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Improving the Use of Agricultural Technologies in Uganda

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In 2009, 20 of agricultural households had access to extension services.

One out of every five agricultural households in Uganda have access to extension services, according to the 2008/9 Uganda Census of Agriculture[1]. Most agricultural households rely on fellow farmers to receive agricultural information. This is the environment despite the fact that the public expenditure on the extension system operated through the National Agricultural Advisory Services (NAADS) programme accounts for over 35 percent of the agricultural sector budget.

Modern farming methods matter for smallholder agricultural productivity and food security. Adoption of improved agricultural technologies has been associated with higher agricultural incomes, improved nutritional status, lower staple food prices and increased employment opportunities. Indeed, the adoption of improved technologies is considered as a major factor in the success of the green revolution experienced by Asian countries.[2]

As earlier noted, in spite of the resources spent on the public extension system in Uganda, there is limited adoption of improved crop varieties, and input use remains generally very low. Only 6 percent of farmers in Uganda were using improved seeds in 2006, while a much lower proportion used inorganic fertilizers.[3] Even for farmers who initially adopt improved agricultural technologies, dropout rates are high. For instance, previous studies show that about 50% of farmers who adopted the high yielding rice variety (New Rice for Africa—NERICA) abandoned the variety within two years.[4] Such is the situation despite widespread evidence that returns to agricultural technology adoption are high in Uganda—adoption of improved seeds was associated with a 21% increase in crop yields for Ugandan farmers[5] Consequently, it is important to understand why adoption of agricultural technologies has remained very low in Uganda despite the documented benefits of agricultural technical change.

This brief provides evidence on the use of modern agricultural inputs in Uganda during 2005/6 and 2009/10. Although Uganda has regularly conducted surveys on tracking various welfare outcomes, only a few surveys have collected detailed agricultural production data at the household level. During 2005/6 and 2009/10, the Uganda Bureau of Statistics (UBoS) conducted a national panel survey—following the same agricultural households. The brief, based on the research report that examined constraints to agricultural input use[6], highlights the challenges faced by farmers in accessing agricultural inputs despite the recent changes in the NAADS programme.

Drivers agricultural technology adoption

Previous studies on agriculture highlights two major drivers of successful agricultural technology adoption in developing countries the availability and affordability of technologies and farmer expectations that adoption will remain profitable.[7] A number of factors drive the above expectations, ranging from availability and size of land, family labour, prices and profitability of agricultural enterprises, and learning from fellow farmers or peer effects.

Availability and quality of land

Helps reduce the cash challenges faced by households and also reduces fear regarding crop loses. Furthermore, ownership of large tracts of land can facilitate experimentation with new agricultural technologies, and also determine the pace of adoption as large land owners are more likely to be first to adopt.

The Quality of land may be a major factor in deciding the use of key inputs such as chemical fertilizers, or adopting improved crop varieties due to expected higher returns. In the availability of land alone may not spur agricultural technology adoption. Furthermore, even in countries with secure property rights but poorly developed financial markets, land availability may not reduce the cash/credit constraint. As such, in order to address the liquidity and supply constraints faced by poor farmers with regard to technology adoption, a number of African countries have implemented various forms of 'smart agricultural subsidies' that target specific farmers.

Presence of mature household members

Previous research shows that life cycle effects are important drivers of agricultural technology adoption. In particular, younger as well as much older household heads are affected by the fear of crop loses and are less likely to adopt new technologies. On the other hand, the presence of mature family members may facilitate the process of technology because most farming households cannot easily acquire hired labour due to limited funds to hire labour. It has also been shown that the continued presence of adults in the household is a major factor in determining whether households continue with the technology after making the decision to adopt.

Expected profits

are a key determinant of sustained adoption by agricultural households Initially attracted by higher product prices, farmers can abandon the technologies if the expected benefits from adoption are lower than the prevailing costs. There are a number of ways through which profitability of products may be lowered. For cash crops, changes in the international trade regime may negatively affect world prices and consequently depress local prices. The global decline in cotton prices due to cotton subsidies in developed countries best illustrates this fact. The changing profitability of agricultural enterprises also introduces the time dimension as a driver of adoption—households may adopt technologies for some but not all periods.

Learning from other farmers can drive the use of modern inputs. In technology adoption process, peer influence can work in three major ways: (1) individuals profit from acting like friends/neighbours; (2) individuals gain knowledge of the benefits of the technology from their friends; and (3) individuals learn about how to use a new approach from peers. With regard to agricultural technology adoption, peer effects can lead to economies of scale by lowering transportation costs.

Uganda National Panel Survey

The 2005/6-2009/10 Uganda National Panel Survey captured information on: household land holdings; type and quality of soils used for cultivation; investments on land; types of crops produced, and the use of improved seeds; the use of organic and chemical fertilizers; agricultural labour inputs; and access to extension services. Specific information was collected on use of fertilizers1 and improved varieties during the previous cropping season. The survey also contained a quiz to test farmer's knowledge of agricultural technologies as well as improved varieties. Finally, the survey enquired from farmers whether they had used any of the improved varieties in the past 12 months or used in the past. Table 1 shows the extent of use of improved seeds and fertilizers based on the UNPS.

Table 1: Extent of agricultural technology use in Uganda

	All	By Agricultural technology adoption			
	Panel	Improved Seeds		Fertilizer	
	House holds	2005 /06	2009 /10	2005 /06	2009 /10
Community use of improved seeds in 2009/10	0.21	0.26	0.39	0.20	0.32
Community use of organic fertilizer in 2009/10	0.13	0.14	0.11	0.23	0.16
Community use of inorganic fertilizer in 2009/10	0.03	0.04	0.06	0.04	0.09
Community use of pesticides in 2009/10	0.11	0.16	0.17	0.17	0.29
Availability of input markets in 2005/06	0.18	0.19	0.17	0.16	0.13
Availability of organic fertilizer mkt in 2009/10	0.01	0.01	0.02	0.02	0.03
Availability of inorganic fertilizer mkt in 2009/10	0.02	0.06	0.07	0.05	0.17
Availability of chemical fertilizer mkt in 2009/10	0.08	0.17	0.19	0.18	0.63
Availability of improved seed mkt in 2009/10	0.11	0.18	0.52	0.14	0.28

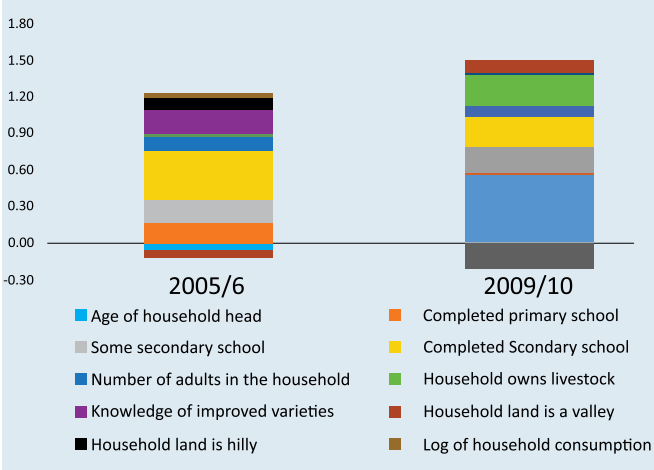
Figures 1 and 2 shows the quantitative determinants of the use of improved seeds and fertilizer respectively. For Uganda,

1 These include organic fertilizers, inorganic fertilizers, and pesticides.

we find that farm size is not important condition for use of improved seeds with the exception for the 2009/10 survey round where households with hilly land parcels are less likely to use improved seeds, but more likely to use fertilizers.

The figures also shows that life cycle effects are only significant in 2009/10 and not 2005/06. In particular, older household heads are significantly less likely to use either improved seeds or fertilizers. Apart from the fear of loss of agricultural output this particular result may also be partly explained by the high susceptibility to poor health by older household heads.

Figure 1: Determinants of use of improved seeds

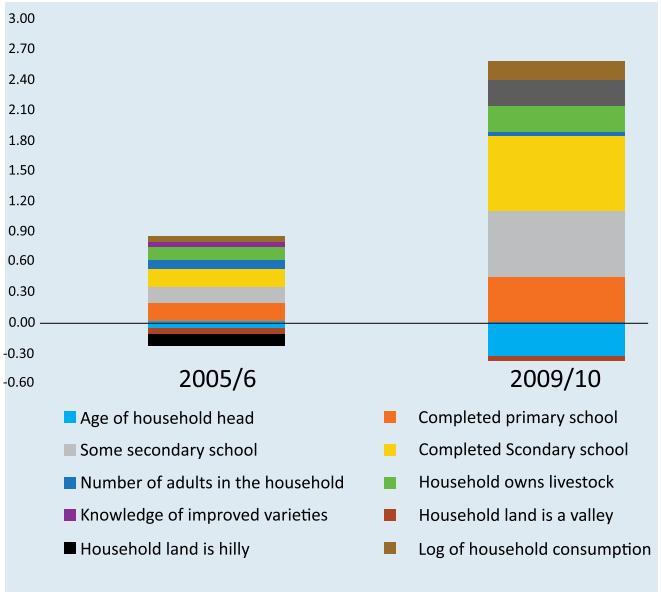


Higher education attainment is associated with an increasing likelihood of use of fertilizers, especially in 2009/10. Also the number of adult household members matters for agricultural technology adoption. This may be partly explained by the fact that there are currently only a few agricultural products in Uganda with improved varieties, and these specific products are labour intensive. At the regional level, farmers in Western Uganda were significantly less likely to use improved seeds in 2005/06 but more likely than farmers in all other regions to use fertilizers. By 2009/10, the regional differences were eliminated.

The results also highlights the importance of supply side constraints as determinants for availability of key agricultural technologies. In particular, communities with good access to input markets are far significantly more likely to use either improved seeds or fertilizers in both survey rounds (2005/06 and 2009/10).

The variable for farmer's knowledge of improved varieties shows that this is a key determinant of adoption of improved seeds and fertilizer use in 2005/06 and, by 2009/10, the effect was insignificant. This particular result may be partly explained by the proliferation of the NAADS programme in Uganda, given that the programme has been a major vehicle for disseminating agricultural information. For the first years of the NAADS programme (2001-2006), it only operated in about one third of sub-counties in Uganda. It was not until 2007/08 that the programme was rolled out across the country.

Figure 2: Determinants of use of fertilizers



Land ownership and education

It is possible that particular farmer characteristics may influence agricultural technology behaviour. For instance, farmers with small farm sizes may not have enough funds to purchase key inputs. At the same time, poorly educated farmers may also have small land parcel, and are as such more likely to seek off-farm employment and are, as a consequence, less likely to engage in intensive agricultural practices. In order to investigate such issues, we interact variables for landholding with education attainment. In particular, we generate quartiles of farm sizes and interact these categorical variables with attainment of secondary education. The results for interaction terms for both 2005/06 and 2009/10 are very significant for the use of improved seeds in 2005/06 and for the second quartile in 2009/10. This suggests that poorly educated farmers are more likely to work on other people's farms without necessarily adopting agricultural technology.

Abandoning modern technology

Dis-adoption of agricultural technology occurs regularly in developing countries. The reasons for dis-adoption can range from life cycle effects to changes in the profitability of agricultural products. We investigated the determinants of dis-adoption by 2009/10 of either improved varieties or fertilizer use for farmers who were initially using these technologies in 2005/06. The results showed that the peer effects as captured by the extent of use of improved varieties in the communities slows down the process of improved seed dis-adoption. Furthermore, farmers from

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Western Uganda are less likely to abandon the use of improved seeds. On the other hand, the increasing presences of adults in the household, and farmers with a higher knowledge of improved seeds in 2005/06 as well as farmers from Eastern Uganda will more likely dis-adopt improved seeds. With regard to fertilizer dis-adoption, Table 4 shows that older household heads are more likely to abandon fertilizers. Previous studies highlight the fact that pressure to withdraw from agricultural technologies set in after 20 years of use.

Our results also show that households that keep cattle are more likely to abandon fertilizer use after some time. This may be explained by the increased availability of organic fertilizer/manures with the presence of livestock on household farmers. Livestock excrement may over time become a cheaper although less effective alternative to inorganic fertilizers. Furthermore, animal manure is less amenable to supply side constraints than chemical fertilizers. At a regional level, farmers from Western Uganda were more likely to abandon fertilizers compared to farmers from central Uganda. Given that Western Uganda accounts for the largest share of livestock in Uganda, the above results are also linked to increased availability of organic fertilizer from livestock.

Conclusions

This brief examined the determinants of agricultural technology adoption in Uganda using the Uganda National Panel Survey 2005/6-2009/10. The focus on two types of agricultural technologies—improved seeds and fertilizer use. We find that farmers with low education and land holdings are less likely to adopt agricultural technologies. In addition, we find that peer effects play a big role in influencing farmers to either use improved seeds or fertilizers. Furthermore, dis-adpotion of agricultural technologies occurs regularly, with cattle keeping farmers in Western Uganda more likely to abandon fertilizers and possibly resort to organic manure from livestock excreta.

Our results also have pertinent policy implications, especially regarding addressing supply side constraints. In particular, the relatively limited adoption and sustained use of agricultural technologies is partly because technologies are not readily available in agricultural markets. Sourcing such inputs from distant markets can reduce the profitability and eventual duration of adoption. As such, there is need for the government to lessen the supply side constraints. The introduction of a fertilizer subsidy may help develop the local fertilizer market and lessen the supply side constraints to agricultural technology adoption.

Endnotes

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