage the national water resources, land resource, forestry and wildlife in a sustainable manner.		18,775,180	19,956,692	21,014,813	22,043,309	23,100,837	104,890,831
3.1 Drought cycle management.	3.1.1 Provide borehole water.	10,000	100,000	155,000	155,000	155,000	575,000
	3.1.2 Establish early warning systems.	10,000	125,000	100,000	55,180	40,500	330,680
	3.1.3 Establish community based irrigation schemes.	10,000	30,000	45,000	70,000	75,000	230,000
	3.1.4 Develop drought reserve areas.	10,000	12,500	15,000	12,000	10,000	59,500
3.2 Pastoralists Natural resource management.	3.2.1 Put in place measures to minimize human-wildlife conflict.	5,000	5,500	15,500	16,000	16,000	58,000

	3.2.2 Protect indigenous environmental knowledge and practices.	10,000	10,000	12,000	13,000	13,000	58,000
	3.2.3 Promote construction o' water-harvesting facilities.	50,000	70,000	80,000	100,000	100,000	400,000
	3.2.4 Build capacity for climate change adaptation as well as capacity in trading in carbon credits.	5,000	5,500	5,500	7,000	7,000	30,000
3.4 Irrigation and drainage.	3.4.1 Rehabilitation and Expansion of existing schemes.	1,000,000	1,050,000	1,102,500	1,157,625	1,215,506	5,525,631
	3.4.2 Development of new schemes; smallholder and public schemes.	2,279,279	2,393,243	2,512,905	2,638,551	2,770,479	12,594,457
3.5 water harvesting and storage in semi-arid areas.	3.5.1 Multipurpose dams (2 large dams and 3 medium size dams).	5,507,493	5,782,868	6,072,011	6,375,611	6,694,392	30,432,375
	3.5.2 Local water harvesting.	2,650,000	2,782,500	2,921,625	3,067,706	3,221,092	14,642,923
	3.5.3 Processing and Marketing of produce from irrigation schemes.	78,002	81,903	85,998	90,298	94,813	431,014
3.6 Rehabilitate land for agriculture.	3.6.1 Identify and target degraded agricultural land for soil rehabilitation programs.	1,809,748	1,900,235	1,995,247	2,095,010	2,199,760	10,000,000
3.7 Rehabilitate and protect water sources.	3.7.1 Rehabilitate water towers.	506,729	532,066	558,669	586,603	615,933	2,800,000
	3.7.2 Rehabilitate other catchment areas (this includes arid and semi-arid areas).	2,497,452	2,622,325	2,753,441	2,891,113	3,035,669	13,800,000
	3.7.3 Rehabilitate other catchment areas river basins in the HRA (include arid and semi-arid areas).	1,411,603	1,482,184	1,556,293	1,634,107	1,715,813	7,800,000
	3.7.4 Harmonize the management of the regulations controlling catchment areas (regulations need to be written) - (sensitization).	36,195	38,005	39,905	41,900	43,995	200,000
	3.7.5 Enforcement.	868,679	912,113	957,719	1,005,605	1,055,885	4,800,001
4. Reform agricultural service credit, regulatory, processing and manufacturing institutions for efficiency and effectiveness.		143,479	176,653	179,986	183,485	187,159	870,762
4.1 Enhance accessibility to water and land resource use in the semi-arid areas.	4.1 Legal and regulatory reforms.	49,001	51,451	54,024	56,725	59,561	270,762
4.2 Protect land available for agriculture in the HRA from encroachment by development for other uses.	4.2.1 Advocate local authorities for the enforcement of existing land-use / zonation laws on land use.	30,000	50,000	50,000	50,000	50,000	230,000

	4.2.2 Enforce existing laws applicable to land use.	50,000	60,000	60,000	60,000	60,000	290,000
	4.2.3 Develop a national land-use policy.	14,478	15,202	15,962	16,760	17,598	80,000
5. Increase market access through development of cooperatives and agri-business.		332,546	2,752,595	2,047,607	5,824,828	8,232,967	19,190,543
5.1 Development of marketing channels.	5.1.1 Improve marketing channels for livestock.	24,000	32,900	142,000	145,150	147,400	491,450
	5.1.2 Enhance access to credit.	2,260	25,370	25,540	25,760	27,000	105,930
	5.1.3 Promote internal and external trade.	10,000	24,500	39,225	60,180	100,390	234,295
	5.1.4 Construct and service abattoirs including livestock auctions.	5,000	50,500	55,125	57,880	60,775	229,280
5.2 Promotion of value addition.	5.2.1 Promote primary processing, preservation and storage of livestock products.	10,000	30,000	40,500	50,000	70,500	201,000
	5.2.2 Promote value addition and marketing of rangeland products.	10,500	20,500	30,000	50,000	50,000	161,000
	5.2.3 Strengthen capacity of private sector in processing, preservation and storage of livestock products - credit.	10,000	1,000,000	1,000,000	1,000,000	1,000,000	4,010,000
	5.2.4 Process and market produce from bio- enterprises - credit.	10,000	20,500	50,000	65,000	70,000	215,500
5.3 Development of support infrastructure.	5.3.1 Invest in construction of access roads.	50,000	100,000	450,000	580,000	900,000	2,080,000
	5.3.2 Promote renewable sources of energy to facilitate production and processing.	10,000	50,000	60,000	70,000	75,000	265,000
	5.3.3 Construct multipurpose dams.	50,000	1,250,500	1, 255,125	3,557,880	5,560,775	10,419,155
5.4 Developing of marketing channels in semi-arid areas.	5.4.1 Improve capacity for marketing of agricultural inputs and produce.	28,526	29,952	31,450	33,023	34,674	157,625
	5.4.2 Enhance access to agricultural credit.	22,260	23,373	24,542	25,769	27,057	123,001
	5.4.3 Promote internal and external trade.	90,000	94,500	99,225	104,186	109,396	497,307
Totals		37,803,528	46,304,181	47,962,781	54,856,660	60,680,113	247,607,263

Source: Government of Kenya, Agricultural Sector Development Strategy Medium-Term Investment Plan (2010)

Table 19. MTIP 2010–2015 Arid Areas budget (Improving production systems under Pastoralism)

Tactic	Activities	Yearly and Total Budget KES '000					
		YEAR 1 (2010/11)	YEAR 2 (2011/12)	YEAR 3 (2012/13)	YEAR 4 (2013/14)	YEAR 5 (2014/15)	TOTAL (2010-2015)
1. Livestock development	1.1 Undertake disease control and livestock health measures.	2,400,000	2,500,000	2,750,000	3,200,000	3,600,000	14,450,000
	1.2 Establish and manage disease-free zones.	140,000	150,000	150,000	150,000	200,000	790
	1.3 Undertake proper range management practices.	6,005	80,800	110,990	120,595	150,625	469,015
	1.4 Undertake livestock restocking.	2,487	15,000	23,760	24,750	29,980	95,977
	1.5 Breed livestock for productivity.	10,000	12,000	15,000	16,000	17,000	70,000
2. Drought cycle management	2.1 Provide borehole water.	10,000	100,000	155,000	155,000	155,000	575,000
	2.2 Establish early warning systems.	10,000	125,000	100,000	55,180	40,500	330,680
	2.2 Establish community-based irrigation schemes.	10,000	30,000	45,000	70,000	75,000	230,000
	2.3 Develop drought reserve areas.	10,000	12,500	15,000	12,000	10,000	59,500
	2.4 Provide capacity for drought cycle management.	5,000	6,000	8,000	9,000	10,000	38,000
3. Pastoralists natural resource management	3.1 Put in place measures to minimize human-wildlife conflict.	5,000	5,500	15,500	16,000	16,000	58,000
	3.2 Protect indigenous environmental knowledge and practice.	10,000	10,000	12,000	13,000	13,000	58,000
	3.3 Promote construction of water harvesting facilities.	50,000	70,000	80,000	100,000	100,000	400,000
	3.4 Build capacity for climate change adaptation as well as capacity in trading on carbon credits.	5,000	5,500	5,500	7,000	7,000	30,000
4. Enhance accessibility to water and land resources use	4.1 Undertake legal and regulatory reforms specific to development of arid areas.	10,000	10,500	20,000	20,500	10,500	71,500
	4.2 Establish policy to guarantee land availability for continued pastoralism.	10,000	10,250	10,500	10,500	10,500	51,750
5. Development of marketing channels	5.1 Improve marketing channels for livestock.	24,000	32,900	142,000	145,150	147,400	491,450
	5.2 Enhancing access to credit.	2,260	25,370	25,540	25,760	27,000	105,930

	5.3 Promote internal and external trade.	10,000	24,500	39,225	60,180	100,390	234,295
	5.4 Construct and service abattoirs including livestock auctions.	5,000	50,500	55,125	57,880	60,775	229,280
6. Promotion of value addition	6.1 Promote primary processing, preservation and storage of livestock products.	10,000	30,000	40,500	50,000	70,500	201,000
	6.2 Promote value addition and marketing of range land products.	10,500	20,500	30,000	50,000	50,000	161,000
	6.3 Strengthen capacity of private sector for processing, preservation and storage of livestock products - credit.	10,000	1,000,000	1,000,000	1,000,000	1,000,000	4,010,000
	6.4 Process and market produce from bio-enterprises - credit.	10,000	20,500	50,000	65,000	70,000	215,500
7. Development of support infrastructure	7.1 Invest in construction of access roads.	50,000	100,000	450,000	580,000	900,000	2,080,000
	7.2 Promote renewable sources of energy to facilitate production and processing.	10,000	50,000	60,000	70,000	75,000	265,000
	7.3 Construct multipurpose dams.	50,000	1,250,500	1, 255,125	3,557,880	5,560,775	10,419,155
8. Capacity building	8.1 Strengthen research and extension systems relevant to dry lands - existing services.	30,000	150,000	150,000	150,000	150,000	630,000
	8.2 Strengthen delivery of extension service in arid areas.	17,000	22,500	35,000	40,000	50,000	164,500
	8.3 Promote private sector participation in service delivery - contracted services.	15,500	20,000	35,000	47,500	50,000	168,000
	8.4 Promote research activities in arid areas - infrastructure.	5,000	20,000	45,000	55,000	75,000	200,000
Total budget for the arid areas		2,952,752	5,960,320	5,673,640	9,933,875	12,831,945	37,352,532

Source: Government of Kenya, Agricultural Sector Development Strategy Medium-Term Investment Plan (2010)

Table 20: MTIP 2010–2015 Semi-arid areas budget

Tactic	Activities	Yearly and Total Budget KES '000					
		Year 1 (2010/11)	Year 2 (2011/12)	Year 3 (2012/13)	Year 4 (2013/14)	Year 5 (2014/15)	Total (2010-2015)
1. Livestock development	1.1 Disease control.	341,000	358,050	375,952	394,750	414,488	1,884,240
	1.2 Disease-free zones.	542,924	570,071	598,574	628,503	659,928	3,000,000
	1.3 Water provision.	50,000	52,500	55,125	57,881	60,775	276,281
	1.4 Range management.	156,005	163,805	171,995	180,595	189,625	862,025
	1.5 Forage production and conservation.	100,000	105,000	110,250	115,762	121,551	552,563
	1.6 Undertake livestock restocking.	90,487	95,012	99,762	104,750	109,988	499,999
	1.7 Breeding for productivity.	78,002	81,903	85,998	90,298	94,813	431,014
	1.8 Early warning systems.	14,840	15,582	16,361	17,179	18,038	82,000
	1.9 Marketing.	39,001	40,951	42,999	45,149	47,406	215,506
	1.10 Processing and value addition.	48,362	50,780	53,319	55,985	58,784	267,230
	1.11 Capacity building.	100,000	105,000	110,250	115,762	121,551	552,563
2. Irrigation and drainage	2.1 Rehabilitate and expand existing schemes.	1,000,000	1,050,000	1,102,500	1,157,625	1,215,506	5,525,631
	2.2 Development of new schemes; smallholder and public schemes.						
	2.2.1 Identification and feasibility studies	138,050	144,953	152,201	159,811	167,801	762,816
	2.2.2 Survey and design	153,829	161,520	169,596	178,076	186,980	850,001
	2.2.3 Implementation	1,822,118	1,913,224	2,008,885	2,109,329	2,214,796	10,068,352
	2.2.4 Monitoring and Evaluation	9,277	9,741	10,228	10,740	11,277	51,263
	2.2.5 Capacity building	156,005	163,805	171,995	180,595	189,625	862,025
3. Water harvesting and storage	3.1 Multipurpose dams (2 large dams and 3 medium size dams).	5,507,493	5,782,868	6,072,011	6,375,611	6,694,392	30,432,375
	3.2 Local water harvesting.	2,650,000	2,782,500	2,921,625	3,067,706	3,221,092	14,642,923
	3.3 Processing and marketing produce from irrigation schemes.	78,002	81,903	85,998	90,298	94,813	431,014

4. Enhance accessibility to water and land resources use	4.1 Legal and regulatory reforms.	49,001	51,451	54,024	56,725	59,561	270,762
5. Conservation agriculture	5.1 Capacity building on conservation agriculture.	50,000	52,500	55,125	57,881	60,775	276,281
	5.2 Developing land under conservation agriculture.	150,000	157,500	165,375	173,644	182,326	828,845
		39,001	40,951	42,999	45,149	47,406	215,506
6. Development of marketing channels	6.1 Improve capacity for marketing of agricultural inputs and produce.	28,526	29,952	31,450	33,023	34,674	157,625
	6.2 Enhancing access to agricultural credit.	22,260	23,373	24,542	25,769	27,057	123,001
	6.3 Promote internal and external trade.	90,000	94,500	99,225	104,186	109,396	497,307
7. Promote value addition	7.1 Promote primary processing and storage.	50,000	52,500	55,125	57,881	60,775	276,281
	7.2 Promote value addition processing initiatives in cooperatives.	44,205	44,205	44,205	44,205	44,205	221,025
	7.3 Promote the development of joint ventures, linkages and partnerships for value addition in cooperatives.	50,000	52,500	55,125	57,881	60,775	276,281
	7.4 Promote agribusiness and investments in cottage industries.	39,001	40,951	42,999	45,149	47,406	215,506
	7.5 Promote establishment of cooperatives and farmer organizations.	50,000	52,500	55,125	57,881	60,775	276,281
	7.6 Promote internal and external trade.	90,000	94,500	99,225	104,186	109,396	497,307
	7.7 Empower farmer organizations.	20,000	21,000	22,050	23,153	24,310	110,513
	7.8 Strengthen capacity of private sector to process farm produce and store strategic grain reserves, training and credit.	0	1,000,000	1,000,000	1,000,000	1,000,000	4,000,000
	7.9 Strengthen capacity of private sector to process livestock produce and store strategic livestock products, training and credit.	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	5,000,000
8. Develop support infrastructure	8.1 Invest in construction of access roads.	3,003,710	3,153,896	3,311,590	3,477,170	3,651,028	16,597,394
	8.2 Promote renewable sources of energy to facilitate production and agro processing.	150,000	157,500	165,375	173,644	182,326	828,845
9. Capacity building	9.1 Develop appropriate capacity of primary producers in semi-arid areas to undertake the above activities.	95,114	99,869	104,863	110,106	115,611	525,563
	9.2 Strengthen delivery of extension service in	300,000	315,000	330,750	347,287	364,652	1,657,689

	semi-arid areas.						
	9.3 Promote private sector participation in service delivery.	30,000	31,500	33,075	34,729	36,465	165,769
	9.4 Promote research activities in semi-arid areas.	200,000	210,000	220,500	231,525	243,101	1,105,126
Total Budget for the semi-arid areas		18,626,213	20,505,316	21,428,371	22,397,579	23,415,249	106,372,728

Source: Government of Kenya, Agricultural Sector Development Strategy Medium-Term Investment Plan (2010)

Table 21: MTIP 2010–2015, High Rainfall Areas budget

TACTIC	ACTIVITIES	YEARLY AND TOTAL BUDGET KSH ,'000					
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
	1.1 Improve access to and affordability of quality inputs:						
1. INCREASE THE PRODUCTIVTY OF THE HRA AGRICULTURAL LAND	1.1.1 Fertilizer.	452,437	475,059	498,812	523,752	549,940	2,500,000
	1.1.2 Seeds.	180,975	190,024	199,525	209,501	219,976	1,000,001
	1.1.3 Pesticides.	90,487	95,012	99,762	104,750	109,988	499,999
	1.1.4 Animal nutrition.	135,731	142,518	149,644	157,126	164,982	750,001
	1.1.5 Disease and pest control.	361,950	380,047	399,049	419,002	439,952	2,000,000
	1.1.6 Artificial Insemination (A.I).	90,487	95,012	99,762	104,750	109,988	499,999
	1.1.7 Breeding Stock.	54,292	57,007	59,857	62,850	65,993	299,999
	1.1.8 Establish bulking sites and fodder banks.	90,487	95,012	99,762	104,750	109,988	499,999
	1.1.8 Fingerlings and fish feed.	452,437	475,059	498,812	523,752	549,940	2,500,000
	1.2 Build capacity of:						
	1.2.1 Farmers / producers (all subsectors) to develop and promote intensive and profitable farming on a conservational and sustained basis	633,412	665,082	698,337	733,253	769,916	3,500,000

	1.2.2 Extension service providers to develop and promote intensive and profitable farming on conservation and sustained basis.	1,284,921	1,349,167	1,416,625	1,487,457	1,561,830	7,100,000
	1.2.3 Other service providers and actors along the value chain.	555,593	583,372	612,541	643,168	675,326	3,070,000
	1.3 Exploit opportunities for larger land units to achieve economies of scale.						
	1.4 Address the physical constraints along the value chain (build and maintain roads provide water cooling plants, build physical markets).	1,809,748	1,900,235	1,995,247	2,095,010	2,199,760	10,000,000
	1.5 Construct multipurpose dams.	200,000	3,000,000	3,200,000	4,000,000	5,000,000	15,400,000
	1.6 Address the non-physical constraints along the value chain (organizations and distribution channels / routes to market).						
	1.6.1 Access to information for farmers / producers and other stakeholders.	452,437	475,059	498,812	523,752	549,940	2,500,000
	1.6.2 Promote farmer / producers organizations to facilitate access to inputs information, credit, storage and handling facilities and markets.	904,874	950,118	997,624	1,047,505	1,099,880	5,000,001
	1.6.3 Appropriate technology transfer and innovation (Technology information incubation centres).	180,975	190,024	199,525	209,501	219,976	1,000,001
2. PROTECT THE LAND AVAILABLE FOR AGRICULTURE IN THE HRA FROM ENCROACHMENT BY DEVELOPMENT FOR OTHER USES	2.1 Advocate local authorities for the enforcement of existing Land use / zonation laws on land use.	30,000	50,000	50,000	50,000	50,000	230,000
	2.2 Enforcement of existing laws applicable to land use.	50,000	60,000	60,000	60,000	60,000	290,000
	2.3 Develop a national land use policy.	14,478	15,202	15,962	16,760	17,598	80,000
3. UTILISE EVERY POSSIBLE AGRICULTURAL LAND AVAILABLE FOR PRODUCTION IN THE HRA (TRUST LANDS HELD FOR SPECULATIVE PURPOSES)	3.1 Develop a policy on urban and peri-urban agriculture.	9,049	9,501	9,976	10,475	10,999	50,000
	3.2 Implement a national land use policy.	50,000	50,000	50,000	50,000	50,000	250,000
4. REHABILITATE LAND FOR	4.1 Identify and target degraded agricultural land for soil rehabilitation programs.	1,809,748	1,900,235	1,995,247	2,095,010	2,199,760	10,000,000

AGRICULTURE							
5. REHABILITATION AND PROTECTION OF WATER SOURCES (CATCHMENT AREAS)	5.1 Reforestation and protection of catchment areas.						
	5.1.1 Rehabilitate water towers.	506,729	532,066	558,669	586,603	615,933	2,800,000
	5.1.2 Rehabilitate other catchment areas (this includes Arid and semi-arid areas).	2,497,452	2,622,325	2,753,441	2,891,113	3,035,669	13,800,000
	5.1.3 Rehabilitate other catchment areas river basins in the HRA (includes arid and semi- arid areas).	1,411,603	1,482,184	1,556,293	1,634,107	1,715,813	7,800,000
	5.2 Harmonize the management of the regulations controlling the catchment areas (regulations need to be written) - (sensitization).	36,195	38,005	39,905	41,900	43,995	200,000
	5.3 Enforcement.	868,679	912,113	957,719	1,005,605	1,055,885	4,800,001
6. INCREASE PRODUCTION OF CAPTURE FISHERIES[1]	6.1 Develop marine capture fisheries.	452,437	475,059	498,812	523,752	549,940	2,500,000
	6.2 Develop and manage inland fisheries resources.	180,975	190,024	199,525	209,501	219,976	1,000,001
	6.3 Ensure fish safety and quality.	180,975	190,024	199,525	209,501	219,976	1,000,001
	6.4 Provide fingerlings and fish feed	200,000	200,000	200,000	200,000	200,000	1,000,000
TOTAL BUDGET FOR HRA		16,229,563	19,844,545	20,868,770	22,534,206	24,442,919	103,920,003

[1] The budget for fisheries caters for the HRA, arid areas and semi-arid areas.

Source: Government of Kenya, Agricultural Sector Development Strategy Medium-Term Investment Plan (2010)

Table 22. Development Partner Spending on Kenyan Agriculture (2000–2010)

Donor/Development Partner	Description	Date	Total disbursement (US$ million)
World Bank	Kenya Agricultural Productivity Project	17.6.2004	40.5
	Micro, Small, and Medium Enterprise Competitiveness Project	13.7.2004	11.0
	Arid Lands Resource Management Project Phase Two	19.6.2003	118.4
	Kenya - Natural Resource Management Project	27.3.2007	30.9
	Kenya Agricultural Productivity and Agribusiness Project	11.6.2009	13.3
African Development Bank	Green Zones Development Support Project	12.10.2005	19.6
	Ewaso Ng'iro North Natural Resources Conservation Project	22.04.2005	7.9
	ASAL-Based Livestock and Rural Livelihoods Support Project	17.12.2003	24.5
	Kimira- Oluch Smallholder Farm Improvement Project	31.05.2006	4.4
	Small-Scale Horticulture Development Project	05.09. 2007	1.2
	Restoration of Farm Infrastructure	29.04.2009	0.4
	Creation of Sustainable Tsetse Eradication Program	08.12.2004	10.1
JICA (excluding technical assistance)		2000	13.1
		2001	15.0
		2002	28.5

		2003	17.2
		2004	14.4
	Total JICA spending		88.2
IFAD	Central Kenya Dry Area Smallholder and Community Services Development Project	2000	10.9
	Mount Kenya East Pilot Project for Natural Resource Management	2002	16.0
	Smallholder Dairy Commercialization Program	2004	16.0
	Smallholder Horticulture Marketing Program	2007	19.4
USAID	Kenya Dairy Development Program (KDDP)	2002-2008	11.77
	Regional Agricultural Trade Expansion Support (RATES)	2002-2009	28.01
	Kenya Maize Development program (KMDP)	2002-2010	14.72
	Kenya Agricultural Biotechnology Support Program	2003-2010	1.78
	Kenya Horticultural Development Program (KHDP)	2003-2009	10.30
	Agriculture Policy Research and Analysis (Tegemeo Institute)	2006-2011	4.33
	Regional Enhanced Livelihood in Pastoral Areas (Kenya, SE Ethiopia, SW Somalia)	2007-2009	0.45
	Regional Enhanced Livelihood in Pastoral Areas (Kenya, SE Ethiopia, SW Somalia)	2007-2009	2.80
	Regional Enhanced Livelihood in Pastoral Areas (Kenya, SE Ethiopia, SW Somalia)	2007-2009	10.00
	Kenya Dairy Sector Competitiveness Program (KDSCP)	2008-2013	8.00
	KARI Agricultural Research Program (Dairy, Maize, Soil, Nutribusiness)	2009-2011	0.75

	Competitiveness and trade expansion program (COMPETE)	2009-2013	84.00
	Kenya Maize Development program (KMDP) - Follow on USAID spending	2010-2012	2.00

Source: Various Development Partners and websites and email communications from other donors.

Note. This list is incomplete as data from other development partners were not obtained. Also, some of the funding (shown in red) is for Regional agricultural programs which include other countries in addition to Kenya

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Karugia, J.; J. Wanjiku, J. Nzuma, S. Gbegbelegbe, E. Macharia, S. Massawe, A. Freeman, M. Waithaka, and S. Kaitibie. "The Impact of Non-Tariff Barriers on Maize and Beef Trade in East Africa". ReSAKSS Working Paper No. 29. 2009.

Fan, Shenggen; Omilola, Babatunde and Melissa Lambert. "Public Expenditure Tracking in Africa: Trends and Composition." ReSAKSS Working Paper No. 28. 2009.

Karugia, J., M. Waithaka, A. Freeman, R. Prabhu, B. Shiferaw, S. Gbegbelegbe, S. Massawe, M. Kyotalimye, J. Wanjiku and E. Macharia. "Responding to Food Price Crisis in Eastern and Southern Africa: Policy Options for National and Regional Action." ReSAKSS Working Paper No. 27. 2009.

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Fan, S.; Johnson, M.; Saurkar, A. and T. Makombe. "Investing in African Agriculture to Halve Poverty by 2015."ReSAKSS Working Paper No. 25. 2009.

Olubode-Awosola, O., P. Chilonda, I. Minde and Y. Bhatt."Indicators for Monitoring and Evaluation of Agricultural Performance and Shared Goals in Southern Africa." ReSAKSS Working Paper No. 24. 2008.

Legg, C. "A Spatial Analysis of Child Nutrition in West Africa." ReSAKSS Working Paper No. 23. 2008.

Johnson, M.; Birner, R.; Chamberlin, J.; Diao, X.; Fan, S.; Nin-Pratt, A.; Resnick, D.; You, L. and B. Yu. "Regional Strategic Alternatives for Agriculture-led Growth and Poverty Reduction in West Africa." ReSAKSS Working Paper No. 22. 2008.

Diao, X.; Fan, S.; Kanyarukiga, S. and B. Yu."Agricultural Growth and Investment Options for Poverty Reduction in Rwanda."ReSAKSS Working Paper No. 21. 2008.

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