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The Impact of Adoption of Agricultural Production Technology in Chiro Woreda, West Hareghe, Ethiopia

Getaye Gizaw*

Department of Principal investigator, Oda Bultum University, Ethiopia

Abstract

This study was designed to assess the impact of adoption of Agricultural production technology on households' Agricultural production in Chiro Woreda using cross sectional data obtained from 191 Agricultural farmers selected from four kebeles to represent major Agricultural producers. The study used propensity score matching to assess impact of adoption of Agricultural production technology on household production levels. The result showed adoption of Agricultural production technology has a robust and positive effect on farmers' Agricultural production in quintal per hectare. The average treatment effect on the treated (ATT) was about 9.48 quintal yield per-hectare increase for adopters as compared to non-adopters. The result of sensitivity analysis also shows average treatment effect on treated is not sensitive to external change.

Keywords: Agriculture • Technology • Adoption • Impact • Production • Propensities Score Matching.

Introduction

Technology can be described as the integration of people, knowledge, tools and systems with the objective to improve people's lives (Porter, 1985). According to Betz (1998), technology is always the means of creating new tools serving humans and their environment. Technology adoption refers to a decision to make full application of an innovation as the best course of action (Rogers, 2003) Agricultural Transformation in many developing countries that led to a significant increase in agricultural productivity resulted fromprogrammers of agricultural research, extension and infrastructural development occurred in the late 1960s, and this revolution was known as Green Revolution. According to Andersen and Hazell (1985) Green Revolution refers to a rapid increase in wheat and rice productivity resulted from the adoption of improved seed varieties, fertilizers and pesticides. Technological change in agriculture comprises of introduction of high yielding variety of seeds, fertilizers, plant protection measures and irrigation. These changes in agricultural sector enhance the productivity per unit of land and bring about rapid increase in production. Ethiopia is a country situated at the Eastern part of Africa with a population of more than 100 million (CSA, 2017). Agriculture is the backbone of the Ethiopian economy, playing a vital role in the country's economic development. The sector accounts for 36.7% of the GDP and generates 88.8% of export earnings. However, the Ethiopian agriculture is a rain feed which its growth depends on favorable climate among others things. For example, the agricultural sector exhibited the lower growth rate of 2.3% in 2015/16 largely on account of Elino effect [1].

Several adoption research findings have pointed to the fact that the use of new agricultural technology, such as high yielding varieties that kick-started the Green Revolution in Asia, could lead to significant increase in agricultural production in Africa and stimulate the transition from low production subsistence agriculture to a high production agro-industrial economy. Scholars in the discipline argues that agricultural production growth will not be possible without developing and disseminating cost effective yield-increasing technology, since it is no longer possible to meet the needs of increasing numbers of people by expanding the area under cultivation or relying on irrigation used a local average treatment effect (LATE) method to examine the impact of improved agricultural technology adoption on rural farmers' welfare in Nigeria, using a cross sectional data of 481 Agricultural producers stated that the decision of small farm households to adopt improved Agricultural varieties were determined by the different socio-economic / demographic and institutional variables such as number of years of residence in the village, access to media, mobile phone, vocational training, livestock ownership, access to improved seed, and income from other crop production significantly increased the probability of adoption. As a result, adopters received more 3.6 quintals of Agricultural additions per hectare used the Propensity Score Matching (PSM) to assess the impact of agricultural technology adoption on poverty in Bangladesh and observes that the adoption of high yielding improved varieties has a positive effect on household

***Address to correspondence:** Getaye Gizaw, Department of Principal investigator, Oda Bultum University, Ethiopia; E-mail: getayegizaw@gmail.com*

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wellbeing in Bangladesh. In the same vein, Kijima, et al., (2008) conducted a study on the impact of New Agricultural for Africa (NERICA) in Uganda and found that NERICA adoption reduces poverty without deteriorating the income distribution. Diagne, et al.,(2009) also assess the impact of NERICA adoption on Agricultural yield in Cote d'Ivoire. The results show a positive and significant increase in yield particularly on the female farmers. More recently, Dontsop-Nguezet, et al (2011) also examined the impact of NERICA adoption on farmers' welfare in Nigeria. The result of the study shows that adoption of NERICA varieties has a positive and significant impact on farm household income and welfare measured by the per capita expenditure and poverty reduction in rural Nigeria. In Ethiopia, despite the significance of Agricultural in the livelihood of many farmers and households, it is only recently that few studies have been done on Agricultural. Furthermore, its impacts on Agricultural production have not yet been studied. Hence, this study was conducted to assess the impact of Agricultural production technology adoption on Agricultural production of the farming households using estimation techniques in Chiro woreda [2].

Research Methodology

Chiro woreda is one of the 17 woreda of Oromia national regional state and found in West Harerghe zone. It is situated at 11058 latitudes and 37041 longitudes. The district is bordered on the south by Tullo, on the west by Miesso, on the north by Somali and on the east by Gorogutu.

In this study, both primary and secondary data sources were used. Both quantitative and qualitative data were gathered from different sources of the study area. A multi stage sampling procedure was used to select the kebeles and sample households. In the first stage, four kebeles were selected purposively from 15 Agricultural producing kebeles based on their agro ecological zone. In the second stage after lists of farmers were obtained from the district Agricultural and rural development office, farmers who were cultivating Agricultural in four kebeles, 91 adopter sample household heads were taken as respondent using probability proportional to size. 100 non-adopter respondents were selected using simple random sampling method based on their proportion. The data was collected from December 2017 up to April 2017 for five months.

Binary logistic regression was incorporated to analyze relationships between a dichotomous dependent variable and independent variables. The probability that a given household is Agricultural production technology adopter is expressed in equation , while the probability for non-adopters of Agricultural production technology is expressed in equation [3].

In this study, PSM was used to construct a group for comparisons based on probability model of adoption of Agricultural cultivation technology. Members who adopted the technology are matched to non-adopters on the basis of the probability [or propensity scores, (PS)]. After matching the individuals with similar characteristics in both the adopter (treatment) and non-adopter (control) groups, the real effect of Agricultural production technology adoption can then be calculated as the mean difference in Agricultural output per hectare between the adopters and non-adopters. In addition to assessing the effect of adoption on Agricultural output, the method of PSM allows us to examine the probability of a farmer adopting a technology. After estimating the propensity scores using the logit or probit model, the next task is to estimate an average treatment effect (ATE) of adoption on Agricultural output. The ATE is estimated as the mean difference in Agricultural output between adopters, denoted by Y (1) and matched control group, denoted by Y (0). Symbolically, equation (1) represents the model for estimation.

ATE = E [Y (1) Y (0)] = E [Y (1)] E [Y (0)] …………… (1)

Where, ATE = average total effect

E [Y (1) = Average outcomes for individual, with treatment, if he/she would adopters (Di=1)

E [Y (0) = Average outcome of untreated, when he/she would non adopters, or absence of treatment (Di=0)

The ATE model compares the Agricultural output of farmers who adopted Agricultural production technology with that of non-adopters or control for farmers that are similar in terms of observable characteristics and also partially control for non-random selection of participants in the Agricultural production technology adoption program. The ATE as calculated in equation could be interpreted as the effect of the Agricultural production technology adoption on Agricultural output. Apart from the ATE, an average treatment effect on the treated (ATT or ATET) is also estimated. The ATT model measures the effect of adoption on output for only farmers who actually adopted the Agricultural production technology rather than across all Agricultural farmers who could potentially adopt this technology. ATT is calculated using the expression in equation as follows:

ATT = E [Y (1) Y (0) D = 1] = E [Y (1) D = 1] E [Y (0) D = 1] ……… ……….. (2)

Where D is a dummy or indicator for treatment (D = 1 for adopters, 0 for non-adopters). Again, one could also estimate the average treatment effect on the untreated or control groups (ATC), which measures what the effect of adoption on output would be for farmers who did not adopt the Agricultural production technology at all. The model for measuring such a parameter is expressed by equation (3) below.

ATC = E [Y (1) Y (0) D=0] = E [Y (1) D=0] E[Y (0) D= 0] ……… (3)

According to Rosenbaum and Rubin (1983), the effectiveness of matching estimators as a feasible estimator for impact evaluation depends on two fundamental assumptions.

Results and Discussion

Socio-demographic Characteristics of the Respondents

The study shows that about 30.89% of the sample households were headed by females and the remaining 69.11% were headed by males. In terms of adoption status for both adopter and non-adopter male households have more probability of adoption than female households. Non adopters' respondents said that, Agricultural production technology adoption requires more labors, and it takes time and is not easy to access agricultural inputs. The larger the farm size the farmer has, the better he/she is initiated to involve in adoption of Agricultural production technology. Therefore, adopter households have more probability of adopting Agricultural production technology than non-adopter households and family size of households is directly associated with adoption of Agricultural production technology.

Parlfor	Mean	Minimum	Maximum	Total
Adopter	3.07	1	7	91
Non adopter	3.07	1	7	100

Table 1. Participated labor force of sample household head.

Definitely, education plays a great role in adoption of Agricultural production technologies and other technologies. About 42.66% of the respondents were literates; this figure is greater than the national figure for adult literacy (36%) indicating that the area is better off in terms of education.

Eduhh	Adopter		Non adopter	
	Frequency	%	Frequency	%
Illiterate	34	17.8	57	29.84
Primary	31	16.23	28	14.66
Secondary	26	13.61	15	7.85
Total	91	47.65	100	53.35

Table 2. Education level of sample household's head.

The landholding of the sample households ranges from 0.125 ha to 3 ha with an average figure of 1.066 hectares. The average livestock (including cattle, sheep, goats, pack animals, and poultry) was 4.46 TLU with the minimum and the maximum holdings of 0.7 TLU and 17.8 TLU respectively.

	Max	Min	Average
Land (in hectare)	3	0.125	1.066
Livestock (in TLU)	17.8	0.7	4.46

Table 3. Land and Livestock Ownership.

Out of the total of adopters 37.17% of households were credit users while 10.47% did not want to take credit. And also showed that out of the total of non-adopters 29.84% of households were credit users while 22.51% did not want to take credit due to various reasons which are food consumptions rather than farm inputs consumption and unexpected expenditure, existing of high interest rate and by having enough money to buy agricultural inputs. About

Extension	Adopter	%	Non adopter	%
Access	53	27.75	33	17.28
Not access	38	19.90	67	35.08
Total	91	47.65	100	52.35

Table 4. Extension services user sample household heads.

According to the data result 18.32% of adopters and about 17.28%of non-adopters were attending farmers training center while 29.32% of adopters and 35.08% of non-adopters were not attending farmers training at farmers training center because of the reason that their home is far from their farmers training center (FTC). About 64.4% of households did not get a chance to participate farmers training at farmers training and keeps them away from gaining best agricultural practices.

Atftc	Adopter	%	Non adopter	%
Attained	35	18.32	33	17.28
Not attained	56	29.32	67	35.08
Total	91	47.65	100	52.35

Table 5. Attending of farmers training center of sample household head.

The impact of technology adoption on Agricultural production

Estimating the propensity score is important for two things. The first one is to estimate the average treatment effect on the treated (ATT); and second, to obtain matched treated and non-treated farming households. According to Grilli, et al (2011), the necessary steps when implementing propensity score matching are: Propensity Score estimation, Choose matching algorithm, Check overlap/common support. Matching of adopter and non-adopter households were carried out to determine the common support region. The basic criterion for determining the common support region is to delete all observations whose propensity score is smaller than the minimum propensity scores of participants and larger than the maximum in the control group [4].

Observations	Mean	Std. dev	Min	Max
Adopters	0.661637	0,2408404	0.148124	0.99637
Non-adopters	0.305657	0.220878	0.150809	0.975966
Total	0.47526	0.290986	0.148124	0.99637

Table 6. Predict propensity score common support region.

The values of Pseudo R-square and LR chi-square before and after matching which can be used as indices for the fulfillment of the balancing requirement. The pseudo R-square indicates how well the regressors X explain the participation probability, meaning all the explanatory (independent) important variables included in the model do exactly explains the probability of households Agricultural production technology adoption. . After matching there should be no systematic differences in the distribution of covariates between both groups and therefore the pseudo R-square should be fairly low.

Sensitivity test for average treatment effect on the treated

Sensitivity analysis is a strong identifying assumption and must be justified. According to (Grilli and Rampichini, 2011) sensitivity analysis is the final diagnostic that must be performed to check the sensitivity of the estimated treatment effect to small changes in the specification of the propensity score. As table 4 below shows the concept of the sensitivity analysis that the significance level is unaffected even if the gamma values are relaxed in any desirable level even up to 100% percent. This shows that average treatment effect on treated is not sensitive to external change. Hence there are no external variables which affect the result above calculated for ATT result [5].

Conclusion

This study tried to assess the contribution of Agricultural production technology adoption on Agricultural production by using propensity score matching method which helps in separating the true impact of adoption of Agricultural production technology. The study employed cross sectional household level data collected in 2016/2017 cropping season from 191 sample farming households. A propensity score matching approach was used to compare adopter households with non-adopters in terms of their Agricultural production levels as measured in quintal per hectare. The results show that Agricultural production technology had a robust and positive impact on farmers' Agricultural production levels. The implication of the findings is straight forward; even if the adoption of Agricultural production technology is quite low in Chiro Woreda, those households who could use the technology could improve their production. It is better to encourage Agricultural technology adoption because the results of this study signified that application of Agricultural production technology increase the production of adopters. Based on the key findings of this study the study recommended that adopting Agricultural production technology as a package (row and spacing, improved seed, fertilizer rates and or compost, early hand weeding and hoeing, tilling repeatedly) is vital as a policy in enhancing Agricultural yield on the marginal farm lands. Complementary agricultural technology adoption best yield results when they are taken up as a complete package together, rather than in the individual elements to give high Agricultural yield.

Reference

1. Caliendo, Marco, and Kopeinig Sabine. "Some Practical Guidance for the Implementation of Propensity Score Matching." J Econ Surv 22, (2008): 31-72.
2. Dontsop Nguezet, Martin Paul, Diagne Aliou, and Olusegun Okoruwa Victor, et al. "Impact of Improved Rice Technology (NERICA varieties) on Income and Poverty Among Rice Farming Households in Nigeria: A Local Average Treatment Effect (LATE) Approach." Q J Int Agric 50, (2011).
3. de Graaff, Jan, Kessler Aad, and Willem Nibbering Jan. "Agriculture and Food Security in Selected Countries in Sub-Saharan Africa: Diversity in Trends and Opportunities." Food sec 3, (2011): 195-213.
4. Kijima, Yoko, Otsuka Keijiro, and Sserunkuuma Dick. "Assessing the Impact of NERICA on Income and Poverty in Central and Western Uganda." Agric Econ 38, (2008): 327-337.
5. Rosenbaum, Paul R, and B. Rubin Donald. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika 70, (1983): 41-55.*

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