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Impact of Input and Output Market Development Interventions on Input Use and Net Income of Households in Ethiopia

Yemisrach Getachew (Corresponding Author)
School of Agricultural Economics and Agri-business Management, Haramaya University
P.O. Box 320, Dire Dawa, Ethiopia
Tel: +251- 921-94-7851 E-mail: misrpa@gmail.com

Moti Jaleta
International Maize and Wheat Improvement Centre (CIMMYT)
Addis Ababa, Ethiopia
Tel: + 251- 911-77-3219 E-mail: m.jaleta@cgiar.org

Birhanu G/medihin
International Livet ock Research Inistitute-Improving Productivity Market Success,
Addis Ababa, Ethiopia
Tel: + 251- 911-40-6500 E-mail: b.gebremedhin@cgiar.org

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Abstract

This study evaluated the impact of input and output market development interventions of the IPMS project at Alaba and Dale PLW, SNNPR on input use, productivity and total net income of the participant households. The study has used cross-sectional sampled household survey of 200 households which was taken from both Alaba and Dale districts. A propensity score matching method was applied to assess the impact of the project on the treated households. The intervention has resulted in positive and significant effect on level of input use on the treated households. This increased use of inputs enabled participants to earn on average a total net income of about birr 1,483 at Alaba and birr 2,228 at Dale form the commodities of intervention over their counter parts. Based on the results obtained scale out of such market development interventions has a paramount importance for economic development of the country.

Key words: Input and output market development intervention, propensity score matching, Pilot learning woreda

Introduction

In an effort to reduce poverty and secure food, the governments around the world prepare different program and plan thereof at different levels. Accordingly, the ministry of Agriculture and Rural development of Ethiopia had prepared plan called PASDEP (“Plan for Accelerated and Sustained Development to End Poverty”) in last decade with the main aim of agricultural development. This plan clearly articulated a development direction of market oriented agricultural production as a means for achieving the plan. As a result of this policy, the IPMS project was developed to pilot and test a “participatory market-oriented commodity value chain development approach”, in four regional states, i.e. Tigray, Amhara, Oromia and the SNNPR using ten pilot learning woredas.

The project tested the approach via input and output market development interventions for marketable crop

and livestock commodities in pilot learning woredas. To know how far the intervention has brought change over intervened households is the main concern of economic allocation of resources in now days. Moreover, scaling out of best practices and knowledge is one of the four key components targeted by the project to achieve its purpose. In this respect, this particular paper is therefore to evaluate the impact of the input and output market development interventions of the project in Alaba and Dale districts of the SNNP region.

Impact Evaluation (IE) rigorously measures the impact that a project has on beneficiaries. It typically does this by comparing outcomes between beneficiaries and a control group (AIEI, 2010). Impact evaluations are technical exercises that rely on econometric and statistical models. The three main kinds of impact evaluation designs are experimental, quasi-experimental and non-experimental. For social program causal evaluation the most suitable technique is the non-experimental methods, of those propensity score matching method is selected to be the most appropriate for the study at hand. This is because of the problem of self selection in intervention assignment of the project. Intervention assignment was not random; it depends on the willingness of participants, resource endowment of participants and experience on the commodity of intervention. As a result of this fact propensity score matching became the first choice for the evaluation of impact of this particular project. Concomitantly this paper contributes to the literature of impact evaluation of development project interventions on input use, productivity and total net income of treated households using propensity score matching method (Baker, 2000).

1.1 Background

Economic growth in Ethiopia has been highly associated with the performance of the agricultural sector. However, the weak performance of the agricultural markets (both input and output markets) in Ethiopia has been recognized in various studies as a major impediment to growth in the agricultural sector and the overall economy (Dawit, 2005). Therefore, a well operating market is vital to attain better return from agricultural production and productivity improvement.

The then Ethiopian Ministry of Agriculture and Rural Development (MoARD) has developed a plan to enhance market-oriented production for priority crops and livestock commodities. To realize this market oriented production plan, projects of many kinds have been implemented to enhance the performance of the sector. Improving Productivity and Market Success (IPMS) of Ethiopian farmers' project is among those development projects which has been working for the development of agricultural production and productivity via input and output market development interventions.

IPMS is a five-year (2005-2009) project funded by the Canadian International Development Agency (CIDA) and implemented by the International Livestock Research Institute (ILRI) on behalf of the Ethiopian Ministry of Agriculture and Rural Development (MoARD). The goal of this project is to contribute towards improving agricultural productivity and production through market-oriented agricultural development, as a means for achieving improved and sustainable livelihoods for the rural population. To achieve this purpose, four key components are targeted: knowledge management; innovation capacity development of partners; participatory marketable commodity value chain development and development and promotion of recommendations for scaling out. The approach is based on the grounds that technology up-take depends on the effectiveness of production, and that production is driven by market demands which require interventions on input supply and services, and output market information to smallholders (IPMS, 2005a).

Prior to the implementation of the project, potential marketable commodities and their constraints were identified with different stakeholders. Based on the identified opportunities and constraints the project has started to intervene using the participatory value chain components i.e. input supply, innovative credit, extension, production and marketing through capacity development, innovative credit and dissemination of market information (IPMS, 2005b). Though many efforts have been exerted and financial resources have been committed, its impact has not been evaluated so far. Hence, this particular study was about to empirically assess the impact of the project on outcome variables (input use, productivity and total net income of treated households) as indicators of the impact of the project.

1.2 Objectives of the Study

The study had a general objective of assessing the impact of input and output market development interventions of the IPMS project at Alaba and Dale PLWs. The Specific objectives were to:

- Evaluate the impact of market development interventions on crop and livestock intensification/input use and productivity of the commodities of intervention;
- Estimate / determine the impact of the market development interventions on total net income of participant households.

1.3 Description of the Interventions

On top of the low food production and productivity, the poor development of both input and output market of agricultural produce and highly growing population density is the main cause for the poorness of the country/ food insecurity. To this regard, IPMS project has been implementing different and multifaceted interventions for a participatory commodity value chain development through input and output markets development. The input market development interventions that are put in to effect are innovative credit, capacity development and dissemination of market information. Market information delivery is the intervention made for both input and output markets.

Regarding the provision of innovative credit, the project has endowed the cooperatives with innovative credit so that they can supply input on time with quantity and quality as required by the farmers. For instance on Apiculture, the project has provided innovative credit to cooperatives so that they can supply modern beehive and bee accessories. In addition for the private carpenters the project has given loan to prepare and offer transitional beehive. The introduction of different bee forage varieties and their managements were the interventions made on apiculture commodity intervention by the project at Alaba.

Pertaining to capacity development to extension workers as well as farmers the project facilitated intensive trainings, tours and demonstrations on different aspects of technical knowledge on the commodities of intervention together with B.Sc. and M.Sc. education for those who have direct stack for agriculture. The project also tested the provision of market information on price for farmer at market place using billboard and loud speaker.

Methodology

2.1 Description of the Study Area

2.1.1 Dale ditrict

Dale district is found in sidama zone of Southern Nations and Nationalitities Peoples' Regional State (SNNPRS). The district is located 47 kms far from the regional as well as zonal capital city, Hawassa and 322 kms from Addis Ababa, the capital city of Ethiopia. The district has a total area of 28,444 hectare; total population of 222,068 and 37,027 households. Out of the total households 34,962 are male headed households and the remaining 2,065 are female headed households. The district has 36 kebeles out of this 15 PAs (105 HH) are reached by IPMS intervention. The district is also characterized by 1% *dega* and 99% *woinadega* agro-ecologies (DDoA, 2009).

The district is found at an average altitude of 1161-3167masl, receives mean annual rain fall of 1300mm and average temperature of 15-19^{o}c. The soil type of the district constitutes Haplic Luvisols (orthic), Chromic Luvisols (nitic), Chromic Luvisols (orthic), Humic Nitisols (mollic), Eutric Vertisols (chernic) and Eutric Vertisols (ferralic). The district is able to produce different crops such as Coffee, Haricot bean, Fruit, Spices and Vegetables and livestock: cattle, sheep, donkeys, mules, poultry and Bee keeping. The district is known for its coffee production (IPMS, 2005).

2.1.2 Alaba special district

Alaba Special district is one of the eight special district in the SNNP region. The district is found 85 kms away from Hawassa and 335 kms from Addis Abeba. It has a total area of 973.8 square kilometers and a total population of 210,243. Out of the total population 104, 517 are male and the remaining 105, 726 are female. In the district there are about 79 rural kebeles and 2 urban kebeles out of these 18 PAs (107 HH) were targeted by IPMS market development interventions (ADoA, 2009). The district is found at an altitude of 1553-2194 masl, receives 853-1080 mm annual rain falls, and has a temperature of 17-20 ^{o}c. The soil type of the district constitutes Andosol (orthic), Solonchak (orthic), Phaeozem (ortic) and Chromic Luvisols (orthic). The district is also characterized by *woinadega* agro-ecologies and is able to produce different crops such as hot pepper, pulses and Fruit and varieties of livestock: cattle, sheep, donkeys, Goats, mules, poultry and Bee keeping (IPMS, 2005).

2.2 *Sources and Method of Data Collection*

Primary and secondary data were the main sources of information for the study. The primary data were collected from sampled household survey using structured and semi-structured questionnaire. And secondary data were also collected from published and unpublished sources.

2.3 Sampling Techniques and Sample Size

A multi-stage sampling technique was employed to draw sample respondents from each PLW. In the first stage PA's where the intervention has been made was selected purposively. In the second stage, 6 PAs (3 PA's from each PLW) were randomly selected. Accordingly, Dagiya, Debub kege and Soyama from Dale and Galeto, Hulegaba Kukie and Andegna Ansha from Alaba were selected. In the third stage, households in the selected PAs were stratified in to participant and non-participant households as well as in to commodity of participation. In the final stage, a total sample of 200 households comprising 100 participants and 100 non-participants was randomly selected from the two PLWs.

2.4 Method of Data Analysis

Matching, especially in its propensity score flavors, has become an extremely popular evaluation method. Both in the academic and applied literature the amount of research based on matching methods has been steadily growing. Matching is in fact the best available method for selecting a matched (or re-weighted) comparison group which 'looks like' the (treatment) group of interest (Barbara, 2009).

Propensity-score matching is a non-experimental method for estimating the average effect of social programs (Rosenbaum and Rubin, 1983; Heckman et al., 1998). The method compares average outcomes of participants and non-participants, conditioning on the propensity score value. The average comparison measures the average impact of a program (Ichimura and Christopher, 2000). The parameter of interest is the average treatment effect and has focused on strong identification conditions.

Propensity score methods require that a separate propensity score specification be estimated for each treatment, group-comparison, and group combination. Furthermore, a researcher should always examine the sensitivity of the estimated treatment effect to small changes in the propensity score specification; this is a useful diagnostic on the quality of the comparison group (Baker, 2000).

Since the propensity to participate is unknown, the first task in matching is to estimate this propensity. To get this propensity scores logistic probability model was used. Any resulting estimates of program effect rest on the quality of the participation estimate, where the dependent variable is 'participation' and the independent variables are the factors thought to influence participation and outcome.

So the binary logit $Pr\ (Ip) = f(X)$ was fitted to get the propensity to participate.

Where Ip is intervention participation, $f(X)$ is the dependent variable of intervention participation and X is a vector of observable covariates of the households.

X = [L, Fs, DDA, MktD, Ed, A, Ls, S]

Where:

L	represents the total cultivated land holding of household in ha;
Fs	represent Family size;
DDA	represents distance (km) between the DAs office & the sampled HH residence;
MktD	represents nearest market distance from samples household residence;
Ed	represents education level of household head;
A	represents age of household head;
Ls	represents Size of Livestock holding;
S	represents sex of the household head.

After obtaining the predicted probability values conditional on the observable covariates (the propensity scores) from the binary estimation, matching was done using a matching algorithm that is selected based on the data at hand. Then the average effect of household's participation in the project on specified outcome variables (Outcome in this study is intensity of input use, level of productivity attained, household total net income) (Y) was specified as:

$$\tau_i = Y_i(D_i = 1) - Y_i(D_i = 0)$$

Where τ_i is treatment effect (effect due to participation in the intervention), Y_i is the outcome on household i, D_i is whether household i has got the treatment or not (i.e., whether a household participated in the intervention or not).

However, one should notice that $Y_i(D_i = 1)$ and $Y_i(D_i = 0)$ cannot be observed for the same household at the same time. Depending on the position of the household in the treatment (intervention participation), either $Y_i(D_i = 1)$ or $Y_i(D_i = 0)$ is unobserved outcome (called counterfactual outcome). Due to this fact, estimating individual treatment effect τ_i is not possible and one has to shift to estimating the average treatment effects of the population than the individual one. Most commonly used average treatment effect estimation is the 'average treatment effect on the treated (τ_{ATT}), and specified as:

$$\tau_{ATT} = E(\tau | D = 1) = E[Y(1) | D = 1] - E[Y(0) | D = 1]$$

As the counterfactual mean for those being treated, $E[Y(0) | D = 1]$ is not observed, one has to choose a proper substitute for it in order to estimate ATT. One may think to use the mean outcome of the untreated individuals, $E[Y(0) | D = 0]$ as a substitute to the counterfactual mean for those being treated, $E[Y(0) | D = 1]$. However, this is not a good idea especially in non-experimental studies. Because, it is most likely that components which determine the treatment decision also determine the outcome variable of interest.

In our particular case, variables that determine household's decision to participate in the intervention could also affect household's input use intensity, level of productivity, household total net income. Therefore, the outcomes of individuals from treatment and comparison group would differ even in the absence of treatment leading to a self-selection bias.

By rearranging, and subtracting $E[Y(0) | D = 0]$ from both sides, one can get the following specification for ATT.

$$E[Y(1) | D = 1] - E[Y(0) \mid D = 0] = \tau_{ATT} + E[Y(0) | D = 1] - E[Y(0) | D = 0]$$

Both terms in the left hand side are observables and ATT can be identified, if and only iff $E[Y(0) | D = 1] - E[Y(0) | D = 0] = 0$. i.e., when there is no self-selection bias. This condition can be ensured only in social experiments where treatments are assigned to units randomly (i.e., when there is no self-selection bias). In non-experimental studies one has to introduce some identifying assumptions to solve the selection problem. The following are two strong assumptions to solve the selection problem.

1. Conditional Independence Assumption:

Given a set of observable covariates (X) which are not affected by treatment (in our case, intervention participation), potential outcomes (input use intensity, level of productivity, total net income) are independent of treatment assignment (independent of how the intervention participation decision is made by the household). This assumption implies that the selection is solely based on observable characteristics, and variables that influence treatment assignment (intervention participation decision is made by the household) and potential outcomes (input use intensity, productivity level, total net income) are simultaneously observed.

2. Common support:

This assumption rules out perfect predictability of D given X. That is $0 < P(D=1 \mid X) < 1.$ This assumption ensures that persons with the same X values have a positive probability of being both participants and non-participants.

Given the above two assumptions, the PSM estimator of ATT can be written as:

$$\tau_{ATT}^{PSM} = E_{P(X)/D=1}\{E[Y(1)|D=1, P(X)] - E[Y(0)|D=0, P(X)]\}$$

Where P(X) is the propensity score computed on the covariates X. The above equation is explained as; the PSM estimator is the mean difference in outcomes over the common support, appropriately weighted by the propensity score distribution of participants.

In the final stage the robustness of the evaluation results were tested for their sensitivity for the hidden variables that may affect participation decision of households.

Results and Discussions

3.1 *Descriptive Results of Pre-Treatment Characteristics*

The two groups were found to be significantly different with respect to sex, education level of the household head, cultivated land holding and relative distance from market place. In contrast to non-participants, participants are male headed, have higher level of years of schooling, larger size of cultivated land holding and situated at a relatively nearer distance to market place. The difference between the two groups with respect to education level, sex, cultivated land holding and market distance were statistically significant at 1, 5,5 and 10% probability levels, respectively.

The results depict that there is statistical difference between participants and non-participants with respect to education level, cultivated land holding, livestock holding, market distance and family size. A look at the years of education indicated that participants has relatively completed higher level of education than that of non-participants and this difference is significant at 1% level of significance. Compared to non-participants, participants have larger size of cultivated land and more family size which were significant at less than 1% significance level each. In addition, participants were situated nearer to market places than that of non-participants and this difference was significant at 10% probability level.

3.2 *Econometric Model Results*

3.2.1 Propensity Scores

Prior to running the logistic regression model to estimate propensity scores of participation, the explanatory variables were checked for existence of sever multicollinearity problem. A technique of Variance inflation factor (VIF) was employed to detect the problem of multicollinearity among the explanatory variables. Accordingly, the VIF (X_i) result shows that the data had no serious problem of multicollinearity. This is because, for all the explanatory variables, the values of VIF were by far less than 10. Therefore, all the explanatory variables were included in the model. Moreover, hetroscedasticity test was done using Breusch-Pagan/ Cook-Weisberg test for hetroscedasticity and the P-value was 0.8972 which is insignificant implying the absence of the problem of hetroscedasticity.

A logistic regression model was fitted to estimate the propensity scores of respondents' participation which helps to put in to practice the matching algorithm between the treated and control groups. The matching process attempts to make use of the variables that capture the situation before the start of the intervention. The logit result revealed a fairly low pseudo R^2. The pseudo-R^2 indicates how well the regressors $\boldsymbol{X}$ explain the participation probability (Caliendo and Kopeinig, 2005). A low R^2 value means participant households do not have much distinct characteristics over all and as such finding a good match between participant and non-participant households becomes easier (Yibeltal, 2008).

The maximum likelihood estimate of the logistic regression model result shows that participation was influenced by four variables at Alaba and three variables at Dale study sites. At Alaba education level, cultivated land holding, sex, and number of livestock holding in tropical livestock unit affect the chance of participation. Meaning those farmers who have better level of schooling, male headed and relatively larger land holding has high chance of being participant. In addition, households having higher number of livestock are more likely to be a participant in the market development interventions of the IPMS project and this is on the contrary to the finding of Zikhali (2008) in Zimbabwe.

At Dale, participation was significantly influenced by cultivated land holding, family size and livestock holding. Speaking differently, those farmers who have larger size of land, more number of family size and higher number of livestock holding have high chance to be included as participant. Cultivated land holding influenced participation moderately at 5% significant level while, family size and livestock holding influenced the probability of participation at 10% level of significance.

According to Caliendo and Kopeinig (2005) there are two approaches to map a common support region for the propensity score distribution, these are minima & maxima and trimming approaches. Moreover, Leuven and Sianesi (2003) recommend the use of both the "common" and the "trimming" approaches at the same time for the identification (imposition) of a common support. Even though it is recommended to use both approaches together, in evaluation studies using PSM the approach that yields in good match is preferred. Thus, the data set resulted in good matches in the case of minima and maxima approach. Therefore, this approach was employed to identify the common support region for this particular case.

3.2.2 Matching Algorithms of Participant and Non-Participant Households

The choice of matching estimator is decided based on the balancing qualities of the estimators. According to Dehejia and Wahba (2002), the final choice of a matching estimator was guided by different criteria such as equal means test referred to as the balancing test, pseudo-R^2 and matched sample size. Therefore, a matching estimator having balanced (insignificant mean differences in all explanatory variables) mean, bears a low pseudo R^2 value and also the one that results in large matched sample size is preferred.

In line with the above indicators of matching quality, kernel with no band width is resulted in relatively low pseudo R^2 with best balancing test and large matched sample size as compared to other alternative matching estimators. Then it was selected as a best fit matching estimator for Alaba's dataset. Similarly kernel with 0.1 band width was selected as the best matching estimator for Dale's dataset.

The initial observations were 50 participant and 50 non-participant households at each study site. After the identification of the common support condition using minima and maxima approach, participants having a pscore below 0.0136 (0.0215) and above 0.7878 (0.8893) are dropped for Alaba (Dale) sites. Then 39 participant households were matched with 50 non-participants both for Alaba and Dale cases using respective matching estimators. This makes from 100 sample households of each study site, only 89 households were identified to be considered in the estimation process.

The kernel density distribution for all respondents is relatively nearer to normal distribution whereas participants' propensity score distribution was skewed to the left while it was skewed to the right for non-participants. Both figures portray that there was a considerable overlap or common support between the two groups of respondents at both study sites.

3.2.3 Treatment Effect on the Treated (ATT) Estimation

Input use

A closer look at the level of input use in case of haricot bean intervention revealed that there was a statistically significant difference between participants and non-participants of the project in terms of their level of input use except for fertilizer at Alaba and seed rate at Dale. With respect to seed rate used at Alaba, the result shows that participants have used about 7 kg more of seed per hectare than non-participants and this difference was found to be significant at 10% level. With regard to number of days used for all activities of haricot bean both at Alaba and Dale, participants work about 6 and 8 days more than non-participants and the difference was statistically significant at 5 and 10% probability level, respectively. Considering fertilizer at Dale, the mean difference between the two groups of respondents was about 20 Kg per hectare, which means that participants applied 20 kg more of fertilizer per hectare of land than non-participants does. This difference was significant at 10% level of significance.

When one looks in to level of input use in teff at Alaba, fertilizer and herbicide applied was significantly different between the two groups of farmers. In terms of fertilizer use, participants applied 27 kg more per hectare than non-participants and this difference was significant at 5% level. In addition, participants used about 6 ml more of herbicide per hectare to control weeds over the non-participants. The average treatment effect of the intervention on input use for apiculture and poultry. Though there was a significant difference between the two groups before matching, after matching their difference with regard to input use for apiculture and poultry at both study sites was found to be insignificant except for poultry feed at Dale.

Productivity

With respect to eggs laid, there was no significant difference between the two groups of farmers both Alaba and Dale, which is the proxy for poultry productivity. While in case of apiculture, kg of honey per transitional or modern hive, participants have gained about 23 kg more of honey over the non-participants and this difference was found to be significant at 5% level of significance. As compared to the non-participants, participants of teff intervention have harvested about 5 Qt more of teff per hectare of land. In this respect, the difference between the groups of farmers was significant at 1% probability level. Considering haricot bean productivity, participants harvested about 8 and 13 Qt more of haricot bean per hectare of land over non-participants at Alaba and Dale, respectively. This difference was significant at 10% for Alaba and 1% level of significance for Dale study sites.

Net income

When one look at the second outcome indicator of the project i.e. total net income of households, the average treatment effect on the treated was found to be positive and statistically significant at the two study sites. At Alaba, participants on average earned about birr 1,483 more from the commodities of intervention over non-participants and this was statistically significant at 5% level of significance. Similarly at Dale, participants earned on average about birr 2,228 more net income compared to non-participants and this difference was significant at 1% significance level.

Regarding the mean differences in terms of net income from individual commodities of intervention, at Alaba, participants got a net income of about birr 30 from poultry though it became insignificant after bootstrapping the standard error. Participants earned about birr 132 from apiculture over non-participants which was statistically significant at 5% significance level. While at Dale, participants of poultry intervention fetch a net income of about birr 497 over non-participants and this was found to be significant at less than 1% level of significance. Considering teff, participants realized a net income of about birr 967 over non-participants which was significant at 5% level of significance. As reported by participants, better income from teff enabled them to change their house form grass roofed ones to corrugated iron roofed. This had been practically observed during the survey work.

With regard to seedling intervention, participants earned about birr 575 more from coffee birr 798 from fruits seedling over non-participants. The difference between the two groups was insignificant in case of coffee after bootstrapping and significant at 5% level for fruits. Moreover, participants on average have

earned about birr 331 and 354 net income from haricot bean over the non-participants at Alaba and Dale, respectively. This difference was significant at 5% level.

The result indicates that the project intervention has resulted in a positive and statistically significant difference between participants and non-participants of the project in terms of net income of households. In total, the intervention has brought about 68% increases in net income of participants in Alaba and correspondingly 89% in Dale pilot learning site over the non-participants from the commodities of intervention.

3.2.4 The Sensitivity of the Evaluation Results

In this section the issue whether the final evaluation results are sensitive with respect to the choice of the balancing scores is addressed. Matching estimators work under the assumption that a convincing source of exogenous variation of treatment assignment does not exist. Likewise sensitivity analysis was undertaken to detect the identification of conditional independence assumption was satisfactory or affected by the dummy confounder or the estimated ATT is robust to specific failure of the CIA.

Regarding input use in haricot bean both at Alaba and Dale, the average treatment effect on the treated of all inputs used except labor and seed rate used at Alaba was found to be insensitive or robust to the dummy confounder. Whereas in case of teff all significant ATT estimates of input use were robust/ not sensitive to the confounder. Looking in to productivity of commodities of intervention, all were robust to the confounder. With respect to net income, both at individual and aggregate level, the CIA remain to be significant/ robust and the results were not sensitive to the confounder both at Alaba and Dale. Pertaining to marketed surplus of households, all the estimates were found to be robust to the dummy cofounder. Moreover the proxies for market orientation were also robust to the CIA identified.

CONCLUSION AND POLICY IMPLICATIONS

4.1 Conclusion

This particular study has evaluated the impact of input and output market development interventions of the IPMS project at Alaba and Dale pilot learning woredas of the project in the SNNPR on input use, productivity and net income of treated households. The study used cross-sectional data collected from both participant and non-participant sample households and the data were analyzed using PSM method.

In PSM method, the important variable of interest is average treatment effect on the treated (ATT). This is the difference between the mean value of the outcome variable with and without the intervention. Here, one can understand that the '*with*' and '*without*' condition cannot be observed from the same household at the same time. There exists a problem of missing or unobserved outcome. The way out here is the use of the counterfactual outcome to get the comparison. The PSM uses propensity score of participation which is estimated from the pre-treatment characteristics to compare the difference due to the intervention. After conditioning on pre-treatment characteristics like socio-economic, demographic variables, matching was done to compute the average treatment effect on the treated (ATT) which is the vital variable of interest in impact assessment.

With regard to input use, the intervention has resulted in about 7 kg more of seed per hectare being used by participants of haricot bean commodity of intervention at Alaba and this difference was significant at 10% probability level. In case of labor use, participants used 6 days more at Alaba and 20 days more per hectare at Dale for the cultivation of haricot bean and this difference was significant at 5 and 10% level, respectively. At Dale, participants used 20 kg more of fertilizer per hectare of land over the non-participants and found to be significant at 10% probability level. In teff commodity of intervention, participants used 27 kg more of fertilizer, 5ml more of herbicide and 3 days more of oxen per hectare over the non-participants and this difference was significant at 5,5 and 10% level, respectively. In case of Apiculture and poultry the input use between the two groups of respondents was found to be positive but insignificant except poultry

feed at Dale. The difference was about 6 kg more per hen per year and significant at 5% level. Pertaining to productivity of commodities of intervention participants has got 23 kg more honey per modern or transitional hive; 5 qt more of teff per hectare and 8 qt more of haricot bean per hectare at Alaba. And these differences were significant at 5, 1 and 10% probability levels, respectively. In the same fashion participants at Dale has harvested about 13 qt more of haricot bean and this difference was significant at 1% level.

Looking in to total net income earned, participants has received a total net income of about birr 1,483 at Alaba and birr 2,228 at Dale form the commodities of intervention over the counter parts. This difference was found to be significant at 5 and 1% level, respectively. Participants of Alaba had earned about birr 30 from poultry; 132 from Apiculture; 967 from teff and 331 from haricot bean intervention over the non-participants. On the other hand, compared to non-participants, participants of Dale earned about birr 497 from poultry; 798 from fruit seedling; 575 from coffee seedling and 354 from haricot bean. Individual net incomes were significant except for poultry at Alaba and coffee seedling at Dale.

Therefore, after controlling the pre-treatment differences the PSM, Kernel matching estimator, has resulted in a positive and significant impact of input use, productivity and total net income of treated households. These estimates were also found to be robust for bootstrapping and sensitivity analysis (dummy confounder).

4.2 Policy Implications

There are policy implications that can emanate from this finding. As the finding of this study reveals a positive and statistically significant impact of the project on participants, an effort of such kind plays a vital role in making smallholder farmers market oriented and makes them better off by making their farming a business enterprise. The increased level of input use (farm inputs and market information and access) by the side of participants made them beneficiaries of the increased productivity and earners of higher net income thereof. The development of input market of such kind which is participatory for the private sector, integrated (multifaceted), and sustainable with the provision of market information and new ways of doing can increase the welfare of the communities in the long run and income in the short run.

In addition, it was observed that the interventions that were delivered by the project were not the kind that develop dependency syndrome among the beneficiaries. It was a kind of making beneficiaries self reliant as to from where inputs are found, as to how to plan farming, to whom to sell and more interestingly as to how to make informed decision regarding output marketing (pricing). Therefore, there has to be such an institution which serve as a bridge among the stakeholders, energizer for the experts of ministry of agriculture & the farmers' institution (co-operatives) and 'knowledge broker' in the country. Moreover, scaling up of the practice of the project to other places has paramount importance for the achievement of growth & transformation plan and development endeavor of the country.

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