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Economics of farmers' demand for private irrigation in Nigeria

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Small-scale private irrigation (SPRI) schemes make up much of the irrigated areas in Nigeria. These irrigated areas, though, are only about three percent of the cultivated area in the country. Constraints on SPRI expansion are investigated by many studies in Nigeria, but key knowledge gaps in at least four areas still need to be resolved. These gaps are: (1) lack of knowledge of water sources; (2) perceptions of risks associated with rainfall and access to good quality water; (3) transaction costs associated with investments in irrigation; and (4) effectiveness of public institutions activities in SPRI.

Background

An estimated 0.9 million hectares of land, only about three percent of the cultivated area, in Nigeria use water management techniques, of which approximately 0.2 million hectares are irrigated with equipment such as pumps and tube wells. Of the cultivated area that benefits from water management, more than 95 percent uses small-scale irrigation schemes managed by the private sector and the farmers themselves. The extent of the cultivated area in Nigeria that adopts irrigation techniques can therefore expand rapidly if the constraints for private irrigation are addressed and appropriate policy is implemented to help meet farmers' demand for small-scale private irrigation (SPRI). Nevertheless, factors that determine demand for SPRI differ substantially across farmers in Nigeria. Many of the factors that affect demand for other agricultural inputs are also known to affect demand for SPRI and factors that are specific to demand for SPRI are hard to isolate because of lack of empirical data.

Types of SPRI in Nigeria can be roughly categorized by source of water (surface or ground), type of body of water, and seasonality of the irrigation practice. Many of these irrigation systems in Nigeria are found throughout Sub-Saharan Africa, especially in the West Africa sub-region (Table 1). Due to lack of access to equipment such as pumps or tube wells, most of SPRI in Nigeria still rely on surface water-based irrigation, which uses traditional tools like a calabash, a shadouf or a bucket. These types of SPRI largely depend on residual moisture on the ground after the floods recede during the rainy season and are often observed on low alluvial plains along major rivers such as the Niger.

Demand for SPRI

Factors that determine demand for SPRI in Nigeria are categorized as agroecological factors, socio-economic factors, and risk factors.

Agroecological

Various types of bodies of water exist in Nigeria (both surface and underground), and are widely used for SPRI. Farmers generally lack the capacity to store water in private facilities such as artificial earth ponds, therefore the majority of them rely heavily on whichever type of body of water that is available to them naturally. As a result, the ability to privately harvest and store water may affect whether or not a farmer adopts SPRI.

There is evidence that demand for SPRI is affected by agroecological conditions, but this is more pronounced in northern rather than in southern Nigeria. In the North, a typical dry season can last for up to six months compared to only two months in the South. These differences in the length of dry season affect water availability and hence the demand for alternative water management technology such as SPRI. Also, the land clearing needed for irrigation is more easily achieved in the North where the land is grassy and can be easily burned, than in the South where vegetation is thick and land is often marshy.

Table 1. Types of irrigation systems in Nigeria

Sources of water		Surface water based				Groundwater based	
Water body		River		Residual moisture	Runoff water harvesting	Shallow aquifer	Deep aquifer
Acquisition methods			Gravity-fed sprinkler, drip irrigation		Water harvesting	Tube well Pedal pump, treadle pump	Bore hole
Seasonality	Seasonal			Systems in which residual moisture along the river is captured after the rainy season • Flood recession	System to capture and store runoff water using circular or semi-circular levees, low ridges of earth	• Seasonal/ unlined shallow well	
	Unseasonal	Basin irrigation Border irrigation Furrow irrigation			Wastewater irrigation in which waste water is stored and applied for various crops	• Shallow tube well • Permanent/ lined shallow well	Bore-hole (wash bore)

Socio-economic

Demand for SPRI in Sub-Saharan Africa is reported to vary significantly because of the type of crops grown, the profitability of such crops, the costs of acquiring and operating various irrigation equipment such as pumps (affected partly by the level of domestic manufacturing industry and the price and accessibility of diesel, electricity, and others), and costs of acquiring complementary inputs (land, seed, fertilizer, labor and credits). The variation in demand for SPRI in Sub-Saharan Africa can also be explained by the transaction costs associated with making the irrigation investment, by institutional frameworks such as decisionmaking systems within communities or customary division of labor by gender, and by farmers' inability to overcome environmental limitations.

In Nigeria, SPRI is commonly used in peri-urban areas for growing vegetables during dry seasons. The adoption of SPRI schemes depends, in part, on the conditions of the output markets, such as the terms of trade for vegetables or an import ban. This reaffirms the notion that favorable output market conditions motivate farmers to adopt SPRI. Other factors that affect demand for SPRI include modern irrigation tools that are usually imported and are expensive for most farmers, and the shortage of maintenance personnel, which raises the costs of the irrigation operation.

In various ways, access to complementary inputs can also significantly affect demand for irrigation technology. First, many Nigerian farmers, particularly those residing in urban and peri-urban areas, see their land tenure as insecure, and are often unaware of their legal rights for occupancy or distrustful of law enforcement mechanisms, and become discouraged from making long-term irrigation investments on their plots. The practice of renting out irrigable land during the dry season also affects long term investment in irrigation, given that this type of arrangement only offers short term tenure rights. In rural areas, complex land ownership by multiple landlords makes it harder for farmers to determine their rights to the rotation of water use, water allocation, and constructions of canals. Land tenure insecurity is more serious in the South than in the North, where uncultivated land is relatively abundant. In addition, irrigation is still labor intensive in Nigeria, requiring substantial manual labor to build facilities because of the low level of mechanization. Increasing rural labor wages and urbanization may be another limiting factor for private irrigation. Lack of access to other inputs such as fertilizer, improved seeds, credits, fuel, and electricity is still a major problem for many farmers. Although farmer groups such as Water User Associations (WUAs) aim to provide complete packages of inputs to farmers, the coverage is still limited.

Irrigation is often done by many farmers at the same time of the day or season and their production schedules are usually not flexible. Since farmers share the water from the same sources, such inflexibility can lead to temporal exhaustion of water during this period and may discourage farmers from making an irrigation investment. Irrigation is also a predominantly male affair, particularly in the North, and even among those who irrigate, female farmers tend to use traditional water lifting device such as bucket in contrast to their male counterparts who tend to use motorized pumps. The search for water, however, tends to be done by all household members including females and children.

Risk factors

The various risks that farmers face when investing in irrigation in Nigeria are well known. The types of risks include the possibility of equipment breakdown or theft, damage of irrigation pump or other equipment, uncertain quality and accessibility of water shared with other farmers, limited water management skills, and risks associated with the change in inputs costs and output prices. There is not much empirical information on the effects of rainfall risk or risks associated with the access to high quality water.

Institutional support for private investment in irrigation

The SPRI sector is currently supported by private agents including irrigation technology service providers, NGOs, and Water User Associations (WUAs); and public institutions such as the National Fadama Development Project (NFDP), the Agricultural Development Program (ADP), the State Irrigation Department (SID), the states and the federal government, rather than large-scale public irrigation schemes. State and federal government involvement in the SPRI sector is weak and narrow in coverage.

Public support for private irrigation systems has been mostly in the form of providing financial assistance to farmers for acquiring irrigation equipment including pumps, tube wells, and wash bores under the NFDP and National Program of Agriculture and Food Security (NPAFS), and training on various water harvesting systems through South-South cooperation with China. The ADP and NFDP offices are often the major implementation arms of such government programs. The ADP and NFDP distribute irrigation and other inputs, often at subsidized prices; link farmers to both government and private suppliers of various inputs and trainings; and link farmers to private manufacturers or traders. The ADP, NFDP and FMWR also carry out irrigation related data management as well as monitoring and evaluation. The services provided by the ADP and NFDP to farmers differ across states. This may in part be driven by a difference in funding levels and it is unclear to what extent it reflects the differing needs of farmers in each state.

Branches of the ADP disseminate private irrigation-relevant information, another important area of public support, through workshops or seminars. Similarly, the NFDPs and the private sector carry out activities that connect actors involved in SPRI (such as farmers, manufacturers or repairers of equipments, and international organizations supplying various types of services).

Private sector agents are also active in the development of private irrigation schemes. Private manufacturers of irrigation equipment provide a warranty for equipment, connect farmers with equipment technicians, bring equipment to the farms, provide credits to certain farmers, and offer training services to farmers, many of whom are illiterate. Various types of community based organizations (such as the Water User Association and the Fadama User Association) or NGOs such as Enterprise Works allow farmers to collectively obtain irrigation equipment or other inputs at subsidized rates, and provide training on the use of irrigation equipment and drilling of tube wells. Similar training is also provided by NGOs such as Sasakawa Global 2000. Public sector institutions such as ADPs and NFDPs have been supporting private sector agents by funding various irrigation projects, facilitating the advertisement of their equipment through demonstration and building the capacity of community based organizations.

Key knowledge gaps for small-scale private irrigation (SPRI) in Nigeria

Although multiple factors that affect demand for SPRI are known, there are still key areas of knowledge gaps and these are better identified by the specific characteristics of SPRI compared to

other input technologies such as improved seeds (see Table 2 for details). Some of the key areas with such knowledge gaps are: 1) cost of accessing knowledge of the locations of water sources, 2) effects of risks, 3) transaction costs and 4) the effectiveness of public institutions. With the exception of the effectiveness of public institutions all issues are unique to irrigation technologies.

Cost of accessing knowledge

Water is the predominant complementary input for irrigation technologies. The cost to detect and access a body of water, whether from surface or underground sources, may be a key factor that affects farmers' investment in irrigation technologies. As water in this context is generally a public good, the social value of detecting the source of water is different (and may be higher) than the value placed on it by individual farmers. The public sector can thus play an important role in obtaining information on the location of water sources, and share it with farmers. However, little empirical information is available in Nigeria regarding the capacity of the government and the public sector to manage the data and information on the type, volume, and location of bodies of water, and to provide easy access to such information to farmers. Also unknown is whether the government has a comparative advantage over private actors (particularly farmer-to-farmer networks) on activities such as disseminating information among farmers.

Table 2. Comparison of SPRI and improved seed as production technologies

Improved seed	SPRI	Relatively important aspects for SPRI
• Recyclable, reproducible	• Durable, not reproducible • Pump can be resold, but less possible for other irrigation equipments like borehole, and tube wells	• Medium to long term returns important • Timeliness of purchase of irrigation equipments less important than for seeds
• Scale neutral	• Scale of economy	• High initial fixed cost for irrigation • Higher demand for hiring service of irrigation equipments
• Various complementary inputs	• Water is the most important complementary inputs • Water cannot be owned personally unless under the effective water rights system	• Cost of access to water (including information of locations of water sources) influential
• Mitigate various types of risks (weather, pest, diseases)	• Specifically mitigate rainfall-related risk	• Impact of rainfall risks on demand for irrigation
	• Breakdown of tools, no access to spare parts	
• Every farmer uses seed	• Not every farmer uses irrigation technology • Only a fraction use irrigation pumps	• Higher transaction costs associated with obtaining information on technology

Effects of certain risks

There is scarce empirical information in Nigeria on how demand for irrigation is affected by the types of risks unique to irrigation technologies, particularly rainfall predictability and access to good quality water. Risk-averse farmers may be more willing to invest in irrigation technologies when faced with increasing risk of extremely low rainfall or uncertainty in the onset of the rainy season or an increasing risk in access to natural sources of water such as depletion of nearby water sources due to frequent drought. Risk-averse farmers may be, however, less willing to invest in irrigation technologies when they perceive higher risks associated with the use of such technologies, including how water use will be regulated, how their rights to use water are protected by law or limited by the others' use of water.

Since rainfall predictability varies significantly within Nigeria, empirical information on how farmers' demand for irrigation technology responds to this unpredictable rainfall will help government effectively target regions with greater need for support in adopting irrigation technology. Similarly, empirical information on farmers' perceptions on their rights and access to good quality water will also help the government determine the necessary intervention required to enforce laws and regulations associated with water use.

Transaction costs

Transaction cost is very important in Nigeria because of the pervasiveness of market failures, yet empirical information regarding the impact of such costs on farmers' adoption of irrigation technologies is scarce. For farmers, the main transaction costs associated with irrigation technologies are the costs of obtaining information on where and when to buy equipment, repairing the equipment in the event of breakdown, operating and maintaining the irrigation facilities, and obtaining information on best production practices using such irrigation technologies. These transaction costs are higher with irrigation technologies because many farmers are less familiar with these technologies than they are with others such as improved seeds or fertilizers.

The effectiveness of public institutions

Empirical information is needed on the impact of the activities of public institutions (such as ADPs, and NFDPs), the private sector, and NGOs on farmers' investment in SPRI. Such information could include the coverage of services provided by these institutions (such as the percentage of farmers who have benefited from the activities supported by each of these institutions) and the kind of farmers who benefit from the work of public institutions (such as whether farmers located near the ADP stations are more likely to benefit). For example, farmers sometimes obtain pumps from the market rather than through the ADPs, and many of the irrigation pumps initially supplied by the state ADP often end up in the hands of middlemen. These middlemen resell the pumps to the intended beneficiaries at exorbitant prices. Empirical information is also needed to analyze the comparative advantages of different institutions in providing services to the irrigation sector. For example, the activities by the ADPs and NFDPs, particularly, seem to overlap in various dimensions, so it will be useful to understand how the two institutions could work together or whether their roles need to be revised. Similarly, further empirical analysis is needed to identify the constraints private sector actors face due to market failure.

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