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The Impact of Potato Production Participation on Rural Households' Income in Machakel Woreda, East Gojjam Zone, Amhara Region, Ethiopia.

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Abstract

In Ethiopia, potato is a major root crop with the highest production volume and the largest area dedicated to root crops. Enhancing its production and yield has the potential to transform the lives of millions of households, as it provides both food and income. This study, focusing on Machakel woreda in the East Gojjam zone of Amhara regional state, examined the impact of potato production on rural household income. The study selected sample household heads through a multi-stage sampling procedure combined with a basic random sampling technique. Data was collected from 152 sample households, supplemented by various secondary sources. The factors influencing households' decisions to engage in potato production were identified using the logit model. The PSM model was used to analyze the impact of potato farming on household income. The results showed that households involved in potato production had a higher standard of living than those that did not. Significant factors affecting involvement included the household head's educational level, the area of cultivated land, access to extension services, loan availability, agricultural input availability, and proximity to the nearest market. The study found a significant mean difference in household income between participants and non-participants in potato production. Participation increased household income by 68,525 ETB, according to the average treatment effect on treated (ATT). The study concludes that potato cultivation is crucial for improving household incomes in the area, with participating farmers experiencing substantial benefits and improved annual income. The study recommends researchers; legislators and extension service providers focus on increasing participation in potato production.

Keywords: PSM, ATT, ATE. Logit model, Participation,

1. Introduction

The potato is one of the most important food crops in the world. Globally, it is a substantial cash crop and a source of revenue (Addisu et al., 2018). The potato is the most popular non-grain food product and the most economically significant crop in the world. In undeveloped countries, potato is a valuable source of revenue and employment and it has a high protein content compared to other roots and tuber crops (FAO, 2018; Getahun, 2020; Mahlet et al, 2020). For low-income homes where a

lack of land is a problem, it has multiple advantages (Dersseh et al., 2016; Diro 2016). For countries like Ethiopia, food security is a major challenge, and this crop is the most important one to address. In undeveloped nations, potatoes can provide wholesome meals for the hungry and impoverished (Hussian, 2016; Shambel 2017).

Ethiopia is one of the Sub-Saharan African developing countries, where food insecurity is a serious and prevalent issue. The primary factors include the pressure brought on by the fast-growing population, the agriculture industry's low productivity, broad environmental degradation, and recurrent droughts (UN, 2024). However, Ethiopia has enormous potential for potato agriculture, largely because of agro-edaphic and climatic circumstances that are conducive to increased productivity and production of potatoes (Ethiopia, 2024).The World Food Programme (WFP) reported that 15.8 million people in Ethiopia face hunger and need food assistance due to drought, flooding, and conflict1. Recent studies highlight that Ethiopia's potato production potential is considerable, with opportunities for increased productivity through improved farming practices and technology (Ethiopia, 2024).

About 67,361.87 hectares of land were used for potato cultivation, according to the Ethiopian Central Statistical Agency's (CSA) 2014–15 survey report. Potato is a crop with a high potential for producing food in a relatively short period. The potato has a great deal of potential to increase income, food security, and human nutrition. Farmers, private investors, and policymakers in Ethiopia are rapidly realizing and examining the potential of this crop. Even though national average yields are still far below feasible levels, there are numerous opportunities to unleash this crop's potential for improving food security and income generation (Elraiah et al, 2015; Tekelmariam, 2014).

One of the most well-liked crops and a major source of revenue in Amhara national regional state is potato (Yazie et al., 2017). In the farming system, it is crucial to reduce hanger during months of food shortage (July to September). This region has the largest area of land used for potato production (43.25%) with 71,000 hectares and 338,781 tons of potatoes produced annually (Emana et al, 2015; Yazie et al., 2017). In the Northern parts of Ethiopia, where it is produced twice a year with and without irrigation, potato farming is the principal source of revenue for various value chain participants. Effective marketing techniques are essential for a sustainable potato crop (Dawit et al., 2017; Hirpa et al, 2016). The qualitative and quantitative analysis of potato production and marketing establishes the extent and level of production efficiency and market perfection.

Nonetheless, the yield of potatoes is generally low in developing nations (FAO, 2013; FAO 2022). Drought is one of the factors contributing to the low production. The Ethiopian Agricultural Research System released 31 potato varieties (MOA, 2013). Most of these strains were created at the International Potato Center (CIP), which is located outside of Ethiopia. Farmers in the bulk of potato-producing regions do not cultivate many of these kinds, despite the fact that some portions of the country do (Woldegiorgis, 2013).

In the West Arsi Zone of Oromia, Ethiopia, three studies were carried out. One study looked at the variables affecting potato yield by smallholder farmers in Shashemene District (Bukul, 2018). In the other two, socioeconomic factors affecting the output of smallholder farmers in Kofele District and household-level potato production in the same zone were investigated (Yassien, E., 2014). The aforementioned studies, however, did not take into account the factors of farmers' age, market distance, and irrigation accessibility, and they employed the OLS regression method. In contrast, this study employed the PSM model to examine the effects and logit to estimate propensity scores. Additionally, no research has been done on how households' income in Machakel is affected by their involvement in potato production. There is no empirical evidence to support the claim that household income is impacted by involvement in potato cultivation, even in those studies conducted across the nation. Low attention is paid to participating in potato production and increasing its productivity, despite the study area's strong potential for potato production. Therefore, the goal of this research is to determine the variables that impact rural household involvement in potato production and the relationship between that involvement and rural household income in the study area.

2. Research Methods

2.1. Study Area Description

The study is being carried out in the Amhara regional state's Machakel Woreda, East Gojjam Zone, Ethiopia, located 235 km east of Bahirdar and 330 km west of Addis Ababa. Machakel is bordered by West Gojjam in the northwest, Sinan in the East, Gozamin in Southeast, and Debre Elias in the South. The area, spanning 79,556 hectares with altitudes ranging from 1500 to 4023 masl, has a population of 146,580 (73,229 men and 73,351 women) across 25 rural kebeles, centered in Amanuel. The primary income source is mixed farming, involving both crop cultivation and livestock rearing. (MWAUR, 2023).

2.2. Data collection methods, sources, and types

Data from quantitative sources were used. Quantitative data were gathered using primary and secondary sources. In order to collect primary data from a cross-sectional survey of households that engaged in potato production practices and those that did not, key informant interviews, focus groups, and structured interviews were employed.

This survey addressed significant socioeconomic and demographic characteristics of households. Furthermore, secondary data was also collected and used from a variety of sources to enhance the primary data. College-educated enumerators who are currently working for the woreda were enlisted and trained in data collection techniques.

2.3. Sampling Procedure and Estimating Sample Size

This study employed a multi-stage sampling technique that included probability and non-probability sampling. The purposive selection method was used in the first step. Based on their potential and high number of potato production participation, 18 of the 25 Kebeles were chosen (MWAO, 2023 report).

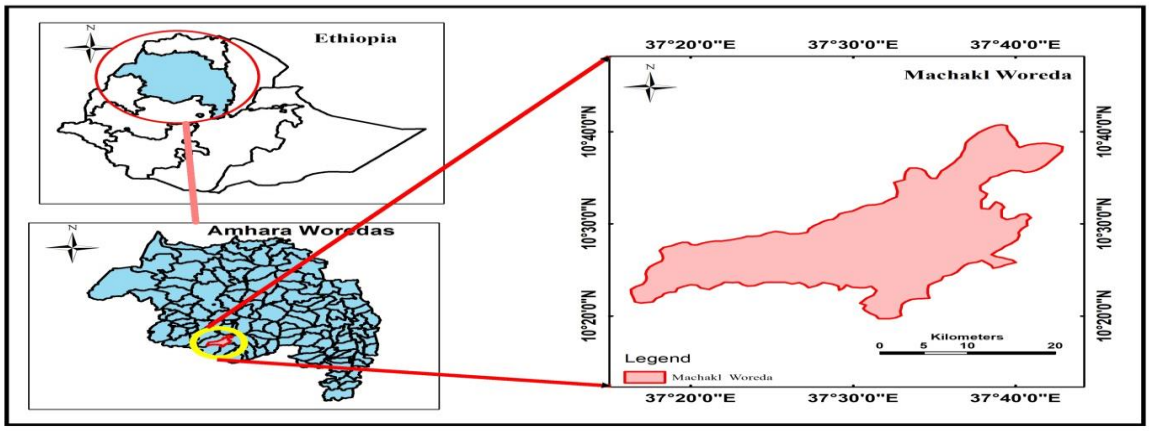

Figure 1. Map of Machakel Woreda source (machakel woreda administrative office).

Out of the 18 possible kebeles (D/kellemo, Amanuel Zuria, Amarie Yewebesh, and Abebdelma), four were chosen at random in the second stage.

Table 1. Household sample distribution by kebele

Sample kebele	Participant households		Non-participant households		Combined	
	Total	Sample	Total	Sample	Total	Sample
D/kellemo	411	20	196	10	607	30
Amanuel Zuria	547	28	287	14	834	42
AmarieYewebesh	82	4	655	33	737	37
Abebdelma	234	12	624	31	858	43

The third stage, the stratified sampling procedure was undertaken means potato producers in one stratum and non -producers in another stratum. Fourth stage random sampling procedure was also involved, from which strata respondents were taken as a sample. The Machakel Woreda Agricultural Office 2022 report (MWAO) estimates that there are 3036 households in the four kebeles and 27049 households in the woredas overall. Therefore, the sample size for this investigation was determined using Kothari's (2004) finite population sampling design formula.

$$n = \frac{Z^2.p.\ q.\ N}{e^2(N-1) + Z^2.p.\ q} \text{ ----------(1)}$$

Where n is the sample size.
N is the study's entire population, and Z is the standard variant value at a 95% confidence level (1.96).
p is the population proportion.
q = 1-P
Allowable error term (0.05) = e
Given N = Total household (hh) in study area (27049), Z = 1.96, p =0. 112, q = 1- p (1- 0.112 = 0.888), e = 0.05

$$n = \frac{(1.96)^2(0.112)(0.888)(27049)}{(0.05)^2(27048) + (1.96)^2(0.112)(0.888)}$$

$$= \frac{10334.6160175104}{68.0020701696} = 152$$

2.4. Method of Data Analysis

Both econometric and descriptive analyses were applied. The Logit model and the Propensity Score Matching (PSM) model were both used for the sake of econometric analysis. Factors influencing rural households' decisions to participate in potato production in the research area were identified using the binary logistic model. However, among many other factors that could influence household income, the impact of potato production participation on a household's income status was determined using propensity score matching (PSM) model.

2.5. Model Specification

The method employed was propensity score matching (PSM). Among alternative non-experimental methods, such as difference-in-difference, regression discontinuity design, randomized selection, and instrumental variable estimate techniques, this one was selected. Propensity score matching (PSM) was employed to generate a comparison group from a sample of non-participants who are most similar to the treatment group using observable factors. Both groups are matched based on propensity scores predicted probabilities of participation given some observed variables. The propensity score matching method compares households that lie in the common support and leaves out others from the analysis (Abadie et al., 2004).

The difference between the mean outcomes of the treated and control groups that is close to the discontinuity indicates the impact of the intervention. When it is feasible to create a comparison group from a sample of non-participants who are most comparable to the treatment group using observable criteria, propensity score matching, or PSM, was finally used. Based on propensity scores and estimated participation probabilities given certain observed factors, the two groups are matched.

2.5.1. The Propensity Score Estimations

The PSM method's phase is estimating the propensity scores. Matching can be done conditioning on P(X) alone instead of X, according to Rosenbaum and Rubin (1983), where P(X) = Prob (D=1|X) is the probability of taking part in potato production conditional on X. The results are independent of participation given P(X) if they are independent of participation given X in the absence of the intervention. A multi-dimensional matching problem is therefore reduced to a one-dimensional problem.

A composite of the pre-intervention characteristics of the sampled households was used to generate propensity scores using a logit model (Rosenbaum and Robin, 1983). The dependent variable in the logit model estimation process is the potato producer, which has a value of 1 if the household engages in potato production and 0 otherwise. The following is a mathematical expression for the logit model:

$$Pi = \frac{e^{zi}}{1 + e^{zi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where Pi, varies from 0 to 1, is the participation probability of the ith household.

Zi is a function of N, the explanatory variable. The equation can be expressed by taking the result's natural logarithm:

Li=Ln (Pi 1−Pi) = Ln (eβ0+ ∑ βjx$jinj$=1) = zi = β0+∑ βjx$jiir$=1 ……(3)

zi=β0+∑ β$ix$$i$ + Ui.....(4)

Where , i = 1, 2, 3, ----, n
β0 = intercept
βi = logit parameter or regression coefficients to be estimated
U stands for disturbance term, and xi for pre-intervention traits.
According to Rosenbaum and Rubin (1983): The conditional likelihood of being assigned to a particular treatment given a vector of observable covariates (xi) is known as the estimated propensity score (e (xi, for the subject, (i=1,...N)),
Z = 1/xi and Pr (Z1…Zn/x1…Xn) = E (xi) where Zi = 0 for control and Zi = 1 for treatment.
For the ith subject, Xi is the vector of observed variables.
The propensity score's values vary from 0 to 1, as it is likelihood.
As above stated, logit model for this study would specify using the explanatory variable as follows;-

$Y = \beta_o + \beta 1Sex + \beta 2age + \beta 3eduhh + \beta 4fmiszhh + \beta 5landsiz + \beta 6accexn + \beta 7accredi + \beta 8Distmkt + \beta 9Irracces + \beta 10acctoagrin + ů$----------(5)

2.6. Choosing the Matching Algorism

Finding households in the control and treatment groups who had the same or a comparable propensity score is the rationale behind matching. A range of matching methods was used to connect comparison units with treatment units after an estimated propensity score was established. In this study, the prosperity scores of producer households (users) were matched with those of non-producers using the nearest neighbor, kernel, caliper, and radius matching estimator techniques.

2.6.1. The Average Treatment Effect on Treated (ATT) Estimation

The difference between the possible outcome in the event of therapy and the potential outcome in the absence of treatment is the influence of a treatment on an individual.

$\Delta I = Y1i - Y0i$ … … … … … … … … … (6)

where Y1i is the result of the ith-treated household, Y0i is the result of the ith-untreated household, and ΔI is the impact of treatment for ith household.
By averaging the effects on every member of the sample population, the mean impact of the intervention was calculated. This metric is called Average Treatment Effect (ATE).

$ATE = E(\Delta I) = E(Y1 - Y0)$ … … … …(7)

The effect of participation on household income is measured by the Average Treatment Impact on the Treated (ATT).

$A = E(Y1 - Y0 \mid D = 1)$ ……(8)

The impact of that intervention on households that have not yet received treatment (participated) is measured by the Average Treatment effect on the Untreated (ATU), which is found in eqn (8).

$D = 0 = A(Y1 - Y0) = ATU$ … … … … (9)

The average result of treated people obtained in the absence of therapy, which is not seen, is E (Y0) | D = 1. The average result of a person who receives no treatment is E (Y0 | D = 0).

3. Results and Discussions

3.1. Econometric Results

3.1.1. Factors affecting potato production participation

The impact of potato production on rural households' income was investigated in this part using the propensity score matching model.

Table 2. Explanatory variables Summary.

Explanatory variable Variables	Notation	Measurement unit and Nature.	Hypothesized direction of significance
Household head's age	Age	Continuous (years)	+/-
Household head's Sex	Sex	Dummy (1 if male, 0 otherwise)	+
Household head's Education Level	Eduhh	Continuous (class year)	+
Household 's Family Size	Fmiszhh	Continuous	+/-
Size of cultivated land.	Landsiz	Continuous (hectare)	+
Extension Service Access	Accexn	Dummy (1 if yes, 0 otherwise)	+
Credit Access	Accredit	Dummy (1 if yes, 0 otherwise)	+
Agriculture inputs Access	Acctoagrin	Dummy (1 if yes, 0 otherwise)	+
Distance from the nearest market	Distmkt	Continuous (km)	-
Availability of irrigation	Irracces	Dummy (1 if yes, 0 otherwise)	+

Source; Own definition, 2023

Analysis estimates of propensity scores for the sample households are presented and discussed. A technique known as propensity score matching is used to generate a comparison group with the treatment group based on factors that affect people's likelihood of participating in the program. This study used a logistic regression model to estimate propensity score matching for control and treatment families. The household's involvement in potato production is a dichotomous dependent variable in the model; it has a value of 1 if the household produces potatoes and 0 otherwise. Four of the ten explanatory variables in the logistic regression model did not exhibit a significant relationship with rural households' involvement in potato production, while three dummy and three continuous variables demonstrated statistical significance in determining rural households' involvement in potato production. Therefore, the interpretation of significant variables and the marginal effect were shown below based on the result of table 3.

Education of household head (Educhh): It is projected that a household's likelihood of engaging in potato production will increase by roughly 6.4 percent for every additional year of education, when all other factors remain unchanged. As anticipated, this variable influences the household's decision to engage in potato production in a way that increases the likelihood that households with greater levels of education will adopt potato production. This correlation could be

explained by the fact that more literate households are more likely to be aware of and use new agricultural equipment and inputs, and they are more willing to diversify their revenue streams in order to protect themselves from the risks of rural poverty and food insecurity. This finding is consistent with research by Mahadi et al. (2012) and Yassin et al. (2014), which discovered that education, had a beneficial impact on farmers' decisions to participate in the potato output market.

Land size: According to the model's marginal effect, at a 1 percent significant level, the average probability of a household head being involved in potato production is predicted to rise by 19.95% as respondents' farm sizes increase by one hectare, holding all other factors constant The interpretation is that, a farmer can produce more and a wider variety of crops as the amount of farmed land grows. This could potentially result in more farmers participating, which would raise household income and consumption. The findings were in line with those of Abebaw et al. (2015), who discovered that farmers with more cultivable land engaged in irrigation practices more frequently than their counterparts.

Access to extension service (accextn): The marginal effect of the model revealed that having a household that obtains extension service improves involvement in potato production by 31.8 percent, holding other factors constant. The outcomes aligned with the findings of Teklemariam (2014), which showed that extension services had a beneficial impact on speedier uptake of technology.

Access to credit: regression findings revealed that being a household that gets credit service increases participation in potato production by 21.19 percent, holding other variables constant and significant at five percent level of significance. The result suggests, raising the quantity of credit increases farmers' ability to afford better inputs, increasing their likelihood of taking part in potato production This result is consistent with those of (Bezabih M., 2016), who noticed that farmers' decisions to participate in grain marketing were positively and significantly influenced by access to credit, and Ahmed et al. (2014), who realized that the amount of credit had a favorable and significantly influenced the amount of durum wheat marketed.

Access to agricultural inputs: the model's marginal effect showed that, when all other factors are held constant, having a household that receives agricultural inputs raises involvement in potato production by 24.44 percent. The results supported the conclusions of (Lavison, 2013), according to which Ethiopia lacks adequate supply of agricultural inputs at the time of sowing, and the study by Temesgen et al; 2019) showed that access to enhanced seed has a favorable and significant impact on the percentage of potato sales value.

Distance from the Nearby Market: When all other factors are held constant, the marginal effect results indicate that a one-kilometer increase in the household head's distance from the closest market reduces the likelihood of the household participating in potato production by 4.95 percent. This result demonstrated potato production is more likely to involve the nearby market household heads than those who live far

away from the market which related to Senbeta's (2020).

Table 3. Marginal effects after logistic

Variable	dy/dx	Std.err	z	p>z	[95% C.I.]	x
Age	.0074191	.00547	1.36	0.175	-.003303 .018142	45.8355
sex*	-.3973059	.2128	-1.87	0.062	-.81438 .019769	.953947
Educhh	.064082	.02098	3.05	0.002	.022968 .105196	3.48684
fmiszhh	.0084677	.02381	0.36	0.722	-.0382 .055135	5.375
landsiz	.1995717	.07228	2.76	0.006	.057907 .341236	1.82128
accextn*	.3180679	.10003	3.18	0.001	.122012 .514124	.888158
accredit*	.2119868	.09193	2.31	0.021	.031816 .392157	.546053
acctoa~n*	.2443978	.0914	2.67	0.007	.065258 .423538	.625
distmkt.	-.0495451	02136	-2.32	0.020	-.091413 -.007677	6.67105
irracces*	.2036337	.11416	1.78	0.074	-.020121 .427389	.256579
y = Pr(potpart) (predict) = .38800421						

{*} dy/dx = for discrete change from 0 to 1 of dummy variables.

Source: Researchers' Survey findings (2023)

3.1.2. Effects of Potato Production on Rural Household Income.

The influence of potato crop participation on household income was calculated using the propensity score matching (PSM) method. Propensity scores have been determined using logit regression, where participation is defined as 1 and 0 otherwise, depending on whether the household has been involved in potato production. All factors that were thought to influence that choice were considered in order to calculate the likelihood that each household would engage in potato production. The variables that were included were age, sex, education, family size, farm size, credit service, extension service, agriculture input, distance from the closest market, and irrigation availability. However, this section is not concerned with determining how these factors affect a household's decision to participate in potato production.

Common Support: Other than conditional independence (CIA), assumptions also include the overlap or common support requirement. P(x) (probabilities) is assumed to be lies between 0 and 1. The evaluation of the treatment effect would exclude respondents who were not located in the common support region. Common support demonstrates that people with the same characteristics have a good chance of treated or not treated in the program. One of the presumptions of the Propensity Score Matching method is the overlap assumption, which asserts that the observations are appropriately matched in the shared support zone. This can be tested using a graph of the propensity scores for the counterparts of the two groups. We must only take into account propensity scores in similar support regions to overlap. We must examine the least and highest propensity ratings for both group in order to pinpoint region of the common

support. According to table 3.2, Predicted Propensity Scores range from.0096554 to.989284 overall. The propensity scores range from.00965544 to.945916 for those who don't participate in potato production, and from.0537642 to.98928399 for the participant. This indicates that eliminating observations with propensity scores below.0537642 and above.98928399 would fall into the region of common support, which is between.0537642 and.98928399. Nine of the 152 households—nine from the non-participants and zero from the potato production participants were removed from the study due to propensity scores that were outside the area of common support. The collected observations (143 families) were adequate to predict how participation in potato cultivation would affect smallholder income for this study. Furthermore, the propensity score data showed that the average propensity score for the selected houses was approximately 0.94, meaning that each household had a 94 percent chance of taking part in potato.

Table 4. Summary of common support result to distribution of the Propensity Score Estimation.

Variable		Observation	Min	mean	Max	Std
Propensity	Potato participant	64	.0537642	.5955887	.98928399	.2303193
Score	Non participant	79	.00965544	.2941173	.945916	.2212183
	Common support	143	.0537642	.4456791	.98928399	.2586616

Source: Researchers' survey findings (2023)

3.1.3. Matching Algorisms Choice

After estimating the propensity score, the impact was calculated. It is crucial to remember that the outcome is not part of the algorithm that determines the propensity score. Simply averaging the changes in outcomes between each treated unit and its neighbor (or neighbors) allowed us to determine the program's impact. PSM commonly uses the Nearest Neighbor Matching, Caliper Matching, and Kernel Matching algorithms. In order to determine the average impact of a certain program intervention, these matching techniques use a variety of strategies to link beneficiaries with the control group.

Three well-known matching algorithms in PSM were tested under different circumstances using different criteria in order to compare the matching algorithms and within the matching algorithm. The mean bias 8.1, the pseudo R square 0.060, the number of balanced covariates 10, and the number of matched observations 143 are the simultaneous test results for nearest-neighbor matching; the mean bias 5, the pseudo R square 0.059, the number of balanced covariates 10, and the number of matched observations 143 are for Caliper Matching; and the mean bias 6.7, the pseudo R square 0.061, the number of balanced covariates 10, and the number of matched observations 143 are for Kernel Matching.

The best matching algorithm, according to this test value, is caliper matching, which has the lowest mean bias, lowest pseudo R square after matching, equal number of

matched observations, and equal number of balanced covariates after matching when compared to other matching algorithms. The best matching algorithm was then determined to be caliper matching with radius 0.0022. In order to quantify the effect of involvement in potato production on household income, the caliper matching method was chosen as the best matching algorithm under PSM.

3.1.4. Matching Quality

One simple approach is to visually examine the distributions of propensity scores for the two groups. Simple graphs for the two groups and a comparison of the minimum and maximum propensity score values in each distribution usually give the researchers a fair first impression of the extent of overlap in the propensity scores of the treatment and control units (Heinrich et al., 2010). A visual analysis of the density distribution for participants and nonparticipants in potato production in figure 2 shows that the two groups' estimated propensity score distributions significantly overlap, suggesting that the shared support condition is met.

3.1.5. Impact of Potato Production Participation on Income of the Household

This section estimates the effect of potato production on household income. Caliper matching (0.0022) may yield the best impact assessment results for this investigation, according to the results previously presented.

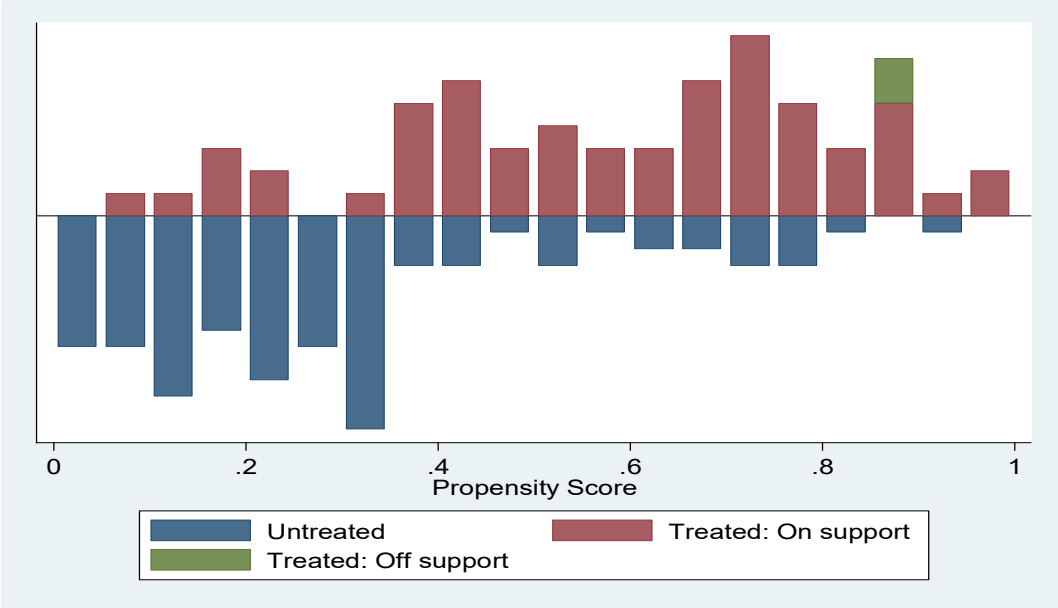

Figure 2. Propensity Score Common Support area and Distribution by participants & Non-participants pair wise comparison in practice of potato production.

Source: Researchers' Survey findings (2023)

As a result, the findings showed that the household income gap between those who participated in potato production and those who did not was 68525 ETB (Table 3.3). At the five percent likelihood level, the matching results were significant. The findings imply that taking part in potato farming raises household incomes in the

research region. Therefore, government representatives and other interested parties ought to have supported the expansion of potato production in the research region and endeavored to resolve the issue impeding it.

Table 3. Impact of Potato production participation on the Household Income.

Variable	Sample	Treated	Control	difference	s.e	t-test
Household income	Unmatched	183329.688	102257.5	81072.1875	12199.7652	6.65
	Matched	179565.625	111040.625	68525	31330.3419	2.19 **

Note:- ** show significance 5% level of probability; ATT= Average Treatment Effect on the Treated.
Source Researchers' Survey Findings (2023), with caliper algorithm radius 0.0022,

We assessed the predicted ATT's sensitivity and specificity after determining the treatment impact. In order to determine whether the treatment impact on the treated is sensitive and specific to the hidden bias (unobservable), sensitivity and specificity analyses were conducted for this study. The results of the analysis showed that the correctly categorized result was 75.00%, while the sensitivity and specificity results were 65.63% and 81.82%, respectively. According to the analysis's findings, an increase in hidden bias (unobservable) has no discernible influence on the average treatment effect on the treated.

4. Conclusions and Recommendations

4.1. Conclusion

The major outcomes of the study confirm that sampled families in Machakel Woreda have an average probability of 94% for participating in potato production. Farmers engaged in potato production earn significantly more than those who do not, indicating a positive impact on household income. The study identified key determinants of potato production participation and estimated its impact on household income using cross-sectional data from four kebeles. Primary data came from 152 randomly chosen households (64 producers and 88 non-producers), and both primary and secondary data were used.

Various data analytical techniques were employed, including a binary logit model to identify influencing factors and Propensity Score Matching to analyze the impact on income of the household. Descriptive statistics showed significant difference b/n producer and non-producer farmers in education status, land size, access to agricultural inputs, extension services, market distance, irrigation, and credit. The income difference between the groups was also statistically significant.

The PSM method revealed that potato production significantly increases household income, with producers earning 68,525 ETB more than non-producers. The study concludes that potato cultivation is crucial for improving household incomes in the area, with participating farmers reporting substantial benefits and improved annual income status.

4.2. Recommendation

As per the conclusion, well-informed household heads are better equipped to

produce potato. Consequently, it is recommended that rural families raise their level of education through both official and informal channels (e.g., arranging farmer field days, sharing experiences with the model farmer, and creating capacity). Potato production is more likely to take place in households with larger farms. So, the government and experts should raise awareness through training, setting up demonstrations, and organizing workshops, all while conducting rigorous follow-up to encourage farmers to engage in potato production. Additionally, farmers who have a large amount of farmland can increase the size of their land and increase their involvement in potato production by expanding their lands in a variety of ways, such as by renting land. Potato production in the research area is positively impacted by loan availability; the woreda government body ought to provide farmers who cultivate potatoes with extra support. The local government and NGOS should, on the other hand, concentrate on establishing and strengthening various microfinance institutions that offer credit for households (potato producer farmers) with balanced interest rates. For instance, when we consider ACSI in the study area, its interest rate is high for the farmers, making it challenging to recover the credit after a year.

To deal with the potato disease problem and shortage of early seed germination, Strong connections between farmers, seed producer cooperatives, and research are required. The study findings advised that research institutes join with seed producer cooperatives for expansion and continually deliver disease resistance cultivars and early-generation planting material. In addition, the local government should work to create market linkages for the product by expanding market centers near to the farm areas. Finally, the government ought to place a high priority on the production of potatoes and the extension service needs to be strengthened because it serves as the primary channel for informing agricultural households about new technology. Increasing the number of extension agents who assist in farmer training and technical assistance should be the government's primary focus.

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