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AGRICULTURAL EXTENSION SERVICES' IMPACT ON FERTILIZER USE

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Abstract

There are many studies which have assessed the impact of extension, some treat the presence or absence of extension as a binary variable and few investigate how the frequency of the contact impact farm household welfare. The results revealed significant differences in the outcomes. Farmers who frequently accessed extension used very less urea fertilizer than farmers who accessed extension only once. Private extension access result in statistically significantly higher incomes but not reduced urea fertilizer application rates.

Keywords: Fertilizer Use, Government Extension, Private Extension, Profit.

Introduction

Increasing agricultural production in many parts of the world is an important strategy to increase income, reduce hunger, and improve other measures of well-being. Few countries have achieved sustained economic growth without developing their agricultural sector. Extension helps in reducing productivity differentials amongst farmers by accelerating technology transfer, increasing farmers' knowledge, and assisting them in improving their farm management practices.

The agricultural extension services increase value, productivity, and food security. Most of the earlier studies evaluating agriculture extension show a positive impact on farm productivity, farm technical efficiency, net farm income and poverty reduction.

There are a few exceptional studies which account for the attributes of extension. Hasan and Otsuki (2011) say that total factor productivity was approximately five times higher among farmers participating in private extension programs than for farmers participating in government programs. Ragasa and Mazunda (2018) found that the

receipt of extension advice had a consistently insignificant effect on crop production and food security, except for farmers who found the extension to be 'very useful'.

Farmers who self-select extension access and the non-access groups often systematically differ in observed and unobserved characteristics like their abilities, desires, risk preferences, and aspirations. Such treatment and control group differences can potentially influence the outcomes of interest.

Impact of Extension on Application of Fertilizer

It is found worldwide; there is evidence of the overuse of chemical fertilizer. In China, the overuse of chemical fertilizer is well established. Fertilizer overuse has multiple effects, it increases production costs and reduces net farm income, causes economic losses, reduces fertilizer utilization rates for crops, reduces soil micronutrients, reduces soil fertility, causes pollution and greenhouse gas emissions which results in harm to the environment, water, soil, atmosphere, biology, and human health.

Besides the transfer of technology and knowledge, extension services identify farm innovations, assist in the distribution of fertilizer and other agricultural inputs, and facilitate rural programs according to national policies.

Methodology

There are various ways to address the potential sources of bias in this study ranging from instrumental variable methods to endogenous switching regression to experimental and quasi-experimental methods This study deploys the endogenous switching regression method, a well-recognized approach to treating endogeneity, including self-selection. The ESR method is like Heckman two-step approach and is especially useful when the treatment is not randomly distributed among the treatment and control groups. This method is popular for exploring food production issues and considering farmers' behavior.

Identification of the ESR model requires at least one additional variable as an instrument. The selection of instrumental variables should directly affect the selection variable but not the outcome variable. Say distance from the village market and the use of mobile phones as the selection instrumental variables and checked the admissibility of the instruments by performing a simple falsification test, if a variable is a valid selection instrument, it will affect the households of farmers who

receive extension services but will not affect the outcome variables of the households of farmers who do not receive extension services.

Statistics Data

The control variables used in this study demonstrate a considerable impact on crop production. These variables have already been used in previous studies. Elias *et al.* (2013) used the household head's age, gender, education, land size, livestock, use of credit, plot distance from home, Wossen *et al.* (2017) used the household head's age, gender, education, marital status, land size, mobile phone access, use of credit, plot distance from agricultural input dealers, and production inputs; Ragasa and Mazunda (2018) used the household head's age, gender, education, land size, child-dependency ratio, household size, annual rainfall, use of credit, plot distance from the nearest market, and an asset index.

Statistics Summary

The comparison between the farmers who had more than one extension contact and those who had no extension contacts is very similar to the first group comparison except for the significantly higher net farm income for the farmers that had more than one extension contact. The farmers who had more than one extension contact had more school years, more ownership of irrigation pumps, and a higher net farm income.

The comparison between the farmers who receive government extension services and those who receive no extension services will show that farmers who receive government extension services have more school years, older household heads, more frequently chose agriculture as their main occupation, and have more irrigation pumps. There was no significant difference in the plot area, per hectare labour use, total urea fertilizer use, phosphorous fertilizer use, yield, and net income.

On the other hand, the subgroup comparison between those who receive private extension services and those who do not receive extension services will show farmers who receive private extension services may have larger land holdings, use much more phosphorous fertilizer, have higher yields, spend less time in the field, and less agriculture as their main occupation. However, there may not be significant differences in the ownership of irrigation pumps, household head age, distance to market, and urea fertilizer use.

Results

The results of the selection equations estimate the propensity to participate in extension services. It is observed that the variables, household head's age, gender, education, own irrigation, and access to credit, are positively associated with extension participation. The ESR regression coefficients for the yield and profit equations. Our interest is in the average treatment effects. Hence, we calculate the observed values of the dependent variables i.e. urea application, yield, and net farm profit on farms which received extension services.

The analysis showed that having extension contact reduced farmers' nitrogen fertilizer use. However, the impact is greater for the farmers who had more than one extension contact. Farmers that received government extension services used similar amounts of nitrogen fertilizer compared to those that did not receive extension services. Similarly, farmers receiving private extension support used a similar amount of nitrogen fertilizer compared to the farmers who did not receive extension services.

Although having extension contacts had a statistically significant treatment effect on yield this higher yield did not convert to a statistically significant net farm profit effect. This may be because these farms used more input and as a result, their production costs were higher. On the other hand, there were positive and significant yield and net profit treatment effects for farms that had more than one extension contact. The yield treatment effects were not significant for farms which received government extension services. A positive and significant profit effect was observed for the farms that received private extension services.

Discussion and Conclusions

This paper aimed to address the absence of the evaluation of the impact of the frequency of extension contact and provider type on fertilizer input use, yield, and profit metrics in contrast to the predominant practice of treating extension contacts as a binary variable.

The results revealed that the traditional binary variable model provided a significantly less nuanced perspective on the impact of extension than we gained from estimating the impact of extension frequency and the sources of the provisions' treatment variables. The binary indicator model found that extension had a significant negative impact on nitrogen fertilizer use. The impact on fertilizer application reduction was even greater for the farmers who had multiple extension

contacts. Although private extension services were estimated to have the greatest profit benefits, they did not reduce the application rate of urea fertilizer. More frequent extension contact resulted in both more profit and reduced fertilizer application.

There are significant critics of extension services as a provision for the 'public good'. It has been described as ineffective in many developing countries and a persistent. This study supports the notion that private provisions may provide greater net income benefits to farmers than public provisions. However, more intensive extension service (public or private) may be the better option for reducing the overuse of chemical fertilizer and increasing yield and profit.

Though many studies assess the impact of extension on crop yield and profit, fewer deal with the impact of agricultural extension on the over-utilization of chemical fertilizers. The findings of this paper are relevant not only in developing countries but also in developed countries where the over application of fertilizer is reported.

PSMis widely used non-experimental technique for estimating causal relationships. This statistical technique constructs an artificial comparison group based on a probability model. . In a first, a non-treatment group is identified that is similar to the treatment group in observable chrematistics, and then the impact of treatment is compared for these two groups to identify the treatment effect with correction for self-selection.

PSM involves estimating the propensity score for each observation. This is the probability of a farmer receiving extension services (P). It is estimated as a probit model with a dependent variable equal to 1 for farmers that received an extension and including a large set of characteristics (X), which can explain the probability of any farmer in the population receiving extension services.

The variable vector X includes a binary gender variable and the education level of the farmer (years of school completed).

A binary agriculture is the main occupation indicator t; a binary indicator takes a value of one if the farmer has any livestock holdings or if the farmer used an improved variety of seeds. βi is the vector of the estimated marginal impact of the characteristics on the probability of receiving extension services.

Secondly, we estimate the average treatment effects (ATEs) of receiving extension services on the dependent variables, fertilizer application

rate, yield, and net crop income. From the above-mentioned probit regression, we can obtain the PS of the treated group, i.e., those receiving extension services, and the non-treated group. Then we are able to estimate the average difference in welfare between treated Y(1) and matched controlled Y(0).

The estimated ATEs are represented as the impact of the extension service on the welfare of the farmers.

However, the treatment effect estimates from the PSM can still be biased in the presence of the misspecification in the propensity score models primarily because of the unobserved attributes of farmers with higher treatment propensity.

The results show that the farmers that received extension contact used significantly higher amounts of urea fertilizer. On the other hand, the relationship between the farmers who received private extension services, government extension services, and those who received more than one extension visit in using urea fertilizer is not significant. Here, private and government extensions show similar results but the extension contact and more than one extension contact groups show different results than the ESR method.

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