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Irrigation potential and investment return in Kenya

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ABSTRACT

The potential for irrigation investments in Kenya is highly dependent upon geographical, agronomic and economic factors that need to be taken into account when assessing the long-term viability and sustainability of planned projects. This study analyzed large dam-based and small-scale irrigation potential and investment needs for Kenya based on agronomic, hydrological, and economic factors. The analysis of small-scale irrigation expansion shows that the potential for investment in small-scale projects in Kenya ranges from 54,000 ha to 241,000 hectares, with an internal rate of return from 17% to 32%. For the dam-based investment analysis, under low-cost assumption, 58 dams of 73 are profitable (IRR > 0). At high cost level, the number is 52. If we raise the IRR cutoff value to 12%, 32 dams are economically feasible. We showed that there is considerable scope for the expansion of both dam-based and small-scale irrigation in Kenya, and we also provided a strategic prioritization for investments in irrigation schemes and projects.

Introduction

Kenya, home to more than 33 million people, is rich in natural resources and yet poor and food insecure. With 80% of the impoverished living in rural areas and 30% of households food-insecure, Kenya desperately needs an effective solution to boost its vital agricultural sector to keep pace with the still growing population (Grimm and Richter, 2006; Kates and Dasgupta, 2007). Kenya heavily depends on rainfed agriculture, with this sector contributing to 55% of the nation's GDP and providing 80% of the nation's employment (Ngigi et al., 2002). Because of unreliable climate and rainfall, some years result in excess production of certain crops while others lead to famine, such as in 2004. With 17% of the land considered to have medium to high potential for irrigation, less than 10% is utilized, which amounts to only about 2% of total arable land in Kenya (FAO, 2005). Improved and expanding irrigation technology can help increase agricultural productivity to close the gap between growing population and food production. The major obstacle facing irrigation expansion is the mounting cost of implementing such projects. 75% of Kenya's total agricultural output is supported by small scale farms, whose typical size is less than one hectare. Most farmers do not have the capital to implement gravity-led nor pump-fed irrigation canals. Due to the insufficient amount of investment in irrigation, the amount of irrigated land has remained stagnant for the past 30 years (Ngigi and Minot, 2004). In light of these challenges, facilitating the right investments in irrigationcan help resolve the difficulties and set Kenya on its path to fulfilling its Vision 2030 (Mwarasomba et al., 2006).

The current paper discusses the methodology and results for assessing the potential for profitable expansion of irrigation capacity in Kenya. We evaluate two approaches in irrigation expansion — surface runoff-based small-scale irrigation and dam-based large-scale irrigation. The first approach assumes the possibility to capture surface runoff to expand irrigation in Kenya. We refer to this approach small-scale irrigation schemes. Dam-based expansion takes advantage of water stored in proposed large reservoirs built for multi-purpose uses (e.g. hydropower), which were identified by the Japanese International Cooperation Agency (JICA) in the 1990s (JICA, 1992). We identify areas able to benefit from the opportunistic use of flow from these reservoirs as large-scale irrigation schemes.

In the following sections we describe the methodology we used to estimate the irrigation potential and investment needs. We further described the datasets used and more importantly the major assumptions made in the analysis. Section 'Results' provides the results for estimated small-scale irrigation and dam-based irrigation expansion, and their economic returns. Finally we conclude

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with some recommendations of further analysis and policy options.

Methodology

There are two main analytic models in our approach: one is IFPRI (International Food Policy Research Institute)'s Spatial Production Allocation Model (SPAM), the other is a model to estimate the economic internal rate of return due to the irrigation investment. The methodology is based on a framework developed in a larger, Africa-wide study (You et al., 2011) but with a few major improvements. First we expanded our crops (from 20 to 35) to explicitly include high-value crops such as vegetables and fruit. This is particularly important for small-scale irrigation as

Table 1
Crop prices in major markets in Kenya (average of 2007, 2008, 2010). *Source:* Agribusiness Directorate, Ministry of Agriculture, Republic of Kenya.

	Central (US$/ton)	Coast	Eastern	Nairobi	North eastern	Nyanza	Rift valley	western	average
Cereal									
Wheat	252	252	252	252	252	252	252	252	**252**
Rice	388	388	388	388	388	388	388	388	**388**
Maize	195	195	195	195	195	195	195	195	**195**
Barley	204	204	185	215	167	207	187	211	**200**
Pearl millet	227	470	322	371	420	507	322	364	**420**
Finger millet	224	463	318	365	414	499	317	359	**414**
Sorghum	229	270	216	291	219	293	215	230	**262**
Roots & tuber									
Potato	214	281	249	229	245	204	145	233	**228**
Sweet potato	249	160	269	353	232	185	136	179	**220**
Yam	107	69	116	152	100	80	59	77	**95**
Cassava	121	108	81	109	178	157	137	122	**129**
Pulse									
Chickpeas	414	312	373	399	214	307	293	647	**448**
Cowpea	489	484	436	514	613	760	645	661	**528**
Pigeon peas	414	312	373	399	214	307	293	647	**448**
Dry beans	542	557	578	540	493	528	540	621	**555**
Oil crops									
Soybeans	300	300	300	300	300	300	300	300	**300**
Groundnuts	816	737	798	807	884	627	578	894	**737**
Sunflower	235	256	260	290	237	243	220	285	**257**
Sesame seed	304	332	337	376	306	315	285	370	**333**
Rapeseed	292	319	324	361	294	303	274	355	**320**
Coconuts	147	160	163	182	148	152	138	179	**161**
Palm oil	144	157	160	178	145	150	135	175	**158**
Sugar									
Sugar beets	35	38	38	43	35	36	33	42	**38**
Sugarcane	27	30	30	34	27	28	25	33	**30**
Fibers									
Cotton	258	281	286	318	260	267	241	313	**282**
Other fibers	365	399	405	451	368	379	342	444	**400**
Stimulants									
Tea	1574	1717	1745	1944	1586	1631	1474	1912	**1723**
Cocoa	155	169	172	192	156	161	145	189	**170**
Tobacco	901	982	999	1112	907	933	844	1094	**986**
Arabic coffee	1887	2058	2093	2330	1901	1955	1768	2293	**2066**
Rubusta coffee	1644	1793	1823	2030	1657	1704	1540	1998	**1800**
Fruits									
Banana/plantain	175	163	195	241	110	114	160	483	**200**
Tropical fruits	470	811	1088	1041	857	558	453	1431	**857**
Temperate fruits	177	162	347	443	323	331	274	162	**266**
Vegetable									
Vegetables	344	288	222	579	233	493	366	465	**387**

Notes:

1. Annual average prices from 2007, 2008, 2010. Bold numbers are national averages.
2. Other Fibers include Flex Raw; or Retted Kapok Fiber; Flax Fiber & Tow; Hemp Fiber & Tow; Jute, Jute-Like Fibers; Ramie; Sisal; Agave Fibers nes; Abaca Manila Hemp; Fiber Crops nes.
3. Tropical Fruits include Cashew apple; Mangoes; Papayas; Pineapples; Avocados; Citrus Fruit Nes; Dates; Figs. Grapefruit and Pomelo; Kiwi Fruit; Lemons and Limes; Oranges common(Sweet orange, bitter orange); Tangerines; Mandarines; Clementines; Satsumas.
4. Temperate fruits include Apples; Apricots; Berries, Nes (Including inter alia: blackberry; loganberry; white, red mulberry; myrtle berry; huckleberry, dangleberry); Blueberries(European blueberry, wild bilberry, whortleberry, American blueberry); Cherries (Mazzard, sweet cherry, hard-fleshed cherry, heart cherry); Cranberries (American cranberry, European cranberry); Currants(Black; red and white); Gooseberries; Grapes (Includes both table and wine grapes); Peaches and Nectarines; Pears; Plums (Greengage, mirabelle, damson; sloe); Quinces; Raspberries; Sour Cherries; Stone Fruit, Fresh nes (Other stone fruit not separately identified. In some countries, apricots, cherries, peaches, nectarines and plums are reported under this general category); Strawberries.
5. Vegetables include Artichokes; Asparagus; Beans, Green; Broad Beans, Green; Cabbages; Carrots; Cassava Leaves; Cauliflower; Chillies, Peppers (Green); Cucumbers, Gherkins; Eggplants; Garlic; Green Corn; Leeks and Other Alliaceous; Lettuce; Melons, Cantaloupes; Mushrooms; Okra; Onions, Dry; Onions, Shallots (Green); Peas, Green; Pumpkins, Squash, Gourds; Spinach; String Beans; Tomatoes, Fresh.