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The Impact of Wheat Row Planting on Farmer's Livelihoods, in Case of Wayu Tuka Woreda East Wollaga Zone, Oromia - Ethiopia

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Abstract: *The aim of the study was to saw the Impact of wheat row planting to on farmer's livelihoods in case of Wayu Tuka Woerda in East Wollega Zone., Oromia Rgion, Ethiopia. Wheat crop planting is a highly valuable grain for Ethiopian people both in production and in consumption. The objective of the research was to investigate the impact of the adoption of wheat row planting on farmer livelihoods in study area. The study was based on cross sectional research which was included both qualitative and quantitative research approach. The data were collected from total 135 respondents selected from three kebels of Wayu Tuka Woerda by using random sampling method. From the total 135 respondents 82 were wheat row planting adopters while 53 were non wheat row planting adopters. Both primary and secondary data used and analysed using descriptive statistics, logit and propensity score matching model. The software used for data entry and analysis were STATA14.2. The results show that about 61% of the respondents are users of wheat row planting whereas 39% can be classified as non-adopters of wheat row planting. The empirical Results revealed that the overall impact evaluation of the study by Propensity Score Matching shows that the average yield output of the participant groups on wheat row planting farm exceeds livelihoods of the non-adopter group by 19,626.18 ETB. Finally, wheat row planting has significant impact on farmer's livelihoods increment. It is better to encourage farmer households as they actively participant in wheat row planting technology and support them by giving training, supplying agricultural inputs and adopting new technology for them with adequate skills for enhancing their annual livelihoods and development of the country economy.*
Keywords: *adoption wheat row planting; impact; livelihoods; PSM; Wayu Tuka Woreda*

I. Introduction

In 2013 alone, African countries spent over $12 billion to import more than 40 million metric tons of wheat, equate to about a third of the continent's food imports. Compared to broadcasting method, row planting gives better yield. To minimize lodging, low seed rate, row planting, late sowing and application of plant growth regulators were used Row planting of wheat, rather than broadcasting method, on production and productivity. Agriculture leftovers the most important livelihoods source of many farm households in sub-Saharan Africa (SSA), productivity levels are stumpy and growth rates have recently idle. Increased uptake of ond crop varieties, inorganic fertilizer, and irrigation is therefore promoted to farmers to achieve similar livelihoods benefits in SSA as observed during Asia's Green Revolution. Furthermore, approximately 6 million farmers grow wheat and it is the dominant cereal crop in over 30 of the 83 high-potential agricultural. Row planting method has now become the latest farming technology aggressively promoted for adoption by smallholder farmers in Ethiopia. Despite such interventions, adoption of row planting technology in Ethiopia and specifically in the study Woreda is still low. Finally, the most impact evaluations do not collect detailed data on the cost of production. This information gap damage understanding of the conditions under which the success of a new technology can be assessed (Doss 2006).

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In a country of over 80 million people, wheat accounts for about 15% of all calories consumed in Ethiopia. Furthermore, approximately 6 million households grow wheat and it is the dominant cereal crop in over 30 of the 83 high-potential agricultural (MOA, 2011), however, production has been increasing at approximately 11%per year (due to land expansion and increase in livelihoods), with high latent demand resulting in price increases as well according to BoARD.

Nevertheless, the culture of recycling some potential sources broadcasting mated such as animal manure and crop residuals has been poor in Wayu Tuka Woreda. As such, this necessitated evaluation of factors contributing to low adoption of wheat row planting and use intensity of non-adopters of wheat row plating of small holder farmers in Wayu Tuka Woreda of Ethiopia.

1.1 Statement of the Problem

Fistum, M. (2016) Sawing in line/row planting/ of Wheat crop plantingwas implemented with few early adopters in Oromia in order to increase crop productivity and yields for small scale farm farmer. On the other hand, its impact on this district was not known and no effort had been made to assess the program and its performance hence creating an information gap that needed to be filed. In spite of the government 's efforts to address the issue of low productivity, the raw planting still remains difficult to be practiced by the farmers.

For instance, the study conducted by Behailu (2014) examine determinants of the adoption of row planting on Wheat crop planting farmer's and yield onment on the production of Wheat crop planting]: the case of Minjara Wored. Yonas, B. (2014). The Impact of row planting of Wheat crop on rural farmer livelihoods: A case of Tahtay Maychew Woreda, Tigray Begashaw, M. (2018). Determinants of adoption of Wheat crop planting (Eragrostis) row planting technology in Moretna Jiru Woreda, North Shoa Zone of Amhara Regional State Mesafint**,** (2017) Determinants and Intensity of Adoption of Wheat crop planting In Minjar Shenkora Woreda, Mekidelawit Ayal (2018).

Wheat crop planting is the major stable food crop to most of the Ethiopian people living in the highlands which comprise more than 65% of the population. However, the national average livelihoods Wheat crop planting is very low, 1.4 ton per hectare and the development of high incoming cultivars would be very beneficial (CSA, 2013). Wheat is a highly valuable grain for Ethiopian people both in production and in consumption. It is a staple food and a source for more than 15% of calories intake by the total population of the country.

1.2 Research Questions

The following research question was prepared to answering the research gap:

1. What are the main factors that impact on an adoption and implementation of sowing Wheat in line practice?

1.3 Objective of the Study

a. General Objective

This Research is to identify impact of wheat row planting to on farmer's livelihoods, in case of Wayu Tuka Woreda East Wollaga Zone, Oromia -Ethiopia.

b. In Line with the Research Questions the Specific Objectives of the Study is:

To investigate the impact of the adoption of wheat row planting on farmer livelihoods in Wayu Tuka Woreda.

II. Review of Literature

2.1 Definition of Some Terms and Concepts

Crop Planting with space' involves the growing of plants on a plot of land with sufficient space between each of the plants so that they can develop their roots and shoots more fully. As focused by ATA (2012) Crop 'planting with space' starts with growing seedlings in a nursery and planting these in the field with sufficient and equal spacing between each seedling.

However, as focused by Ray (2001), adoption does not essentially follow the suggested stages from awareness to adoption; trial may not be at all times practiced by farmers to adopt new technology. Decision-making process is the process via which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to achievement of new idea, and to confirmation of the decision (Ray, 2001).

2.2 Factors Affecting Technology Adoption

The purpose of wheat row planting program is to increase farm production and productivity through creation of awareness and technology adoption. The factors documented in literature include farming farmer specific characteristics, available farm resources, access to credit, information and market.

The result of analysis shows that: -Those with small land holding are: -

- ❖ Order farmers have lower probability of adopting new technologies
- ❖ Information found to be crucial determinant for technology adoption.
- ❖ Literacy level, closeness to extension service center and accessibility of family labor has shown positive relationship with rate of technology adoption

2.3 Improved Technologies and Wheat incomes

Some of the highest spring wheat row planting yields worldwide are obtained in African countries (Egypt, Ethiopia, Namibia, Zambia, Zimbabwe), but only by very few farmers. Despite the importance of wheat in Ethiopia, in come are remarkably low. While in 2012 - 2013, wheat land productivity reached 1.4 ton per hectare, this is rather low when compared to other cereals such as maize (3.1 ton per hectare), rice (2.8 ton per ha) and wheat (2.1 ton per ha) (CSA 2013). Several factors explain these low livelihoods. First, modern input use in wheat production such as inorganic fertilizer and ond seed is low.

2.4 Empirical Literature

The general trend saw farmers who planted later with relatively smaller yield increases compared to those who planted during the traditional season and earlier (ATA, 2013a). As to the study made by ATA (2013a) in Oromia farmers who planted three weeks near the beginning experienced slightly higher average yield increases than during the traditional planting period. In this three-week period before the traditional planting period farmers had 66% to 90% average yield increases in comparison to 67% to 72% increases through the traditional planting time. Farmers who planted 4-5 weeks early experienced lowest average yield increases, 20% to 51%, which were even lower than those farmers who planted in late August and September.

2.5 Conceptual Framework

The determinant of degree and direction and degree of astonish of adoption are not uniform; the impact varies depending on type of technology and the conditions of areas where the technology is to be introduced (Legesse, 1998).

In this study efforts will be made to figure out the impact of sowing in line of wheat according to farmers' personal characteristics, accessibilities to different services such as credit, extension, and psychological factors. Furthermore literature, practical experiences and field observations have established that technology adoption by farmers' can be enhanced in a sustainable manner by understanding those factors influencing the pattern, extent and direction of adoption and plans through farmers empowering, increasing farmers access to infrastructure, information, credit field support, etc and acquainting them how to make use of the technology. Farmers' contribution in technology expansion, and dissemination strategies as well as result evaluation should be considered, because farmers have long years of farming experience and social contact with ecological conditions.

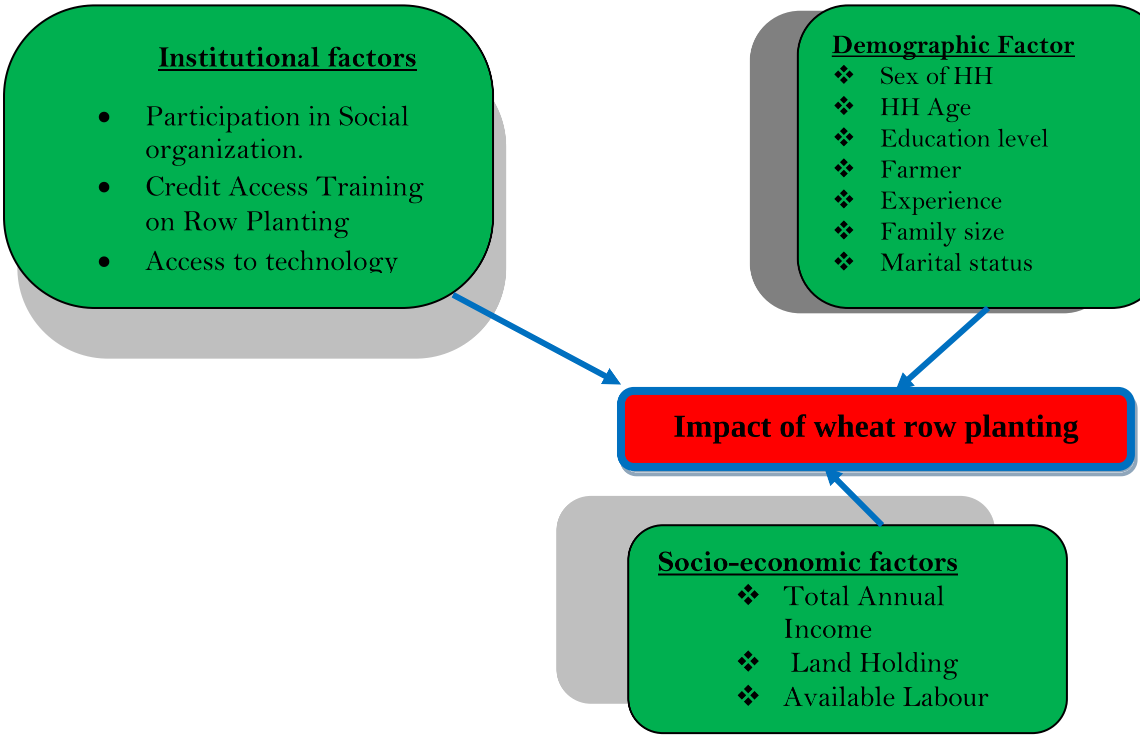

Figure 1. *Conceptual Frame Work on Adoption of Row Planting*
Source: Researcher Own Design (2022)

III. Research Methods

Both quantitative and qualitative data from primary and secondary data sources were collected for this study. The primary data was collected using structured and semi-structured questionnaire, interview and focus group discussions. In addition, Secondary data was collected to supplement the primary data.

Structured questionnaire was administered to 135 sampled households. Enumerators who have experience in socio-economic survey were employed after training on basic interview techniques and survey questionnaire administration. Sampled households are asked to answer a series of questions included in the survey questionnaire. The survey questionnaires are prepared to bring out information on a variety of topics including resource endowment of households, access to markets, agricultural and extension services, Perception about the soil fertility and Access to information of the household respondents.

In addition to official survey, data were collected via focus group discussions. Moreover, interviews guided by semi-structured questionnaires were held with development agents, key informants, experts and officials who work in close collaboration with the households in the study area. This information is valuable in providing insights into perceptions of different actors and also it will supplement some information that was not captured by the questionnaire and to cross-check the reliability of the reaction from the household survey.

3.1 Sampling Procedure

They are 17 Woreda that found in east Wollega zone in Wayu Tuka is one among this woreda. To select sample respondents from that woreda has three stage stratified sampling technique is employe. In the first stage, Wayu Tuka Woreda was purposely in this selected. The fact that this woreda was appropriate because; wheat row planting of wheat is practice widely and wheat coverage from total cultivate land in the woreda is better than other. In the second stage, using purpose full sampling technique three kebeles. Those are: - Magna Kura, Gara Abalo and Boneya Molo kebeles was selected from 12 kebele based on their practice of row planting better than others and 135 farmers was select as sample size. Hence these kebele have both households practicing the wheat row planting and those do not practice row planting.

At last, the household heads list will identify followed by a systematic random sampling technique to select sample households from each kebele, those households who adopt row planting technology and those farmers who practice the traditional farming system. Then the sample respondents from each stratum was been select randomly using simple random sampling technique (Wayu Tuka Administration office, 2022).

3.2 Sample Size Determination

As to Dawson, (2009) the correct sample size in a study is based on the nature of the population and the function of the study. This research was conduct with five percent precision, 95 percent confidence interval and 0.5 population variance. Then the following formula was used for the calculation of the sample size since it is relevant to this study and sampling method (Watson Jeff, 2001) provides a simplify formula to calculate sample sizes.

$$n = \frac{\dfrac{P(1-P)}{\dfrac{A^2}{Z^2}+\dfrac{P(1-P)}{N}}}{R}$$

Where; n=sample size; N=Number of population (1750);

P=Estimate of variance in a population as a decimal of 0.1 for 90-10;

A=precision level, expressed as decimal of 0.05;

Z=Confidence level of 1.96 for 95 percent;

R=Response rate, as decimal of 0.95.

$$n=\frac{\left(\dfrac{0.1(1-0.1)}{\frac{(0.05)^2}{(1.96)^2}+\frac{0.1(1-0.1)}{1750}}\right)}{0.95}=\frac{\left(\dfrac{0.09}{\frac{0.0025}{3.8416}+\frac{0.09}{1750}}\right)}{0.95}$$

$$=\frac{\left(\dfrac{0.09}{0.0006507705+0.000051428}\right)}{0.95}=\frac{\left(\dfrac{0.09}{0.0007021985}\right)}{0.95}=\frac{(128.1688)}{0.95}=134.91=\underline{135}$$

Table 1. Number of Sample Respondents in Each Kebele

No.	Kebeles	Household heads			Sample taken		
		Adopter	Non-Adopters	Total	Adopter	Non-Adopters	Total
1	Magna Kura	370	300	670	28	24	52
2	Gara Abalo	520	310	830	40	24	64
3	Boneya Molo	130	120	250	14	5	19
	Total	1020	330	1750	82	53	135

Source: Wayu Tuka Agriculture Office (2022)

3.3 Method of Data Analysis

The main objective of the study is to analyse of impact of wheat row planting on farmer livelihoods. To achieve this objective the type of data analysis is econometric models were used for analyzing the data collected from households and other sources in relation to the study.

3.4 Econometrics Model Specification

Model Specification applies linear regression model the analysis of this study on the existing literature review that identification of the impact of wheat row planting on farmer livelihoods. The study was affected by the independent variables such as demographic factors, social factors, Economic factors, sources of livelihoods factors, household education. This all factors of independent variables affect dependent variables like household livelihoods/livelihoods. Impact of wheat row planting, propensity score matching (PSM) has gain attention as a potential method to estimate causal treatment effects. Even it used as method of analysis to evaluate and cancel the inefficient policy technology.

According to Rubin, (1974) the standard framework in evaluation analysis to formalize this problem is the potential outcome approach. The most important pillar of this model is individual's treatment and potential outcomes. The treated households were from the wheat row planting technology adopter and non- adopter for comparison. In order to overcome the problem Propensity, score matching method was been applied for impact evaluation in the absence of baseline survey data. Imbens (2000) and Lechner (2001) when leaving the binary treatment case, the choice of multinomial logit is quite easier to analyze dichotomous variables and approaches relatively preferable mathematical performance to estimate. In the cause of binary treatment, the adopter indication Di equals 1 and 0 otherwise.

The potentia outcomes were then defined as Yi (Di) for each individual i, where i =1…, N and N denoted the total population. The treatment effect for an individual ith term was written as follows:

$$T = Y(1) - Y(0)$$

A logit model would be used to estimate propensity scores using a composite of pre-intervention characteristics of the sample households (Rosenbaum and Rubin,1983) and matching was then performed using propensity scores of each observation. In estimating the logit model, the dependent variable was wheat row planting technology adopter, which took the value of 1 if a household non-adopter in wheat row planting 0. The expression of the logit model was:

It begins from the linear probability model of:

$$P(y=1/xi) = \text{Zi} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + --- + \beta_k x_k ----------(1)$$

$$\text{Pi} = \frac{1}{1+e^{-zi}} \quad \text{is simplified to: Pi} = \frac{e^{zi}}{1+e^{zi}} \text{ ---}\mathbf{(2)}$$

Where, Pi is the probability that the i^{th} households was adopters of wheat row planting, z_i -is a linear function of 'n' explanatory variables (x) and was been expressed as:

$$Zi = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + --- + \beta_k x_k + Ui ----------------(3)$$

Where, βo -intercept, βi - regression coefficients to estimate, U_i– is an error term.

$1 - Pi = \frac{1}{1+e^{-zi}}$ is simplified to:

$1 - Pi = \frac{1}{1+e^{zi}}$-- (4)

Where 1 – Pi is the probability that a household belongs to the non-adopters.

$$\frac{Pi}{1-Pi} = \left(\frac{1+e^{zi}}{1+e^{-zi}}\right) = e^{zi} \quad \text{or}$$

$$\text{Or } \left(\frac{Pi}{1-Pi}\right) = \left(\frac{e^{zi}}{1+e^{-zi}}\right) = e^{\left(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + --- + \beta_k x_k\right)} ------(5).$$

This is known as Odds ratio. By taking the natural logarithm of odds ratio, the logit model is:

$$Li = \ln\left[\frac{Pi}{1 - Pi}\right] = \ln e^{\left(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + --- + \beta_k x_k\right)}$$

$$= \beta_0 + \beta_1 x_1 + \beta_2 x_2 + --- + \beta_k x_k \ldots (6)$$

Where x_1, x_2, --------, x_k are demographic, social and Economic factors that cause impact of wheat row planting which was been included in the above econometric model.

3.5 Impact of Wheat Row Planting on Farmer Livelihoods

a. Propensity scores and PSM

Prior to analysing the impact of wheat row planting technology by employ PSM matching algorithms, logit regression model is used as a necessity to identify the technology adapter annual livelihoods in order to understand the importance of wheat row planting technology. As indicted in the former sections the dependent variable in this model is a twofold variable indicating whether the household head is wheat row planting technology adapter or non-adapter. The model is estimated with STATA software using the propensity score-matching algorithm developed by Leuven and Sansei (2003). Propensity score matching (PSM) build a statistical evaluation group that is based on a model of the probability of adapter in the row, using observed characteristics. Technology adapter are matched on the basis of this probability, or propensity score, to non-adapter of the technology. The average treatment impact wheat row planting of the technology is then deliberate as the mean distinction in outcomes across these two groups. The validity of PSM depends on two circumstances: (a) conditional independence (namely, that unseen factors do not affect adapter) and (b) sizable common support or overlap in propensity scores across the adapter and non-adapter samples (Shahidur R. Khandker,Gayatri B. Koolwal & Hussain A. Samad, 2010).

In the estimation process data from the two groups, namely, impact wheat row planting technology adapter farmers and non -adapters were joint and the dependent variable takes value of 1 if the household was an adapter and 0 non-adopter. The variables included in the model are hypothesized to influence household head's adapter in the technology and the non-adapter variable household head's would be annual livelihoods.

In this section, empirical model to be estimated for the analysis of impact of wheat row planting of is adapter. Wheat row planting is the dependent variable here. McDonald et al (2018) found impact wheat row could have positive impacts on maintaining and raising the livelihoods level of the farmers' community. Galipeau et al. (2013) compared the distinction between an adapter community and a non-adapter community in term of livelihoods and number of livestock, showing that adapter communities have a higher livelihoods level.

To estimate the impact of wheat row planting of adapter population, the Propensity Score Matching (PSM) econometric model was employed**.** The researcher decided to keep my dependent variable as a continuous variable (i.e. livelihoods of farmer population that was given in Birr). This model to be approximate is specified as:

Evaluating the impact of interventions requires the establishment of the necessary counterfactual that signifies what would have happened had the project not taken place or what otherwise would have been true (Baker, 2000). The establishment of this counterfactual often creates problems where before intervention situation remains missing. Impact through this outcome variable was obtained by matching an ideal comparative group (non-adapter farmers) to the treatment group (adapter farmers) based on propensity scores (P-scores) of X. X was the set of observable characteristics that impact of wheat row adapter.

Equation 1 below presented the basic evaluation problem comparing outcomes Y across adapter and non-adapter individuals i: $\mathbf{Y_i} = \boldsymbol{\alpha}\mathbf{X_i} + \boldsymbol{\beta}\mathbf{T_i} + \boldsymbol{\varepsilon}_\mathbf{i}$……………………………………..(1)

Here, T is a dummy equal to 1 for those who adapter of wheat row technology and 0 for those who do not wheat row planting in the technology. X was set of other observed characteristics that impact wheat row planting and '**ε**' is an error term reflecting unobserved characteristics that also affect Y. To develop the PSM model, let $Y_i$be the outcome variable of household i, such that Y_{1i} and Y_{0i} denote household outcomes with and without adapter, respectively. A dummy variable T_i denotes adapter by household i, where $T_i = 1$ if the household had adapter and, $T_0 = 0$, otherwise. The result observed for household i, Y_i was defined by control regression (Quandt, 1972).

$\mathbf{Y_i} = T_iY_{1i} + \mathbf{(1-T_i)}Y_{0i}$…………………….....………(2)

The impact of wheat row planting of farmer i's is given by;

$\mathbf{\Delta_iY_i = Y_{1i} - Y_{0i}}$………………………………………….… (3)

Where, $\mathbf{\Delta_iY_i}$ denotes the change in the outcome variable of farmer i, resulting from adapter of wheat planting. A farmer cannot be both ways, therefore, at any time, either $\mathbf{Y_{1i}}$ (adapter farmer) or $\mathbf{Y_{0i}}$ (non-adapter famer) is observed for that farmer. The most commonly used evaluation parameters are averages (Heckman et al., 1997), i.e., using the average adapter impact, (AI) and the average non-adopter Impact (NAI). For this study, AI was used to estimate the impact of wheat row planting on farmer livelihoods of population and it was represented as follows:

$iwrp = \{E(\Delta_i|I_i = 1)\} = E\{Y_{1i} - Y_{0i}|I_i=1\} = E\{Y_{1i}|I_i=1\} - E\{Y_{0i}|I_i=1\}$….. (4)

From equation (4), $E\{Y_{0i}|I_i=1\}$ was the missed data representing the outcomes of non-adapter group. The outcomes of non-adapter farmers could rewrite as:

$E\{\Delta_i|I_i=1\} = E\{Y_{1i}|I_i=1\} - E\{Y_{0i}|I_i=1\}$…………………… (5)

However, a bias of the magnitude indicated in equation (6) below results when non-adapter farmers were selected for comparison with adapter farmers, without controlled for the non-adapter assignment (Namara, 2014).

$Bias = E\{\Delta_i|I_i=1\} + \{E[Y_{0i}|I_i=1] - E[Y_{0i}|I_i=0]\}$…………… (6)

Finally, up on establishing common support for the adapter farmers, the NAI of non-adapter' livelihoods can then be estimated using the following equation

$$ATT = [E(\Delta_i|I_i = 1] = \frac{1}{I_i}\sum(Y_{0i})I_i = \frac{1}{I_i}\sum\Delta_i I_i .... (7)$$

3.9. Sensitivity test

The CIA is a basic assumption to identify the true treatment effect in the ATT estimation strategy. While the validity of the CIA cannot be tested using non-experimental data, there are some methods that help to assess the sensitivity of the baseline estimates to violations of the CIA (Crinò, 2011). The post estimation sensitivity analysis examines how strong the influence of γ (unobserved) on the participation process needs to be. In observational studies, treatments are not aimlessly assigned to experimental units, so that randomization tests and their associated interval approximation are not generally applicable. In an effort to balance for the lack of randomization, treated and control units are often matched on the basis of experimental covariates; however, the possibility remains of bias due to residual imbalances in unobserved covariates. If there are unobserved variables that affect assignment in to treatment and the outcome variable simultaneously a hidden bias might arise to which matching estimators are not robust (Rosenbuan, 2002).

In participation probability given by:

$$P_i = P(X_i, u_i) = P(D_i = 1 / x_i, u_i) = F(, x_i + \gamma u_i) \ldots\ldots (8)$$

Where $\mathbf{x_i}$ are the observed characteristics for individual **i**, $\mathbf{u_i}$ is the unobserved variables and γ is the effect of $\mathbf{u_i}$ on the participation decision. If the analysis is free of hidden bias γ is zero and the participation probability will be fixed only by $\mathbf{x_i}$. In case of hidden bias both group with the same observed covariates **x** has different chances of receiving treatment. Selectivity test evaluates how program effect is affected by change in γ. The following bounds on the odds ratio of the participation probability of both individuals are applied.

$$\frac{1}{e}\gamma = \frac{pi(1-pi)}{pi(1-pi)} \leq | \, e^{\gamma} \text{ or } \quad \frac{1}{\gamma} = \frac{pi(1-pi)}{pi(1-pi)} \leq \Gamma \ldots\ldots (9)$$

Both individuals have the same probability of participation if Γ or $\mathbf{e^{\gamma} = 1}$. $\mathbf{e^{\gamma}}$ is a measure of degree of departure from a study that is free of hidden bias (Rosenbuan, 2002).

IV. Discussion

4.1 Introduction

In this chapter, data was presented and discussed regarding Impact of wheat row planting on farmer livelihoods. Findings gained from descriptive and econometric analyses are presented and discussed. The econometric analysis was used to identify and analyse impact of wheat row planting on farmer livelihoods using logit model. This model was used to identify factor-affecting livelihoods of farmers via OLS. Then on the second level, impact of wheat row planting participation on livelihoods of farmers was investigated using PSM. The dependent variable is impact of wheat row planting which is dummy variable (1=adopter 0= non-adopters). Before discussing the econometric results, some descriptive statistics were presented. Propensity score matching (PSM) method was employed to estimate the impact of wheat row planting on farmer's livelihoods.

4.2 The Major Challenge Impact of Wheat Row Planting in the Study Area

Different challenges were faced to adapters and non- adapters during impact of wheat row planting. Lack of train, lack extension contact. As the researcher was undertook FGD with the sampled household heads they were raised more ideas regarding to challenges problems faced to them. Especially those adapters households were talk different factors that challenged them to involve in the impact wheat row planting. Those factors are distance from market, age, family size mean that over populated and joblessness while non adapters were talked problems like shortage of land distance from market due to it shared for adapters household and other social resources which is common for all societies impact of wheat row on framer livelihoods. Adapters applied in Wayu Tuka Woreda one of the impacts of wheat row on framer livelihoods under taken by the Government support. The result of this study was exposed that adapters more beneficial than their non-adopters due to enhance their livelihoods and other facilities in the study area.

4.3 Impact Evaluation for Wheat Row Planting

The impact evaluation is a vital problem of missing data, because one cannot observe the output of program involvements had they not been beneficiaries. Without information on the counterfactual, the next best options are to compare output of treated individuals or households with those of a comparison group that has not been treated. In the doing so, one attempts to pick a comparison group that is a very similar to the treated group, such that those whose received treatment would have output similar to those in the comparison team in absence of treatment. Success of impact evaluations hinge on finding a better comparison team (Shahidur, R. Khandker, Gayatri B. Koolwal & Hussain A. Samad, 2010).

4.4 Propensity Scores

Prior to analysing the technology by employ PSM matching algorithms, logit regression model was used as a necessity to identify the adapters ‘total annual livelihoods in order to understand the importance of impact of wheat row planting. As indicted in the former sections the dependent variable in this model is a twofold variable indicating whether the household head was wheat row planting adapters or non-adopters. The model was estimated with STATA 14.2 computing software using the propensity score-matching algorithm developed by Leuven and Sianesi (2003). Propensity score matching (PSM) builds a statistical comparison group that is based on a model of the probability of raw planting adapters in the impact of wheat row plating, using observed characteristics. Adapters are then matched on the basis of this probability, or propensity score, to non-adapters of the wheat row planting. The average the impact of wheat row plating is then calculated as the mean difference in outcomes across these two groups.

In the estimation process data from the two groups, namely, wheat row planting households and non-adapters of wheat row plating households were joint and the dependent variable takes value of 1 if the household was adopters of wheat row planting and 0 otherwise. The variables included in the model were hypothesized to influence household head’s adapters and the non-adopter’s variable household head’s annual livelihoods.

4.5 Evaluation of Impact of Wheat on Farmers Livelihoods of Propensity Score Matching

Under this, Propensity score use logit model to estimate the probability of each group i.e., adopters and non-adopters as a function of observable covariates. The result of propensity score matching of adopter and non-adopter. Additionally, the excellence of matching algorithms also recognized in orientation to the propensity scores pseudo R_2 and significance level of each covariate. Out of used for analysis, the result of logit model shows that nine variables were significantly influence the adopter of wheat row planting. Along with the variables access to credit of household, availability of lobar force, age of household in years and access to input supply are affect the likelihood of adopter of wheat row planting negatively.

The Pseudo R2 which make clear to how well the regresses explain the adopter probability is 0.4839 for logit model is larger. A large pseudo-R2 value shows that impacts of wheat row planting households do have some divergent individuality overall and automatically finding a good match between adopters and non-adopters households becomes less challenging.

Depending on the propensity score-matching distribution of both adopter of wheat row planting and non-adopter of wheat row planting, the common support region was identified. As shown on table {4.1} below the estimated propensity scores vary between 0.0614232 to 0.9994814 for the adopter and 0.0221737 to 0.9794189 for non-adopter wheat row planting.

The common support region is area, which lies between 0.0614232 up to 0.9994814, is larger than that of wheat row plantings are common support region [0.0614232 to .9994814]. Therefore, household whose estimated propensity score is less than 0.0221737 and larger than 0.9794189 were surplus from common support region. So observations which lie outside this region are discarded from analysis. It is support by (Marco and Sabine Kopeinnig, May, 2008). Thus, 13 households from wheat row planting were out of the common support region while 69 household head were involved in common support region.

Table 2. Distribution of Estimated Propensity Score Matching

Variable	Obs	Mean	Std. Dev.	Min	Max
Total observation	135	.605329	.3498569	.0221737	.9994814
Adopters	82	.8059215	.2458929	.0614232	.9994814
Non – adopters	53	.2949783	.244153	.0221737	.9794189

(Source: Own computation survey data, 2022)

4.6 Matching Algorithms

As to Khandker et' al (2010), comparing varies matching methods results is one approach to check robustness of average treatment effect. The four matching algorithms (i.e., The Nearest Neighbor matching, The Radius matching, The Calliper matching, and Kernel matching) were checked to choose the best matching methods.

The low pseudo R2 value and the large matched sample size are more preferable. In order to accept the findings of PSM, it is suggested that the standardized mean difference needs to be at most 20% and the pseudo R^2needs to be low after the matching process (Rosenbaum, 2005; Caliendo and Kopenig, 2008). In line with those authors, the researcher would be obtained the least amount of pseudo R^2 was 12.6% and 122 number of matched observations.

In addition to above idea other authors stated, a matching estimator which balances all explanatory variables (i.e., results in significant mean differences between the two groups), a model which bears a low pseudo R^2 value and results in large matched sample size is a preferable matching algorism (Dehejia and Wahba, 2002).

Thus, depending on the kernel matching criteria, kernel (0.5) was selected in which the mean difference of the two groups explanatory variables were significant, Pseudo R^2 is the lowest compared to other matching categories and finally balance 122 sample size.

Table 3. Performance of Propensity Score Matching Estimators

Matching estimator **Sample size**	**Balancing test**	**Pseudo R2**	**Matched**
Nearest Neighbor matching			
NN(1)	173.2*	0.391	122
NN(2)	119.0*	0.213	122
NN(3)	108.7*	0.187	122
NN(4)	104.7*	0.176	122
NN(5)	103.4*	0.173	122
Calliper matching			

0.01	163.0*	0.367	81
0.1	173.2*	0.391	122
0.25	173.2*	0.391	122
0.5	173.2*	0.391	122
Radius matching			
0.01	192.0*	0.400	122
0.1	184.5*	0.383	117
0.25	192.0*	0.400	122
0.5	192.0*	0.400	122
Kernel matching			
0.01	122.7*	0.238	81
0.1	122.5*	0.238	122
0.25	95.2*	0.149	122
0.5	**85.5***	**0.126**	**122**

Source: Own computation survey data (2022)

4.7 Testing the Balance of Propensity Score and Covariates

A common support or have common characteristics condition assumes that units (sampled households') with the similar covariate values have a positive probability of being both treated and untreated. As shown in Appendix 8&9, the PS distributions appear with sufficient common support region that allows for matching. PSM require the fulfilment of the balancing property, i.e., the covariate means between adopters and non-adopters should be similar after matching. The aim of this is belonging to verify that treatment is independent of unit characteristics after conditioning on the observed covariates (Dagne and Fischer, 2015).

Table 4. Propensity Score Matching and Covariate Balancing

Variable	Samples	Mean		Reduction Bias %	t-test	
		Treated N=82	Control N=53		T	p>│t│
Sex	Before Matching [Unmatched]	.7439	.89024	-33.5	-2.45	0.015
	After Matching [Matched]	.76812	.92186	-35.2	-2.53	0.012
Credacc	Before Matching [Unmatched]	.41463	.76829	-86.7	-4.91	0.000
	After Matching [Matched]	.47826	.71103	-57.1	-2.85	0.005
Acctrain	Before Matching [Unmatched]	.69512	.80488	-23.9	-1.63	0.106
	After Matching [Matched]	.71014	.79789	-19.1	-1.19	0.234
Acipsu	Before Matching [Unmatched]	.5122	.20732	65.6	4.26	0.000
	After Matching [Matched]	.56522	.3368	49.2	2.75	0.007
Acctt	Before Matching [Unmatched]	.59756	.60976	-3.2	-0.16	0.874
	After Matching [Matched]	.52174	.5687	-12.2	-0.55	0.583
Avlf	Before Matching [Unmatched]	8.7927	10.598	-66.5	-3.32	0.001
	After Matching [Matched]	8.2899	9.6343	-49.6	-2.21	0.028
Agehh	Before Matching [Unmatched]	45.902	53.72	-72.7	-4.19	0.000
	After Matching [Matched]	45.101	50.567	-50.8	-2.55	0.012
Dismark	Before Matching [Unmatched]	16.39	21.098	-59.9	-4.13	0.000
	After Matching [Matched]	16.275	20.402	-52.5	-3.30	0.001
Nltlu	Before Matching [Unmatched]	8.8902	13.5	-119.1	-6.11	0.000
	After Matching [Matched]	8.8986	12.534	-93.9	-4.38	0.000
Lands	Before Matching [Unmatched]	10.116	6.928	54.5	3.73	0.000
	After Matching [Matched]	10.638	7.3449	56.3	3.37	0.001

Farmexp	Before Matching [Unmatched]	7.9756	8.5122	-16.7	-1.17	0.245
	After Matching [Matched]	8.0145	8.0015	0.4	0.02	0.980
Educ	Before Matching [Unmatched]	.71951	.67073	11.5	0.68	0.500
	After Matching [Matched]	.66667	.63054	8.5	0.44	0.659
Excoag	Before Matching [Unmatched]	.54878	.80488	-53.1	-3.62	0.000
	After Matching [Matched]	.56522	.75794	-39.9	-2.43	0.017

T= Treated group
The whole balance indicators of covariates C=Control group

Sample	No. of Observation			Ps R2	LR chi2	p>chi 2	Mean Bias	Med Bias	B	R	%Var
	135	T	C								
Unmatched	53	53	0	0.126	24.03	0.045	22.9	14.9	85.5*	3.57*	29
Matched	82	13	69	0.224	42.81	0.000	37.5	44.6	122.5*	0.94	57

Source: Own computation from survey data, 2022

As shown in the table 4.13 above, matching reduce total bias, increase pseudo R^2 from 0.126 before match to 0.224 after match and any difference between the two groups covariates mean in the matched sampled has been increased and after matching seven variables are significant as before matching and were balanced treated and control group{also see appendix 9}.

Table 5. Impact of Wheat Row Planting Decision on Household Livelihoods (ATT-Average Treatment effect on Treated)

Variable	Sample	Treated	Controls	Difference	S.E.	T stat
Toanin	Unmatched	109616.439	94737.717	14878.722	7694.08159	1.93
	ATT	113433.812	93807.6283	19626.1833	10862.0377	1.81

Source: Own computation from survey data, 2019

Average Treatment effect on the Treated (ATT) was estimated depending on Kernel (0.5). The Kernel (0.5) algorithm estimated the average total annual livelihoods of the matched treated household farmers to be 1, 13,433.812ETB and of the matched control of household head farmers to be 93,807.6283ETB. Hence, the ATT for that reason wheat row planting adopter participant was received 19,626.1833ETB total annual livelihoods. The mean difference between the two groups is significant at 1% significance level with t-value 1.81. In summary, the empirical findings suggest that involvement of wheat row planting participation is enhanced households' annual livelihoods for treated households in a significant way.

4.8 Sensitivity Analysis

After estimating the treatment effect, sensitivity analysis, Rosenbaum bound estimation was conducted between the gammas values of 1, 1.25, and 1.5 and ongoing up to 3 to test whether the treatment effect on the treated is sensitive to the hidden bias (unobservable). In this study, sensitivity analysis was carried out on the estimated average treatment effect using alternative matching estimators for household total annual livelihoods. The results show that the effect of wheat row planting participation does not change, even though the participant and non-participant households were allowed to differ in their odds of being treated up to 300% ($\mathbf{e^r}$ = 3) in terms of unobserved covariates. Thus, impact estimates (ATT) are insensitive to unobserved selection bias, in the range of $\mathbf{e^r}$ is 1 to 1.25 upper bound significance level and gamma values of $\mathbf{e^r}$ **is** 1 and 3, by adding 0.25 on 1 and continuing up to 3 at lower bound significance level, the result is pure effects of wheat row planting participants. Thus, it can be concluded that impact estimates (ATT) of this study are insensitive to unobserved selection bias and are a pure effect of wheat row intervention, while

e^r = 1.5 to 3 were sensitive in the upper bound of significance level. This shows that as the number of gammas value increase the sensitivity also increasing.

Table 6. Results of Sensitivity Analysis on ATT Results of Outcome Variables

Outcome variables	**Bound**	**e^r=1**	**1.25**	**e^r =1.5**	**e^r =2**	**e^r =2.5**	**e^r =3**
Total Annual Livelihoods	Upper bound	0	0	1.1e-16	5.1e-13	9.1e-11	2.9e-09
	The lower bound	0	0	0	0	0	0

e^r = *(Gamma) =log odds of differential due to unobserved factors where Wilcoxon Importance level for each significant outcome variable is calculated*
Source: Own computation from survey data, 2022

4.9 Summary

This study aimed at identifying the major constraints of adopters and non-adapters wheat row planting farmers livelihoods Wayu Tuka Worada of Ethiopia. To select respondents for the study, three kabeles were selected purposively based on the impact wheat row planting on farmer's livelihoods. Accordingly, primary data was collected from 135 respondents of which 82were adopters and 53 were non-adopters' impact of wheat row planting on farmer's livelihoods.

In order to examine impact of adoption of wheat row planting on farmers livelihoods, the study assessed transaction costs associated with adoption of wheat row planting on farmers livelihoods, factors affecting adoption and use impact of wheat row planting on farmers livelihoods and impact adoption on households' farm livelihoods.

In relation to constraint to impact of wheat row planting on farmers livelihoods, the results showed that out of 82 (61) Present adopters, in relation to constraint the results showed that out of 53(39) none use of wheat row planting also non-adapters, the of high transaction costs, Lack of livestock, Low skill, distance from market and Lack of capital were analysed. The respondents positive influenced wheat row planting adoption while the remaining seven factors influenced adoption decision of wheat row planting positively. Therefore, it is important to consider both stages in evaluating strategies aimed at promoting the adoption and use of wheat row plating. Further, households who had adopted wheat row plating earned better average per hectare farm livelihoods compared to the non-adopters. This implies that the adoption of wheat row plating had positive impact on households' farm livelihoods in the study area therefore farmers should be encouraged to use wheat row plating.

V. Conclusion

5.1 Conclusions

This study has investigated powerful factors which determine the probability of wheat row planting adopters and non-adopters' wheat row planting in Wayu Tuka Woreda, Oromia region, Ethiopia. A cross sectional at with a sample of 135 has been famers in the analysis. Today, there is a general consensus that wheat row planting production is considered as one of the most important inputs for the achievement of increased agricultural production and productivity in the Ethiopia, which is one of Sub-Saharan Africa countries. The result of the study has shown that the constraints use of wheat row planting technology to age households, distance from market and inadequate labour.

An increase in the household age discouraged adoption wheat row planting showing that young household heads are more interested in trying out new agricultural technologies because of their risk-taking nature than mature household heads who are risk unwilling. empirical estimate of the first hurdle of this study revealed that access technology, total annual income, numbers turning and access to technology are positive relate to likelihood of adopting wheat row planting. The positive effect of training might be due to increase in possibility of meeting with other farmers to be informed about the new technology and that of livelihoods might be because of that a household whose livelihoods depends on farm activities does not have enough turning to use adapters of wheat row plating. The study found out that more experienced farmers seem to no- have better information and knowledge accumulated over time. This result is reasonable because farming experience on farmer's behaviour of coping up with problems of non wheat row planting (broadcasting) and reduces likelihood of non-wheat row planting adoption (broadcasting) and lower the use of broadcasting could possibly result in more use of adapters of wheat row plating. This implies that the adoption of wheat row planting positive impact on households' farm livelihoods in the study area therefore farmers should be encouraged to use wheat row planting.

Generally speaking, this study has concluded access to wheat row planting has a profound impact on improving the yield output of household farmers in the study area.

5.2 Recommendation and Policy Implications

This study has the following useful for policy implication and future researchers in the area study area factors affecting the adoption wheat row planting on farmer livelihoods in Wayu Tuka Woreda in particular and Ethiopian in general. The study drew attention to information that can guide policy towards influencing adoption Wheat row planting and non-Adopter wheat row planting which can have a potential benefit, increased productivity and environmental sustainability. Therefore, the policy implication of this study is as it is better to encourage row planting technology adoption because the results of this study signify that application of wheat row planting technology; enlarge considerably both the yield and livelihoods of adopters. On the other hand, the number of adopters and the cropped area under wheat row planting is significantly low to show larger impact on the overall increase of production. Depending on the finding the following recommendations were given by researcher:

- Most of farmers' household head were depending on agricultural production or obtaining their livelihoods from faming activities rather than non-farm livelihoods due to low diversification of non -farm activity during comparison with farm livelihoods in study area. A total annual income is significant and positively related to Wheat row planting. So it is better if local or regional government giving more attention to on wheat row planting for rural households as they increase their annual livelihoods.
- Farmers who have access to agricultural input supply can increase their livelihoods rather than those who have no access to agricultural supply inputs. Therefore, it is better if the Government facilitating agricultural input supply for the farmers and giving awareness as they adapt using these inputs in modern ways to increasing their annual livelihoods.
- An increase in the household age discouraged adoption of wheat row planting. Young household heads are more interested in involving in new agricultural technologies because of their risk taking character is higher than old household heads that are risk averse. So it is better to encouraging young people as they actively participate in wheat row planting by Woreda agricultural sectors to on their annual livelihoods.
- Technology is positively relation with wheat row planting and producing large output. It puts forward that a farmer who is facing challenges coming from technology is more likely to impact of the wheat row planting on farmer livelihoods. It is better to encourage farmers as they actively adapt technology for enhancing their livelihoods and government should facilitate the condition for these farmers side to side.

- Availability of labour force used was found to be positively and significantly influencing farmer's wheat row planting. The low productivity of crop may strongly associate with the lack of availability of labour forces and other factors. Hence, farmers require immediate intervention and support. Therefore, it is better to providing the adaptation of wheat row planting by using modern technology to minimizing traditional labour force in the study area.
- It is better if the farmers trained on wheat row planting techniques. Government should be assigned DA's for farmers' trainee as they increase their knowledge regarding to understand the utilization of all modern agricultural inputs such as seed varieties, commercial of fertilizer and different chemicals through training.
- The detail is that the farmers could not have adequate money to buy all the essential agricultural inputs on cash and be short of habit to use short-term credit from financial institutions in the last cropping seasons. So, it is required for the national and regional strategy makers to assess and find out customs in which farmers to get the tradition of use credit facility for acquire of agricultural inputs in order to produce surplus product for food achievement.

Hence, expansion in the level of technology adoption would consequently result in substantial agricultural productivity and output on a sustainable basis. Generally, wheat row planting has a potential to increase farmers farm livelihoods. As such, the smallholder farmers should be encouraged to adopt wheat row planting technology so as to increase their farm livelihoods and on their livelihood.

Referance

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