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Infrastructure and Agricultural Productivity in Africa

Ousman Gajigo and Alan Lukoma[1]

Contents

The findings of this Brief reflect the opinions of the authors and not those of the African Development Bank, its Board of Directors or the countries they represent.

Mthuli Ncube
Chief Economist
and Vice President
ECON
m.ncube@afdb.org
+216 7110 2062

Charles Leyeka Lufumpa
Director
Statistics Department
ESTA
c.lufumpa@afdb.org
+216 7110 2175

Désiré Vencatachellum
Director
Development Research
Department
EDRE
d.vencatachellum@afdb.org
+216 7110 2076

Victor Murinde
Director
African Development
Institute
v.murinde@afdb.org
+216 7110 2075

1 Introduction

The development impact of agricultural productivity growth for the African region is hard to over-emphasize. It has a direct effect on poverty reduction, given that 50 percent of the African population is directly engaged in agriculture. The indirect effects are also substantial. Research has shown that the multiplier effect of growth in agriculture is higher than in other sectors (de Janvry and Sadoulet 2010). Moreover, without agricultural productivity growth, a critical step in the process of economic transformation and growth in many countries would be missed. Indeed, it was in recognition of the essential contribution that agriculture makes to the continent's development that the African Heads of State and Government adopted the Comprehensive Africa Agriculture Development Program (CAADP) in 2003, to combat poverty and hunger.

Beyond this well-established relationship, recent events underscore the urgency of increasing agricultural productivity in Africa and the need for a massive boost. According to the FAO, the number of undernourished people in Sub-Saharan Africa represents one-third of the population.[2] Moreover, the FAO classifies 43 African countries as Low-Income Food-Deficit Countries (LIFDCs), which means that their net food trade positions have been substantially negative over several years.[3] Africa has been massively affected in recent years by spikes in international food prices, which has hit the poorest the hardest. Food prices doubled between 2006 and mid-2008, a trend driven in part by droughts in grain-producing regions, increased oil prices and sales of corn to produce biofuels.[4] The situation could deteriorate further with the effects of climate change, in addition to the very high projected level of population growth in Africa over the long term. Indeed, Africa is now the fastest-growing continent, according to the latest UN estimates.[5] Boosting agricultural productivity can therefore help to address a raft of problems besetting the continent: food insecurity and hunger, poverty, and economic competitiveness.

A major determinant of agricultural productivity growth is infrastructure. In addition to other factors such as human capital,

[1] Statistics Department, African Development Bank, Tunis.
[2] FAO, The State of Food Insecurity in the World, Rome, FAO, 2010. See also "Africa Food Security Brief," Issue No. 1, June 2011, Tunis, Chief Economist Complex, ADB.
[3] FAO-GIEWS, (Global Information and Early Warning System on Food & Agriculture), March 2011.
[4] "Global Strategy to Improve Agricultural and Rural Statistics," World Bank, FAO and UN, 2011.
[5] UN, Department of Economic and Social Affairs, Population Division, The 2010 Revision of the World Population Prospects, May 2011.

credit markets, extension services, and technological research, the presence of reliable infrastructure increases both output per capita and output per unit of land. It is therefore a key contributor to productivity, mainly by reducing transaction costs in input and output markets, as well as better integrating markets within subregions. This brief summarizes the well-established relationship between infrastructure and agricultural productivity. Given the criticality of financing constraints, it also highlights an emerging source of funding for infrastructure in the agricultural sector.

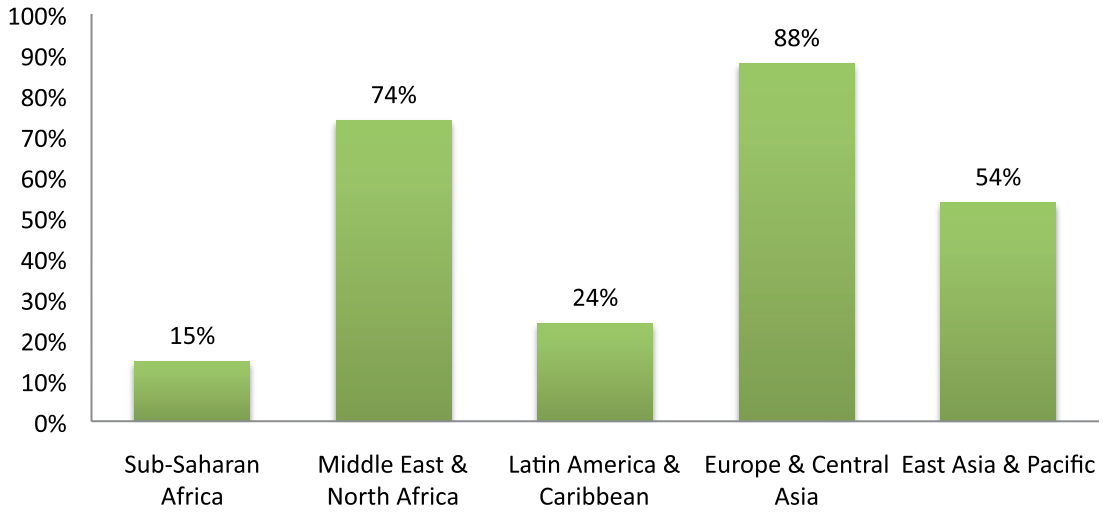
2 Types of Agricultural Infrastructure

This brief reviews three types of infrastructure – (a) road networks; (b) irrigation technology; and (c) post-harvest storage technology– as these all have a direct impact in boosting agricultural productivity. Other types of infrastructure (e.g. telecommunications and electricity supply) also play a major role but their impact is more evenly dispersed across all sectors, less specifically targeting agriculture.

(a) Roads: A well-maintained road network is crucial when infrastructural issues relating to agricultural productivity are being discussed. Roads link farmers not only with their input markets but also with their product markets. Lack of efficient transportation links and substandard roads decrease farmers' margins by increasing the cost of inputs and reducing their accessibility to their product market. The current state of the region's road networks is in dire straits and a scaling-up of investment is badly needed to confront the problem. Only about 30 percent of the region's rural residents have access to all-season roads (ADB 2009). As Figure 1 shows, the African region continues to lag behind other parts of the world in the quality of its road networks, which impacts not only agriculture but all other sectors of the regional economy. This acts as a constraint to conducting trade at all levels, both among African countries and at the international level, since the premium it adds to transaction costs renders African goods more expensive and less competitive in the global marketplace.

The ADB has been active in the financing of road project projects in Africa. This focus is evidenced by the fact that one of the pillars of its 2008-2012 Medium Term Strategy is infrastructure development (ADB 2008). Box 1 provides an example of a regional road project (Nacala) that spans three countries in Southern Africa.

Figure 1 The percentage of paved roads between 1990 and 2005 across various regions



Source: World Bank, World Development Indicators, 2011.

Another effect of the resulting high transportation is that it prevents price equalization of traded agricultural commodities, which induces shortages in some regions and surpluses in others that are separated by short distances. This issue can be easily demonstrated with the case of rice and maize in Eastern Africa. Given that both commodities are tradable and fairly homogeneous, there should be very a small price differential across cities within a given country, if transportation costs were kept within reasonable limits. This is, however, not the case. While small spatial price differences are to be expected, the scale of the differences presented in Table 1 is indicative of unusually high transaction costs. Put differently, high transportation costs stemming from poor road networks inhibit market integration between countries and sub-regions. Another increasingly important complementary infrastructure in this area is telecommunications, which can enhance the multiplier effects of a good road network. Given the high penetration rate of mobile telecommunication in the African region over the past decade, there is scope for innovation that allows for both the aggregation of market information and its dissemination to farmers to take advantage of price information when road networks are improved.

Box 1 The Nacala Road Corridor Project in Southern Africa

The Nacala Road Corridor is a 1,033km road construction project identified by ADB in 2007 with a total cost of approximately €220 million. It spans three countries (Malawi, Mozambique and Zambia), two of which are landlocked. Also included is the construction of one-stop border posts on both the Malawi-Zambia and Malawi-Mozambique borders to reduce delays during border crossings. The first phase of the project was approved in 2009 and includes the construction of 348km of roads linking Malawi and Mozambique. The second phase has been approved in September 2010 and covers 360km of roads linking Zambia to Malawi. Preparatory work for third and final phase is currently being undertaken.

The main goals of the project are to reduce transportation cost, improve access to markets and increase road safety, which are critical for agricultural productivity. Both Malawi and Zambia are dependent on the agricultural sector, which accounts for 30% and 20% of their GDPs respectively. However, the high cost of moving goods from these countries, especially in the case of Zambia, has not only had a negative effect on the agricultural sector but has slowed the process regional integration.

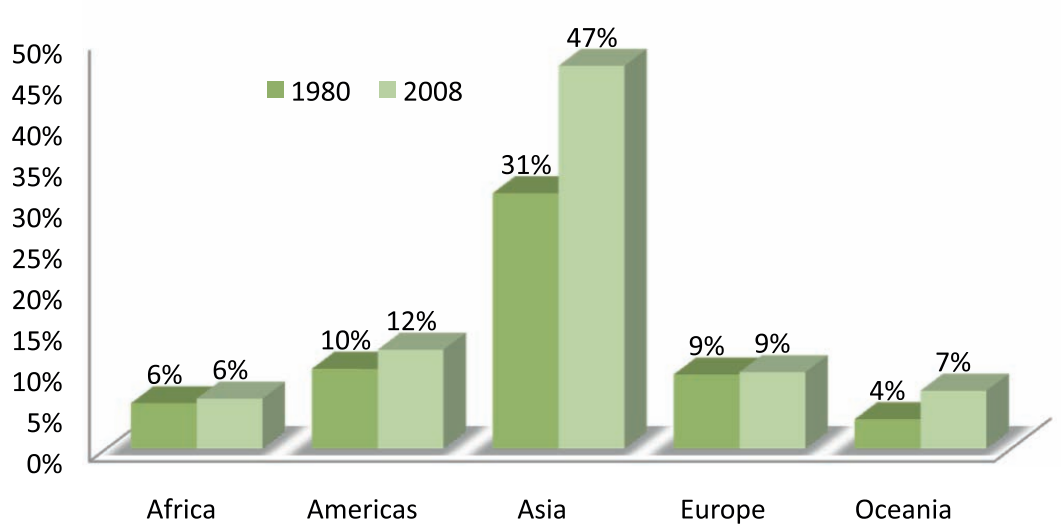
Inadequate infrastructure in the form of poor road networks also exacerbates unequal access to credit, particularly for small and medium-size enterprises (SMEs). Given the reality of the low population density in most African countries, this inadequacy leads to higher financial intermediation costs, since long distances increase the administrative cost of lending, monitoring, and loan recovery. (b) Irrigation: Another type of infrastructure of paramount importance for agriculture is irrigation technology. Agriculture in the region continues to be almost wholly dependent on rainfall, which is highly unpredictable. This leads the substantial shocks in agricultural outputs. It also increases the risk for individual farmers due to the fact that rainfall is spatially covariant, which reduces the scope for idiosyncratic risk-sharing among farmers located in a given area. The importance of irrigation stems from its ability to free farmers from these limiting factors. Figure 2 shows not only the relatively low level of irrigation infrastructure on the continent but also the low growth rate over the period 1980–2008. Irrigation also demonstrates high intraregional differentiation (Figure 3), which suggests the need for greater investments in certain subregions to ensure growth is more equitably distributed.

Table 1 Cost of infrastructure as reflected in spatial commodity price dispersion in some African countries

Country	Commodity	Price Dispersion (January to June 2011)
Kenya	Rice	32%
	Maize	39%
Tanzania	Rice	25%
	Maize	37%
Uganda	Rice	14%
	Maize	30%

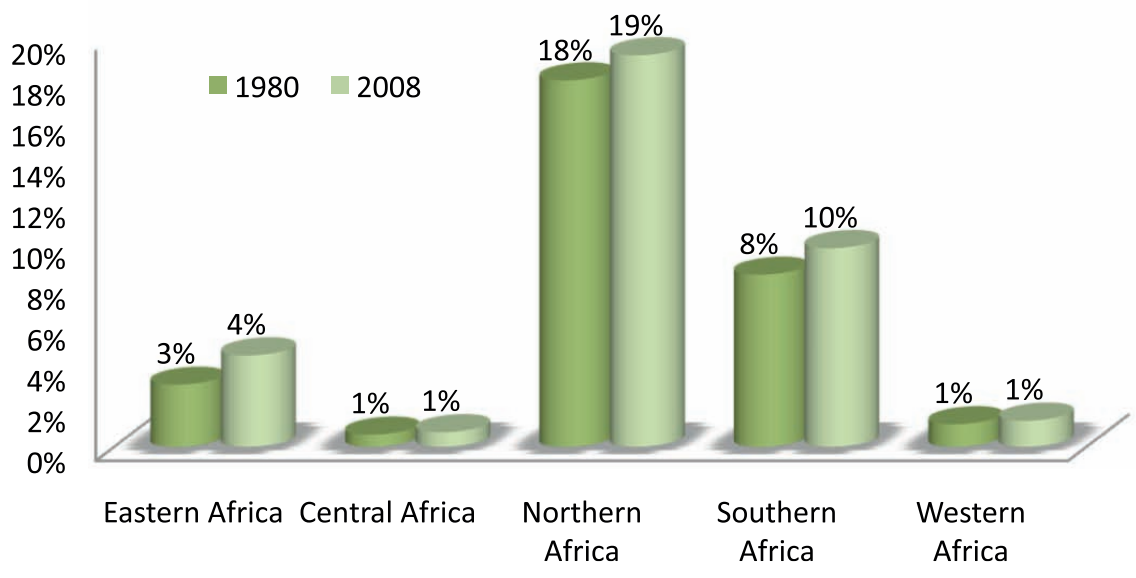
Source: Regional Agricultural Trade Information Network (RATIN), 2011.
Price dispersion is defined here as the ratio of monthly price differences in major cities in a country to the monthly average price level of commodity.

Figure 2 **Percentage of arable land irrigated in 1980 and 2008 across global regions**



Source: World Bank, World Development Indicators, 2011.

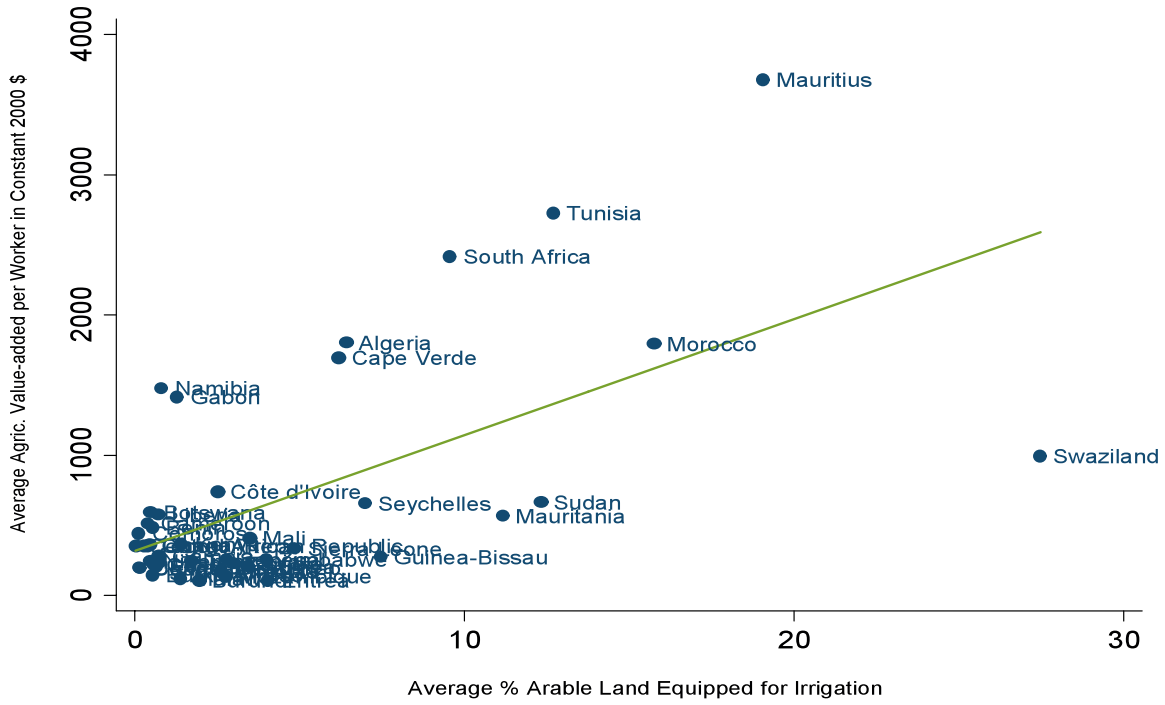
Figure 3 **Subregional differences within Africa in the growth of irrigation technology, 1980 and 2008**



Source: FAOSTAT; FAO, 2011.

Investment in irrigation infrastructure has a major positive effect in terms of both output per unit of land and per worker. Figure 4 shows a positive relationship between agricultural value-added per worker and growth in irrigation investment for a number of African countries.

Figure 4 **The positive relationship between agricultural value-added per worker and irrigation, 1980–2009**



Source: World Bank, World Development Indicators (2011); FAOSTAT (FAO), 2011.

(c) Storage Technology to Reduce Post-Harvest Losses. Even when farmers manage to achieve higher crop yields through input subsidies, favorable rainfall patterns, or irrigation infrastructure, their harvests are still at risk because of inadequate storage facilities. For example, most existing storage facilities cannot protect crops from destructive pests or weather-accelerated decay. Sub-Saharan countries face huge post-harvest losses: for perishable agro-commodities such as fruits and vegetables, the losses average 35-50 percent of total attainable production, while for grains the loss varies between 15 and 25 percent. Food availability decreases just a few months after harvest because sellers find it difficult to store perishable commodities. The reduction in the food supply inevitably increases prices, leading to high temporal price variations, in addition to the existing spatial price variations caused by poor road infrastructure. The effect of poor storage facilities also limits the development of high-value agri-business industries that specialize in horticulture or other highly perishable agricultural products.

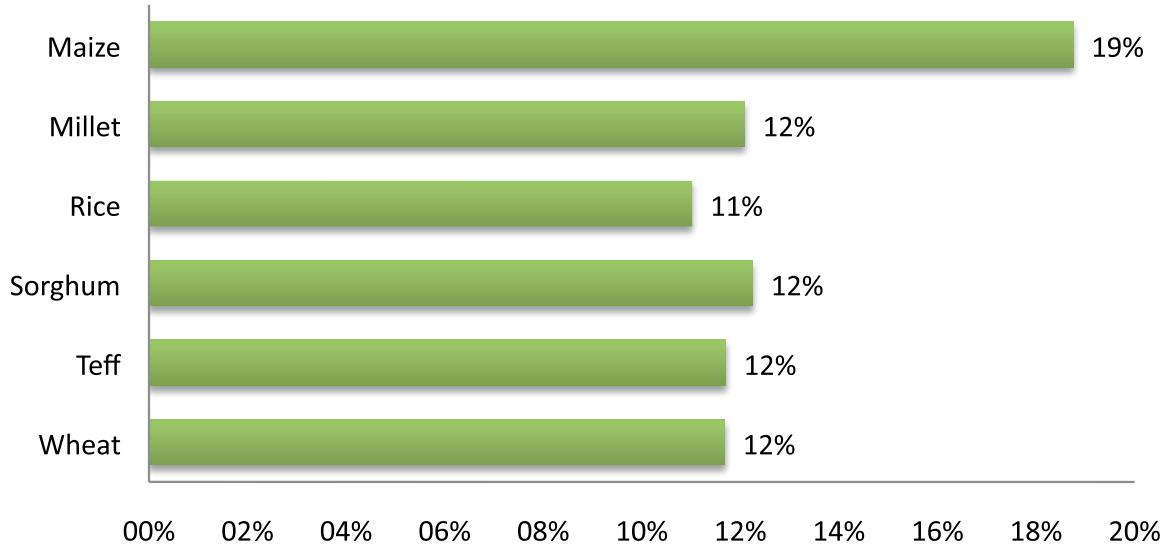
Efforts to reduce post-harvest losses are being undertaken by a number of African and pan-African organizations to include activities such as:

- Training on storage and processing techniques;
- Training and capacity building for agricultural extension, combined with capacity building for local farmers and artisans; and
- Establishment of seed store facilities.

The African Development Bank, as part of the African Food Crisis Response, is formulating a strategy for post-harvest losses that will feed into its strategy for agro-industries.

In this way it aims to support its regional member countries in identifying critical interventions along the entire food chain.

Figure 5 **Post-harvest loss estimates of major staple crops in Africa between 2003 and 2008**



Source: World Bank, World Development Indicators (2011); FAOSTAT (FAO), 2011.

3 Innovative Financing of Agricultural Infrastructure

The delivery of infrastructure of almost any kind is costly, including that related specifically to agricultural productivity. This accounts for the secular decline in infrastructural investments across most regions of the world until recently.

In theory, agriculture-relevant infrastructure could be provided either by the private sector or the public sector. For the private sector, however, several issues make infrastructure provision difficult. User fees that would be required to recover investments, operations, and maintenance cost may become prohibitively high. Moreover, there may be political complications if the particular infrastructure is sensitive in nature, affecting for example land or settlement rights. This problem in turn can affect the likelihood of securing financing for infrastructure projects.

Public financing of agricultural infrastructure projects presents its own challenges. The expertise to manage and operate specialist infrastructure may be lacking for most governments in the region. Raising the necessary level of funding from the private capital market may also be difficult where the investment climate is not favorable. On the other hand, many infrastructure projects such as roads have a public goods aspect, implying the need for some government involvement. Other infrastructure projects such as irrigation or storage have less of a public goods characteristic and may present greater opportunities for private sector engagement.

Due to these factors, public-private partnerships (PPPs) may represent a good way forward, since they mitigate risk in infrastructure projects through recourse to different sources of financing. Government participation in PPP projects can take the form of subsidies or equity stakes of those components where revenue recovery may be difficult. A project financed through PPP can access sources of capital through both concessionary lending (due to the presence of a government) and the private market (given the presence of a creditworthy private participant). The Markala Sugar Project, discussed in Box 2, demonstrates the potential of PPPs in financing and delivering much-needed infrastructure for the agricultural sector.

Africa's immense agricultural potential presents a compelling opportunity for development. This brief has focused on the importance of infrastructure for the sector, and has highlighted an innovative financing model involving a PPP in Mali, which could be replicated in other areas.

While the discussion has centered on roads, irrigation, and post-harvest storage technology as key areas, other kinds of infrastructure (e.g. communications and electricity) also have a major role to play. Given the region's historically low infrastructure investment, exponential progress not only in agriculture but also in most other sectors of the economy could be achieved by scaling up agricultural infrastructure. This finding has over the past several years guided the Bank's strategies, as espoused in its Medium Term Strategy (2008–2012) and Agricultural Sector Strategy (2010–2014). This focus is already being translated into action in its prioritization of infrastructure projects through both public and private sector operations.

Box 2 The Markala Sugar Project in Mali

The Markala Sugar Project in Mali is the first public-private partnership (PPP) in the agricultural sector to be funded by the African Development Bank. The project has both an agricultural component (run by CaneCo) and an industrial component (managed by SoSuMar). CaneCo is responsible for establishing a 14,132 hectare irrigated sugar cane plantation while SosuMar is establishing an ethanol plant, power co-generation facility, and a sugar mill. The government of Mali owns 90 percent of CaneCo and 10 percent of SoSuMar. The remaining shares are owned by private (both foreign and Malian) investors. In December 2010 the ABD approved total funding of €65 million to the project through a combination of a €30 million private sector loan, plus a €35 million loan for the public sector.

Infrastructure is a key component of this PPP project. Specifically, the project will install a central pivot irrigation system for the sugarcane plantation with 21 pumping stations. A 30 megawatt power plant will be built, which will supply (principally) the sugar processing mill and also the national power grid. Access roads linking the market and the sugar cane estate will be upgraded.

The project will produce approximately 1.5 million metric tons of sugarcane per annum, leading to annual production of 190,000 metric tons of processed sugar. The objective is to turn Mali from a net sugar importer to a net exporter. Molasses, which is a by-product of the sugar mill, will produce 15 million liters of ethanol a year, reducing the country's reliance on imported fossil fuel. Approximately 1,100 additional farmers will benefit through an outgrower/contract farming scheme.

The average sugarcane yield in Mali before the project was 70 metric tons per hectare. For the area under cultivation in the project, the average yield will be 105 metric tons per annum. Therefore, the productivity increase of the project over this country's average is 50 percent. While a combination of many factors is responsible for this productivity effect, a major part can be attributed to irrigation component.

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