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Transaction Costs and Investment in Irrigation Pumps: Evidence from Nigeria

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Small-scale private irrigation schemes (SPRI) have been the major driving force behind the expansion of irrigated areas in Nigeria, despite government efforts to promote large scale public irrigation schemes. SPRI allows adjustment of irrigation schedules in accordance with observed crop needs[1]. The irrigated area in Nigeria is, however, far below its potential and an increase in farmers' investment in irrigation is essential. While Nigerian farmers' low level of investment in irrigation may be partly due to low returns, it is also the result of high transaction costs associated specifically with making such an investment. Although reducing transaction costs is important because the reduction provides farmers with a more enabling environment, transaction costs are often unobservable and little is known about what factors contribute to them. This brief provides insights into how farmers' socioeconomic characteristics relate to the transaction costs in irrigation pump investment. It also offers policy options to reduce such costs.

Background

Small scale private irrigation schemes (SPRI) have been popular among Nigerian farmers who have enough resources to invest in them. The adoption of the irrigation pump is a key factor responsible for the key factor responsible for the expansion of irrigated land in Nigeria in recent years. The pumps are commonly adopted because they allow one hectare of land to be irrigated at a time while traditional water-lifting devices such as shadoufs can irrigate only up to 0.1 hectare at a time. These pumps also fill in the labor gap associated with the aging of farmers, which is becoming a serious issue in Nigeria, compounded by the rapid out-migration from rural communities. The demand should therefore be high for labor-saving devices such as irrigation pumps.

However, the pace of adopting irrigation pumps in Nigeria is low relative to their potential. While the actual investment in irrigation pumps is determined by factors that affect the return per investment, the transaction costs could be considered a limiting factor. In particular, these costs, from a farmer's point of view, are the identification of a seller, making certain of the pump's quality, and the time and transportation costs for purchasing it. Farmers often need whole packages of complementary inputs (farm land, water, improved seeds, fertilizer, fuel, and electricity) for using an irrigation pump, but may incur high transaction costs for obtaining those inputs.

Farmers commonly make repeated trips to pump suppliers as pumps are not always in stock and farmers only learn of their availability by actually travelling to the shop. They may also face higher risks of buying defective pumps due to Nigeria's weak certification system. In Africa, such transaction costs are generally high and often discourage farmers from making investments that are profitable and could lead to productivity growth. These transaction costs are often independent of the level of investment farmers plan to make, and thus only farmers with significantly higher willingness to invest will actually do so in the presence of such high transaction costs. In addition, such costs are often specific to individuals and unobservable. Government policies to lower such transaction costs would be essential for increasing farmers' investment in irrigation pumps.

While various studies have examined factors affecting returns of irrigation technology, relatively little is known about the impacts of the aforementioned transaction costs on farmers' decisions. Analyzing this impact can provide critical information about how to promote private adoption of the irrigation pump in Nigerian agriculture.

Method and data

This study estimates how transaction costs, as defined below, relate to the socioeconomic characteristics of farmers and to what extent they lead to non-investment in irrigation pumps. More specifically, the model establishes the relationship between transaction costs and the minimum investment level required for farmers to justify incurring such costs (threshold). The model also explains how farmers with a certain level of willingness to invest (WTI) decide whether or not to do so (Figure 1). We focus on the irrigation pump investment in Fadama II areas. We chose the locations benefiting from Fadama II because there is rich information about various socioeconomic characteristics contained in the dataset that evaluated this program.

Source of dataset and main descriptive statistics

The proportion of farmers who invested in irrigation pumps was higher among those who owned portions of their land and who were Fadama II members, than among those who did not own land or were not Fadama II members (Table 1).

While 9 percent of farmers who owned land invested in irrigation pumps, only three percent of landless farmers invested.

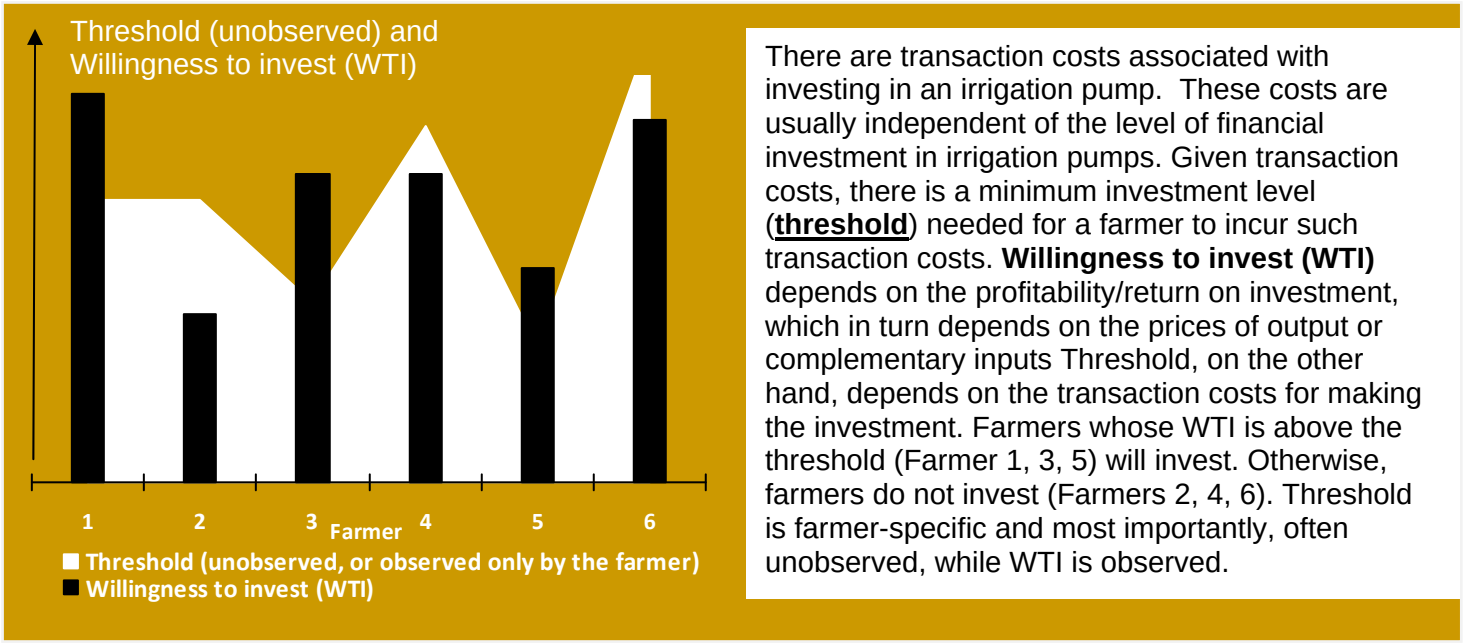
Table 1. Key characteristics of households investing in irrigation pumps (2006)

	Yes	No
Farmer owns land (%)	9	3
Farmer belongs to Fadama II (%)	16	2
	Investor	**Non-investor**
Median distance to nearest market (km)	3.5	5
	Male	**Female**
Proportion of farmers who invested(%)	5	3
Investment value (US$)		
Median	238	393
Min	0.08[a]	71
Max	3,937	7,244

[a] The figure is too low and we think it is a transcription error

Similarly, 16 percent of Fadama II members invested, while only 2 percent of non-Fadama II members did so. Those who invested are located closer to the nearest market than non-investors. Slightly lower proportions of female-headed households than male-headed households invested in irrigation pumps in 2006. Female-headed households that did invest, however, did so within the range of US$71 to US $7,244, with a median of US$393, which was generally higher than the investment made by male-headed households, which is $238 at the median.

Figure 1. Example of Farmer willingness to invest (WTI) in irrigation pump and unobserved threshold



There are transaction costs associated with investing in an irrigation pump. These costs are usually independent of the level of financial investment in irrigation pumps. Given transaction costs, there is a minimum investment level (**threshold**) needed for a farmer to incur such transaction costs. **Willingness to invest (WTI)** depends on the profitability/return on investment, which in turn depends on the prices of output or complementary inputs Threshold, on the other hand, depends on the transaction costs for making the investment. Farmers whose WTI is above the threshold (Farmer 1, 3, 5) will invest. Otherwise, farmers do not invest (Farmers 2, 4, 6). Threshold is farmer-specific and most importantly, often unobserved, while WTI is observed.

Summary findings

This study focuses on factors that affect transaction costs (and thus threshold level—minimum required investment level) rather than the factors that affect the returns to investment (and farmers' willingness to invest).

Table **2** presents key household characteristics associated with transaction costs and how they raise or lower the threshold level investment for an irrigation pump. The table also presents characteristics that affect farmer's willingness to invest. Female-headed households face higher transaction costs and find it worthwhile to incur such costs only when they are willing to invest US$2,434 more in pumps than male-headed households of the same characteristics (Figure 2). Female-headed households, however, can realize the same high returns per investment as male-headed households when they actually invest. The threshold level rises by US$25 for every 1 kilometer added to the distance between the farmer's residence and the nearest market. Threshold is also higher for households that do not own their land, do not have access to public irrigation facilities, and have a high ratio of non-working household members to working-age household members.

Being a member of the Fadama II project seems to significantly lower the transaction costs of investment, particularly in the dry regions, although Fadama II membership does not affect farmers' willingness to invest. The impact of the Fadama II project is unique and slightly different from the provision of subsidy alone, because subsidy for an irrigation pump, which is part of the Fadama II project, is expected to affect the farmers' actual investment level and not the transaction costs of investment. The Fadama II project members therefore seem to benefit from other factors derived from the project. Such benefit includes (a) the capacity building of farmers-networks, which lower the cost for individual farmers to search and locate irrigation pump suppliers and to learn about the quality of the pump being supplied, and (b) infrastructure such as improvement and extension of roads that lowers the farmers' costs of traveling to the pump market.

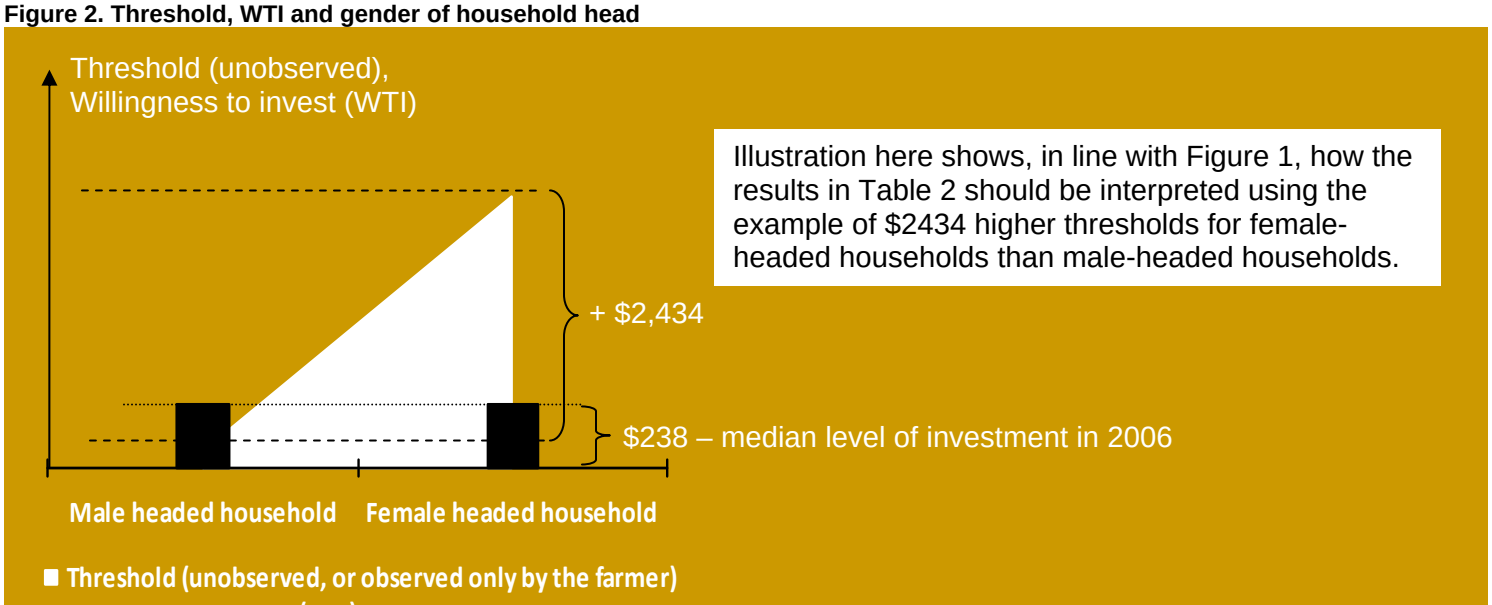
Table 2. Key factors that affect threshold and willingness to invest (US dollar, 2006)

Household characteristics	Change in threshold level	Change in willingness to invest
Female-headed household	+ 2,434	
Distance to nearest market (km)	+ 25	
Household that owns land	– 932	
Household with access to public irrigation facility	– 2,244	
Fadama II project membership	– 1,271	
Fadama II project membership × annual rainfall (1000mm)[a]	+ 514	
Age of household head		– 9
Dependency (ratio of non-working age member to working age member)	+ 166	+ 21
Total asset value (US$)		+ 0.1
Household that received credit in 2005		+ 230
Member of cooperative		– 302
Median level investment in 2006	238	

[a]'×' means "interacted with"

The findings indicate that many household characteristics affect the threshold, while they may not affect the willingness to invest. Moreover, the effect of household characteristics on the threshold seems considerably large. Reducing transaction costs associated with investment in irrigation pumps can significantly increase farmers' investment in pumps and their adoption of irrigation technologies. For that reason, such policy is as important as policies targeted to raise farmers' willingness to invest by increasing returns.

Figure 2. Threshold, WTI and gender of household head



Conclusions

Transaction costs associated with investment in irrigation pumps, though not fully observable, seem substantially high in Nigeria. It was already known that investment in irrigation pumps may be limited by the lack of a profitable environment with a low output price and the lack of complementary inputs such as fertilizer or improved seeds. This study suggests that the investment is further limited because of the high transaction costs associated specifically with making such an investment. Such costs can be significantly high for female-headed and landless households that have no access to a public irrigation facility and are not members of Fadama II.

From the research perspective, empirical studies analyzing farmers' behavior regarding irrigation pump investments provide biased results if they ignore the aforementioned farmer-specific nature of transaction costs. Nor should these studies ignore how these costs affect farmers' decisions to invest or not regardless of the potential profitability.

From the policy perspective, the findings reemphasize the importance of reducing market failure and creating an enabling environment in which farmers can engage in profitable farming activities. Support to female-headed households, the facilitation of land trade or rental, strict enforcement of land ownership title and rural infrastructure would be especially helpful. Such measures alone may significantly increase farmers' purchase of irrigation pumps. They may even do so in the absence of policies or the environment that raises the return on the irrigation pump, such as a subsidy for buying irrigation pumps or other agricultural inputs.

This brief is excerpted from a forthcoming Nigeria Strategy Support Program (NSSP) Background Paper on Transaction Costs and Investment in Irrigation Pumps: Evidence from Nigeria It is intended to promote discussion; it has not been formally peer reviewed, but it has been reviewed by at least one internal and/or external reviewer.

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