Original Research

EAST AFRICAN JOURNAL OF PASTORALISM
Volume 4 Issue 1

Impact of Productive Safety Net Program on the Livelihood of Pastoral Households: The case of Degahbour Woreda, Jarar Zone of Somali Regional State, Ethiopia

Ridwan Abdirizak[a,*], Kownin Abdimahad[b]

[a]Department of Rural Development and Agricultural Extension, College of Dryland Agriculture, Jigjiga University
[b]Department of Animal and Range Sciences, College of Dryland Agriculture, Jigjiga University

ABSTRACT

This study was conducted in Degahbour woreda of Jarar zone, Somali Regional State, Ethiopia with the objective of assessing impacts of productive safety net program on the livelihood of pastoral households. In order to achieve the objective of the study and thereby give answers for the basic research questions mixed research approach was used. The study employed a combination of descriptive and explanatory followed with cross sectional design, both primary and secondary data were used. Random sampling was used to select representative sample accordingly 156 from program and non-program participants were selected. Descriptive statistics was carried out and compared the mean of two groups (participants and non-participants) with respect to important demographics, socio-economic and institutional variables. T-test and chi-square were applied to statistically compare the two groups for continues and discrete variables of the model respectively. To identify the variables that had significant influence on the outcome variables, logit regression analysis was carried out. The result from the logit regression analysis revealed that sex and education were found significant and negative effect on the household whereas non-farm, extension service, access credit and access food aid were significant and positive effective with 1% and 5% level of probability. Appling a propensity of score matching technique was functional to deal with and the results of the logistic regression model was engaged to estimate propensity scores for matching treatment household with control households, the study found that the program has increased participating households' income by 6.03% compared to the income of non-participant households. And livestock 0.50% compared to TLU of non-participant household. Therefore, it is important to encourage both program participant and non-participants to have income with both livestock and non-farm since aid income is not permanently. Policy makers should look for means of improving these activities.

Key Words: Productive Safety Net Program, Income, Livelihood of Pastoral Households, Propensity Score Matching.

1. Introduction

The productive safety net program (PSNP) was designed as large scale and long term coordinated effort to fight food insecurity throughout the country, contrasting with the previous strategy based on ad hoc emergence assistance (Gilligan et al., 2009) the program, launched in 2005, broadly falls in the cash for work category poor members of the community can receive small payments (in cash or sometimes in kind) in exchange for working project in their community. The PSNP is the largest program of its kind in Africa reaching more than 8 million Ethiopians or 10 percent of the population (Sabates-Wheeler and Devereux, 2010).

The Programme covers households in Somali Afar, Dire Dawa, Harari, Oromiya, Southern Nations, Nationalities and Peoples (SNNP), Amhara and Tigray, and targets households that are chronically and transitorily food insecure. The Programme provides cash and/or food transfers to these households (MOA, 2014). The PSNP has two components: public works and direct support. Public works are used to mitigate the impacts of climatic and food insecurity risks on chronically food-insecure farmers by providing employment to "able-bodied" laborers. It is the core component of the safety net program and creates a labor market for unskilled labor, primarily by involving them in labor-intensive, community-based activities. Direct support is a minor component and delivers assistance to members of the community who cannot participate in public works but need help (Andersson et al., 2011). Payments of cash and food go to the very poor through the PSNP to prevent people from going hungry. But there are other reasons for making sure that payments are not late. This is to avoid the things families will do when they do not have enough food. In addition to cutting meals and eating food with little nutritional value, people may be forced to borrow money at high interest rates, take their children out of school, or sell one of their only animals. And the sale

* Corresponding author:Ridwan Abdirizak: Ridwanb301@gmail.com

Article Information:
Article Received for review: 14 February 2023
Article Reviewed: 10 March 2023
Revised Comments: 14 April 2023
Accepted for publication: 15 June 2023 Available Online: 31 July 2023
How to Cite this Article:
Ridwan A, Kownin A (2023): Impact of Productive Safety Net Program on the Livelihood of Pastoral Households: The case of Degahbour Woreda, Jarar Zone of Somali Regional State, Ethiopia East African Journal of Pastoralism, 4(1):23-35.

of a breeding sheep means more than just the loss of that particular sheep (Sandford and Hobson, 2011).

According to (MOA (Ministry of Agriculture), 2014), the Programme provides technical assistance and training in livelihood activities (crop and livestock, off farm, and employment) to clients to enable households to increase and diversify their incomes and build their assets. While many clients who participate in livelihoods activities are referred to credit providers, for the poorest households, the Programme provides livelihood transfers that do not need to be repaid, helping them build their assets more rapidly while avoiding a cycle of indebtedness.

Somali region is one of the beneficiary regions in the country this program was also initiated with the objective of improving the livelihood of chronically food insecurity households in the PSNP target woredas through diversifying livelihood options. Therefore, out of 93 rural woredas in the region, the program has been implementing 60 chronically food insecure woredas. Degahbour woreda is one of the intervention areas of the program in Jarar zone, this program works 15 kebeles out of 16 kebeles of the woreda. The influence of household participation in the program on improving the livelihood of pastoral households will be examined in this study. Household involvement is expected to boost household income, consumption, and asset ownership, which will be used in this study as indicators of the outcomes of the program. Furthermore, the Program is intended to safeguard household assets, as well as ensuring that a minimal amount of food consumption is met. It is also intended to encourage households to raise the amount of money they earn from livestock and to build up assets.

The PSNP represents a serious and innovative attempt on the part of the government of Ethiopia to move away from responding to chronic hunger through emergency appeals towards a more predictable response with predictable resources for expected community problems. The PSNP program is one of the flagship reform programmes developed by Ethiopian Government with other international funding agencies which represent significant transformation of the Government's policy and strategy for meeting the millennium Development Goal (MDG) to fight with poverty and hunger in Ethiopia (Slater et al., 2006).

In Somali region in general, and particularly in Degahbour woreda, pastoralist are characterized by subsistence production and suffered from complex and interrelated socioeconomic problems. recurrent drought, animal diseases and environmental degradation are the most significant problems that challenge the lives of the population . Fifteen kebeles out of the sixteen kebeles of the woreda are classified as food insecure kebeles. Among others, the regional government has allocated huge number of resources to protect the pastoral communities' asset depletion and diversifications of pastoral income of households. Although efforts have been made to raise animal production, the food insecurity problem is still a major challenge in the woreda, in particular. To increase the animal productivity, the offices of agriculture and livestock resource and pastoral development has been promoting adoption and diffusion of improved technologies by pastoralist.

A considerable body of research shows that the PSNP had in general positive impacts on some attributes. PSNP has been found to have positive impacts on the food security of households, increasing livestock and households' income. It has also been found to impact welfare in the form of improved health and school attendance, higher rates of insurance uptake, and improved cognitive skills in children. . Despite the fact that the PSNP has been implemented since 2010 in the region to address the problems and shortcomings of the previous practice of assistance that focuses only on saving lives, evaluation of the effects of such programs is not yet given due attention it deserves. But the impact of the program in terms of diversifying livelihood has not been much studied in the study area. This study, therefore, attempt to fill this research gap by conducting an empirical study on the impact of the PSNP on the pastoral households' livelihood in the kebeles of the woreda beneficiaries. Therefore, this study was carried out to assess the impacts of productive safety net program on the livelihood of pastoral households in Degahbour woreda.

2. Materials and Methods

2.1. Description of the Study Area.

Degahbour woreda is one of the 93 woredas in Somali regional state and it is under the Jarar zone administrative. the woreda is located at the eastern part of agro-pastoral areas in the region. It shares border on the north by Ararso, south by Birqod, on the west by Bilcilbur, southeast by Gunagado and east by Yo'ale and aware woredas. The maximum and minimum annual temperature is 35 C0 and 19 C0, while the annual rainfall ranges between 300 to 400 mm per year, from April to June (spring) and October to December (autumn) periods. The rainfall pattern is erratic and uneven distribution . The livelihood system of the majority of pastoral and agro-pastoral communities is normally uncertain and vulnerable to a number of risk factors. They frequently experience shocks (events with adverse effects) that erode their ability to cope and this makes them more vulnerable to further shocks. Usually, one rain failure is enough to cause a drought situation and the poorer of such communities easily find themselves in situations in which they need external assistance.

2.2. Research Design.

The study utilized a descriptive design, incorporating both qualitative and quantitative approaches over a specific period.

2.3. Sampling Technique and Sample Size Determination.

Firstly, Degahbour woreda was purposively selected from among the ten woredas in Jarar zone, where the program had been running. second stage two pastoral kebeles namely Garawo and Dhabile of Degahbour woreda were

Table 1: Distribution of sample size determination

Sample kebeles	Total PSNP HHs	Participant sampled HHs	Total non-PSNP HHs	Non-participants sampled HHs	Total HHs	Total Sampled HHs
Garawo	1830	55	1004	31	2834	86
Dhabile	1023	31	1295	39	2318	70
Total					5152	156

Source: (Field survey data, 2021

selected simple randomly sampling in the woreda out of the total 16 (sixteen) kebeles. Ultimately, households were selected stratified random sampling. The sample size from the two selected kebeles was determined through applying probability proportional to size (PPS) sampling procedures. Finally, based on probability proportional to size sampling technique 156 out of 5152 households sample respondents were selected randomly using the stratified random sample method in total 86 from PSNP and the rest 70 HHs from Non PSNP.

This study was used a simplified formula provided by (Yamane ,1967) to determine the required sample size at 95% confidence level, and 5% level of precision

$$n = \frac{N}{1 + N(e)^2} n = \frac{5152}{1 + 5152(0.08)^2} = 156H \qquad (1)$$

Where n is the sample size, N is the population size (total household heads size), and e is the level of precision. Therefore, the sample size was 156 households out of total population of two kebele is 5,152 household of pastoralist in Degahbour district.

2.4. Data Sources and Collection Methods.

The study utilized both primary and secondary data sources. Primary data was gathered directly from a sample of pastoral households using structured questionnaires and key informant interviews. Secondary data was collected from various published and unpublished sources, including regional and woreda-level reports from the Agriculture and Natural Resource Development Bureau, as well as documents from university and public libraries. A comprehensive data collection strategy was employed, featuring pre-tested, structured survey questionnaires administered by trained enumerators to both PSNP participants and non-participants. These household surveys provided detailed information on income derived from livestock and non-farm activities, converted into birr. Additionally, key informant interviews with two PSNP task force members and two kebele chairpersons, using semi-structured questions, offered valuable insights into stakeholder perceptions. In-depth interviews further ensured a thorough understanding and validation of the program's impact on the livelihoods of pastoral households.

2.5. Methods of Analysis .

2.5.1. Descriptive Analysis.

Descriptive statistics such as frequency, percentage, was used to describe the socio-economic characteristics of households and the impacts of PSNP on livelihood status in the study area. The results were presented in the form of narrations, tabular summaries. The aim was to understand the importance and magnitude of households' livelihood activities taking situation of household's program impacts. The study population was categorized using tables, mean difference, and other appropriate statistical tools.

2.5.2. Econometric Analysis

Propensity score matching model was used to address the objectives /to evaluate the impact of PSNP on livelihoods of pastoral households. Propensity score matching (PSM) method: According to **(Khandker et al.,2010)** impact evaluation is the act of studying whether the changes in well-being are indeed due to the intervention and not to other factors. The main aim of PSNP was to ensure sustainability of food insecure households in addition to improve their livelihood status. To this effect, there is a need to see whether the intervention of PSNP has significant influence on the participant households or not. However, to compare the before and after intervention difference, baseline survey was not conducted prior to the intervention of the PSNP in the study area.

2.5.3. Procedures of Propensity Score Matching Estimation

The first step in PSM method is estimation of the propensity scores. To get this propensity scores any standard probability model can be used. Like, logit, probit or multi-nominal logit. **(Rajeev et al., 2007)**. As described by **(Rosenbaum and Rubin ,1983)**, matching can be performed conditioning on P(X) alone rather than on X, where P(X) = Prob(D=1|X) is the probability of household members conditional on X. If outcomes without the intervention are independent of membership given X, then they are also independent of membership given P(X). This reduces a multidimensional matching problem to a single dimensional problem.

A Logit model is eligible and the most widely used model to estimate propensity scores using a composite of pre-intervention characteristics of the sampled households (Rosenbaum and Jalan, 2003) and matching was then performed using propensity scores of each observation. In estimating the logit model, the dependent variable is household membership on PSNP participants which takes the value of 1 if a household is member and 0 otherwise. The mathematical formulation of logit model is as follow:

$$P_i = \frac{e^{zi}}{1 + e^{zi}} \qquad (2)$$

Where, P_i is the probability of participants

$$z_i = a_0 + \sum_{i=1}^{n} a_i x_i + u_i \qquad (3)$$

Where, i= 1, 2, 3, - –, n = intercept a_i = regression coefficients to be estimated u_i = a disturbance term, and X_i= pre-intervention characteristics.

The probability that a household belongs to non-member is:

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

According to matching theory, (Rosenbaum and Ravallion, 2003) the logit model via which the propensity score is generated should include predictor variables that influence the selection procedure or household members in the program and the outcome. Several factors guide selection of predictor variables. In this study, explanatory variables of the logit model were identified using findings of previous empirical studies on impact of productive safety net program on the livelihood of pastoral households.

2.5.4. Matching Estimators

In search for an appropriate matching estimator is the major task of a program evaluator. Later on, estimation of propensity score matching. Therefore, there are different matching estimators in theory. Below, only the most generally useful matching estimators. These are: Nearest Neighbor Matching (NN), Caliper Matching and Kernel Matching. How and which method is the best to select. Clearly, there is no single answer. The choice of a given matching estimator depends on the nature of the available data set. The choice of a specific method depends on the data, and in particular on the degree of have common characteristics between the treatment and comparison groups in terms of the propensity score. When there is considerable overlap in the distribution of the propensity score between the comparison and treatment groups, most of the matching algorithms yield is similar results (Wahba, 2002).

2.5.5. Nearest Neighbor Matching (NN)

It is the most straightforward matching estimator. In NN matching, an individual from a comparison group is chosen as a matching partner for a treated individual that is closest in terms of propensity score (Caliendo and Kopeinig, 2005). NN with replacement a comparison individual can be matched to more than one treatment individuals, which would result in increased quality of matches and decreased precision of estimates. NN matching without replacement, a comparison individual can be used only once. Matching without replacement increases bias but it could improve the precision of the estimates. In cases where the treatment and comparison units are very different, finding a satisfactory match by matching without replacement can be very problematic (Wahba, 2002). When there are few comparison units similar to the treated units, we may be forced to match treated units to comparison units that are quite different in terms of the estimated propensity score.

2.5.6. Caliper Matching

The NN matching faces the risk of bad matches, if the closest neighbor is far away. To prevail over this problem researchers, use the second option matching algorism called caliper matching. Caliper matching means that an individual from the comparison group is chosen as a matching partner for a treated individual that lies within a given caliper (propensity score range) and is closest in terms of propensity score (Caliendo and Kopeinig, 2005). If the dimension of the neighborhood is place to be very small, it is possible that some treated units are not matched because the neighborhood does not contain a control unit. On the other hand, the smaller the size of the neighborhood the better is the quality of the matches (Becker and Ichino, 2002). One problem in caliper matching is that it is difficult to know a prior what choice for the tolerance level is reasonable.

2.5.7. Kernel Matching

This is another matching method whereby all treated units are matched with a weighted average of all controls which are inversely proportional to the distance between the propensity scores of treated and controls (Becker and Ichino, 2002). Kernel weights the contribution of each comparison group member so that more importance is attached to those comparators providing a better match. The difference from caliper matching, however, is that those who are included are weighted according to their proximity with respect to the propensity score. The most common approach is to use the normal distribution (with a mean of zero) as a kernel, where the weight attached to a particular comparator is proportional to the frequency of the distribution for the difference in scores observed **(Bryson, 2002)**. According to (Caliendo and Kopeinig, 2005), a drawback of this method is that possibly bad matches are used as the estimator includes comparator observations for all treatment observation. Hence, the proper imposition of the common support condition is of major importance for kernel matching method. A practical objection to its use is that it will often not be obvious how to set the tolerance. However, according to (Mendola, 2007), kernel matching with 0.25 band width is most commonly used. The question remains on how and which method to select. Clearly, there is no single answer to this question. The choice of a given matching estimator depends on the nature of the available data set (Bryson, 2002). In other words, it should be clear that there is no 'winner' for all situations and that the choice of a matching estimator crucially depends on the situation at hand. The choice of a specific method depends on the data in question, and in particular on the degree of overlap between the treatment and comparison groups in terms of the propensity score. When there is substantial overlap in the distribution of the propensity score between the comparison and treatment groups, most of the matching algorithms is yield similar results (Wahba, 2002)

According to (Wahba, 2002), before choosing the matching estimator, different criteria such as equal means test referred as the balancing test, pseudo-R2 and matched sample size is used. A matching estimator which balances all explanatory variables (i.e., results in non-significant mean differences between the two groups), bears a low R2 value and also results in large matched sample size is preferable. Considering these criterions, Kernel with band width 0.25 was found fit for the data .

Choosing the matching estimator, needs different criteria such as equal means test referred as the balancing test, pseudo-R2 and matched sample size is used. A matching estimator which balances all explanatory variables (i.e., results in non-significant mean differences between the two groups), bears a low R2 value and also results in large matched sample size is preferable.(Wahba, 2002).

2.5.8. Region of common support condition

Having presence common support condition guarantee that any combination of characteristics observed in the treatment group can also be observed among the control group **(Bryson, 2002)**. The common support region is the area which contains the minimum and maximum propensity scores of treatments and control group households, respectively. It requires dropping of all observations whose propensity scores is smaller than the minimum and larger than the maximum of treatment and control, respectively (Caliendo and Kopeinig, 2005).

2.5.9. Testing the Matching Quality

Using predicted probabilities of participation in the program (i.e. propensity score) match pairs are constructed using alternative methods of matching estimators. Then the impact estimation is the difference between simple mean of outcome variable of interest for participant and non-participant households. In our case, C is the Mean impact of the intervention. The mean impact on household income is given by:-

$$C^p(Y_{ij1}^{NP} Y_{ij0} P) \tag{5}$$

Where, Y_{ij1} is the post intervention outcome variable of household (income and livestock owned). Y_{ij0} is the outcome variables of the i^{th} non-participant matched to the j^{th} participant household, P is the total number of participants and NP is the total number of non-participants.

2.5.10. Examining Treatment Effect on the Treated

This is the question of identifying factors that bring heterogeneity in impact of the treatment on the treated. In other words, it would be important to further analyze data to answer the question —why impact of the program varies, if any, among participant households? The idea is that the effect of the program varies among households due to beneficiaries own and other characteristics. The effect of the treatment on the treated was explained by using a standard multiple linear regression models, which is specified as follows:

$$Y_i = \beta_0 + \beta_i x_i + u_i \tag{6}$$

Where, $Y\,i$ is magnitude of the impact of the program on beneficiaries expressed, β_0 is the regression intercept, i is a vector of regression coefficients to be estimated, $\beta_i x_i$ is pre intervention independent variables and u_i is an error term.

The explanatory variables used in this model are pre-intervention since the objective is to identify pre-intervention characteristics which bring variation in income among program participants and draw issues for policy implication in relation to targeting. Had they been post-intervention variables, they might have been the effect of the program itself so that it is not possible to suggest on targeting.

2.5.11. Sensitivity Analysis

Recently checking the sensitivity of the estimated results becomes an increasingly important topic in the applied evaluation literatures (Caliendo and Kopeinig, 2005). Matching method is based on the conditional independence or un confoundedness assumption, which states that evaluator, should observe all variables simultaneously influencing the participation decision and outcome variables. This assumption is intrinsically non-testable because the data are uninformative about the distribution of the untreated outcome for treated units and vice versal (Becker and Ichino, 2002). However, if there are unobserved variables which affect assignment into treatment and the outcome variable simultaneously, a hidden bias 'might arise (Rosenbaum and Rosenbaum, 2002). Since it is not possible to estimate the magnitude of selection bias with non-experimental data, the problem can be addressed by sensitivity analysis.

2.6. Definition and Measurement of Variables

The procedure after the selection of econometric models for estimation of experimental hypothesis is the choice of variables that can influence the expected outcomes and participation. Once the analytical procedure of the study and its requirements are known, it is necessary to identify the potential explanatory and dependent variables that will be used in the models. A combination of socioeconomic and demographic factors is used to explain household's participation in the PSNP and the outcomes in terms of household well-being indicators in their livelihood.

2.6.1. Dependent variable

The dependent variable used in the PSM estimation has a dichotomous nature and is represented in the model by 1 for households participating in the Productive Safety Net Program and 0 for non-participating households.

2.6.2. Outcome variables

- Total annual household income: Annual income is a continuous variable and it is the amount of total income (measured in Birr) that a household has earned from different sources in the last twelve months. it is expected that households who have large income, are better in their livelihood.
- Livestock Ownership (TLU): It is a continuous variable, which refers to the numbers of livestock owned by household measured in terms of Tropical Livestock Unit (TLU). The number of livestock increase, the household expected to have more income sources.

2.6.3. Independent variables

- The independent variables of the model are those variables that were expected to have relationship with the participation in the Productive Safety Net Program. The demographic, socio-economic and institutional factors hypothesized to affect the dependent variable are the following.
- Age of the household head: It is continuous variable measured in years. Age of household head plays a significant role in increasing livestock productivity by exerting his/her labor and also it may affect adoption to new technologies. Its hypothesized that household head with young age will have strong labor which can produce more and seek new technologies to improve his/her livelihood.
- Household family Size/number (HHFS): is a continuous variable measured in terms of numbers of family in the household. It is hypothesized those who have a large size of family numbers implies having high manpower for non-farm activities which generates income and will alleviate food gap of the households.
- Sex of Household Head (SEX): It refers to the sex of the household head taking a value of 1 for male and 0 for female. Labor supply plays a great role; due to lack of labor female headed household they are forced to rent their land. Male-headed households are in a better position to pull more labor force than the female-headed ones; sex of the household head is an important determinant of livelihood security. Based on this assumption, it is hypothesized that households who are female-headed, were more likely to gain from the program and probability of household to be participant will be higher for female headed than male headed.
- Education level of household head: It is an essential factor for diversified activities in human life. In the study area, the main occupation of the population is livestock. Education level could measure the household's human capital. So, since the program is for food insecure household's education level. It is hypothesized to have a negative effect on dependent variable.
- Land holding size of the household: Losses of farm land to other uses because of population pressure and limits to the amount of new land that can be brought into production are among the constraints of food production. as the land size increases, provided other associated production factors remain constant, the likelihood that the holder gets more output is high. It is hypothesized to have a negative effect on dependent variables.
- Extension service: It is a dummy variable taking the value of 1 if the household has access to extension service and practical training by development agents and otherwise. Frequent visit of extension workers helps to understand the livelihood status of households. Thus, it is hypothesized that, more extension visit is may lend to a high probability of being included in PSNP
- Credit service: It is a dummy variable that measure access to credit. The pastoral credit can be classified into two namely, credit for livestock as well as production and credit for household asset building. The pre-intervention credit will be linked with credit for veterinary service. It is hypothesized that those who have got access credit to buy inputs for their livestock can easily be food secured than those who didn't get access to credit.
- Participation in non-farm activity: This represents the participation of pastoralist in nonfarm income generation activity expressed as a continuous variable. hence, it is hypothesized that the participation in non-farm income generating activities is positively associated with household asset.
- Access to food aid: It is a dummy variable taking the value of 1 if the household has accesses to have gotten food aid in kind or by cash from any governmental and non-governmental organization and 0 otherwise. it is hypothesized that a families or households have gotten aid frequently have positive relationship on dependent variables
- Participation in Social Networks /institutions: it is a dummy variable measured in terms of capability of the household participating in different social networks, 1 if the household is capable of participating in different social networks implies the household is in sustainable livelihood status, 0 otherwise. it is hypothesized that a families or households participating social institutions have positive influence on livelihood status.
- Distance to market: It is a continuous variable and average kilometers from home of the households to the nearest market. It is hypothesized to the more the closest the households have more advantages to engage him/herself to non-farm employment.

2.7. Data Analysis And Interpretation

2.7.1. Descriptive Analysis

In this chapter the results of descriptive statistics, econometric model are presented. Descriptive statistical tools such as mean, percentage, standard deviation, t-test, and chi-square test to compare and contrast different characteristics of the sample households while PSM econometric model was used the second objective of my specific objective to identify the impact of productive safety net program on the livelihood of pastoral household level.

3. Results and Discussion

3.0.1. Demographic Characteristics of Sample Households

Age of the household head

The age of a HH head was another demographic variable hypothesized to have an association with impact of PSNP as indicated in the table below, the mean age of participant household heads was 45.16 and that of non-participant household heads was 44.45 years with standard deviations of 6.11 and 8.15 respectively. The mean age

Table 2: Variables, definition and measurement

Variable	Type and definition	Measurement
Dependent variable		
PSNP participant & non-participant	Dummy variable, PSNP participants	1 if HH member otherwise 0
Outcome variables		
Annual Income	Continues variable, annual income	Birr
HH livestock owned	Continues variable, Livestock owned	Tropical Livestock Unit TLU
Independent variable		
Age of HH	Continues, age of household head	number years
Sex of HH	Dummy, sex of HH	0 Female 1 Male
Family size	Continuous, total number of family AE	Number of family
Marital status	Category, marital status of HH	
Education	Dummy, education level of HH	0 illiterate and1 literate
Land size	Continuous	hectare
Non-farm	Dummy, non-farm membership	1 Yes 0 No
Extension service	Dummy, Access to extension	1 Yes 0 No
Access credit	Dummy, Access to credit	1 Yes 0 No
Food aid	Dummy, Access to food aid	1 Yes 0 No
Social capital	Dummy, participating social capital	1 Yes 0 No
Market Distance	Continues variable, market distance	Kilometer

difference of the two group participant household heads and non-participant household heads is statistically insignificant. Accordingly, this study indicates that non-participant households are headed by elderly persons compared to the participant ones. This outcome is inverse with a study done by **Anwar Ahmed (2015)**. Impact assessment of PSNP program on household food security the case of Fadis woreda, east Hararghe zone of Oromia regional. This results that are statistically significant differences between participant and non-participant households with respect to age of household head.

Family size

The result of the study shows that the mean family sizes of sampled households were 4.8 in with standard deviation of 1.7 the mean family size of participant households was found to be greater than that of non-participant households. The mean family size of participants and that of participated /non-participant households was 4.89 and 4.87 respectively with standard deviations of 1.8 and 1.7 respectively. Results in the table below, shows that the family size mean difference between the two groups is statistically insignificant. Based on the survey results the non-participant households tend to have higher family size. However, it was found that there was statistically insignificant mean difference between the participant and non-participant households in regard with Family size of household.

Land Size

Despite the new land policy of the country, land is still owned by the households. In these pastoral areas land is sold, inherited and redistributed as any other personal possessions. The size of land is so vital for the betterment of the household's welfare. Rangeland is the asset of the pastoralist. Therefore, land holding is among the important factors that easily distinguish between participant and non-participant households. In the study area, as indicated in the table below, the mean land holding size by participant and non-participant households is 1.59 and 1.61 Ha with standard deviation of .72and .51 respectively. Furthermore, there was no statistically significant difference in mean land size by households between participant and non-participant.

3.0.2. Distance to Market

The market places in the study areas are mostly located in the open rural villages and small towns. These markets are traditional in nature and are characterized by inadequate marketing facilities and services, such as good sanitation, product protection, market shelter and so on. They are also constrained by deficient transportation system and thus, most rural households transport their livestock product to the market centers by bajaj, donkeys and/or using human shoulders. The result of the study in table 3 shows that the mean distance to market of sampled households was 11.6km in with standard deviation of 1.6km. The mean distance to market of participant households was found to be less than that of non-participant households. The mean distance to market of participant and that of non-participant households was 11.39km and 12.07km respectively with standard deviations of 1.44km and 1.71km respectively. Results in the table below, indicates that the distance to market mean difference between the two variable categories there was statistically significant at 1% significance level the mean difference in distance to market between the two groups of households. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

3.0.3. Description of Sample Households for Categorical Variables

Sex of household head

Of the total respondents from the distributed questionnaire non-participant households 43 (27.6%) of them were male headed households, while the remaining 27 (17.3%) were female. The number of participant household female headed households is 47 (30.1%) while the male respondents is 39 (25.0%) both non-participant and participant the number of female was lower than the number of male, The chi-square test shown that there was no statistically significance mean difference between non-participant and participant

Table 3: Summary statistics for continuous variables of the household characteristics

Variables	Total respondent		Participants		Non-participants		T-value
	Mean	Stand d	Mean	Stand d	Mean	Stand d	
Age	44.84615	7.08397	45.16279	6.110474	44.45714	8.151973	-0.6176
Family size	4.887436	1.758467	4.897558	1.801019	4.875	1.717602	-0.0794
Land size	1.602564	.6393493	1.593023	.7256301	1.614286	.5189973	0.2060
Distance to market	11.69872	1.604107	11.39535	1.449374	12.07143	1.713725	2.6694***

*** and ** means significant at the 1% and 5% probability levels, respectively

Table 4: Sex of the respondents

Variables	Category	Non participant		Participant		Total respondent		X^2
		Freq	Perc	Freq	Perc	Freq	Perc	
Sex of hh	Female	27	17.3%	47	30.1%	74	47.4%	
	Male	43	27.6%	39	25.0%	82	52.6%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

HHs with regard to gender of the household head, which is in line with the prior expectation of that male-headed households are greater than the female headed households. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

Education status of household head

Educational level of household head determines the exposure of an individual with the outside world. It is linked with other socio-cultural and demographic factors either positively or negatively. However, the purpose of this study is limited to food poverty. The result of the study in table 5 shows that the majority of the sampled household heads were found to be illiterate 121 (77.5%) while 35 (22.4%) of them were found to be literate. Many research results proved that household head's educational status could determine poverty status of the entire household. The total of respondents from the findings of sample the illiterate of non-participant households is 47 (30.1%) while the literate of non-participant respondents is 23 (14.7%) similarly the respondents of participant of illiterate is 74 (47.4%) and 12 (7.7%) were literate, both non-participant households and participant respondent the literate people is smaller than the illiterate households, However, The chi-square test the study result showed that there was 1% of statistical significant difference between illiterate and literate household heads with respect to the non-participant and participant households. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

Extension service

Survey results in 'Table 6' show that 57 (36.5%) of non-participant household haven't got the access of extension service while 13 (8.3%) of the sample households of participant have access to extension service, on other hand 51 (32.7%) of participant households have got the access of extension service while 35 (22.4%) of participant households haven't got the access of extension service. The chi-square test indicated that there was 1% of statistically significant between the two group participant and non-participant households to extension service. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

Access to credit

Access to credit is one of the elements affecting household's allocation of resources and to engage in non-farm activities also credit is crucial for pastoral for purchasing livestock inputs like feed, animal drug, and to participate non-farm activity like petty trading. The survey result in table 7 revealed that, 56 (35.9%) of the non-participants haven't access to credit, while 14 (9.0%) access credit during program and 45 (28.8%) of participants haven't access to credit while 41 (26.3%) of the participants have access to credit respectively this implies that less respondents have access credit. The chi-square test indicated that there was statistically significant at 1% probability level between the participant and non-participant households to access credit. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

Access to food aid

Food aid plays a role in giving relief to those households who are perceived to be most at risk of severe food insecurity. The survey result in table 8 revealed that, 62 (39.7%) of the non-participants haven't access to food aid, while 8 (5.1%) access food aid and 45 (28.8%) of participants have access to food aid while 41 (26.3%) of the participants haven't access to food aid respectively this implies that less respondents have access food aid. the chi-square test indicated that there was statistically significant at 1% probability level between the participant and non-participant households to access food aid. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

Non-farm activity

Mostly during slack periods many pastoralists can earn additional income by engaging in various non-farm activities. In the study area self-employment, sale of charcoal and woods, petty trade and remittance were found to be major non-farm activities in which sample respondents were participating. As the Table 9' below showed that non-farm activities 42 (26.9%) of the non-participant had no access for non-farm activities while 28 (17.9%) of them had access. Whereas 60 (38.5%) of participants had access to non-farm activities. While 26 (16.7%) had no access. the chi-square test indicated that there was statistically significant at 1% probability level between the participant and non-participant

Table 5: Education status of the household head

Variables	Category	Non participant		Participant		Total respondent		X^2
		Freq	Perc	Freq	Perc	Freq	Perc	
Education status of the HH	Illiterate	47	30.1%	74	47.4%	121	77.5%	0.003***
	Literate	23	14.7%	12	7.7%	35	22.4%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

Table 6: Extension services provided in the study area

Variables	Category	Non participant		Participant		Total respondent		X^2
		Freq	Perc	Freq	Perc	Freq	Perc	
Extension service	No	57	36.5%	35	22.4%	92	59.0%	0.000***
	Yes	13	8.3%	51	32.7%	64	41.0%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

households to access non-farm activities. With regards to this pre-intervention variable, the alternative hypothesis is accepted.

Social cooperative membership

Participating social capital

Participating social cooperative depends on capabilities of the households. As the following result in 'Table 10' shows the membership of social cooperatives 54 (34.6%) of non-participant are not members while 16 (10.3%) are members. Whereas 75 (48.1%) of participants are not members where 11 (7.1%) as the results indicates the fewer respondents participates the social cooperative membership

Outcome Variables

Total annual income

The annual income of households plays a crucial role in asset creation and contributes to food security in the study area. Household income is derived from livestock production and non-farm activities, supporting various economic, social, and cultural functions. According to the survey results, the average annual income for non-participant households is 19,828.57 Birr, with a standard deviation of 2,049.79, while participant households have a higher average annual income of 21,906.98 Birr, with a standard deviation of 2,457.296. On average, participant households earn more annually than non-participants. A test of means indicated a statistically significant difference in annual income, measured in Birr, between the two groups.

Livestock owned

Livestock are used for various purposes in the Somali region. The prime reason why they keep cattle and camels is for milk production as the mainstay of their diet. Small ruminants (sheep and goats) are reared to generate income when cash is needed, despite their limited milk yield. Camels are also used to transport portable huts, while donkeys are used as pack animals and may haul water, firewood, etc. for family use. The secondary importance of livestock in pastoral society includes employment generation, production of manure, utilization of marginal land etc (IPS, 2002). Following Storck et al. (1991), types and herds of livestock owned by the sample households was converted into tropical livestock unit (TLU), so as to facilitate comparison among participant and non-participant households. As survey result in table 10 indicates the average livestock species owned by both PSNP participant and non-participant was 8.882051 in TLU with the standard deviation of 1.70. The mean of number of livestock owned participant and non-participants are 8.97 and 8.77 with the standard deviation of 1.72 1.68 respectively. Test of mean revealed that there was no statistically significant mean difference livestock holding in TLU between the two groups.

Data from PSNP participants

The program's overall goal is to establish "food security for those who can accomplish it, and food sufficiency for

Table 7: Access to credit

Variables	Category	Non participant		Participant		Total respondent		X^2
		Freq	Perc	Freq	Perc	Freq	Perc	
Access credit	No	56	35.9%	45	28.8%	101	64.7%	0.000***
	Yes	14	9.0%	41	26.3%	55	35.3%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

Table 8: Access to food aid

Variables	Category	Non participant		Participant		Total respondent		X^2
		Freq	Perc	Freq	Perc	Freq	Perc	
Access credit	No	62	39.7%	41	26.3%	103	66.0%	0.000***
	Yes	8	5.1%	45	28.8%	53	34.0%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

Table 9: Non-farm activity among respondents

Variables	Category	Non participant		Participant		Total respondent		X^2
		Freq	Perc	Freq	Perc	Freq	Perc	
Non-farm	No	42	26.9%	26	16.7%	68	43.6%	0.000***
	Yes	28	17.9%	60	38.5%	88	56.4%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

Table 10: Non-farm activity among respondents

Variables	Category	Non participant		Participant		Total respondent		$X2$
		Freq	Perc	Freq	Perc	Freq	Perc	
Social cooperative membership	No	54	34.6%	75	48.1%	129	82.7%	0.044**
	Yes	16	10.3%	11	7.1%	27	17.3%	
	Total	70	44.9%	86	55.1%	156	100%	

*** and ** means significant at the 1% and 5% probability levels, respectively

those who can't," for male and female members of chronically food insecure households in chronically food insecure areas. As the below table 12 shows 82 (95.3%) the majority of the PSNP participants knows when the program started, while the remaining 4 (4.7%) don't know when the program started. Also, the 31 (36%) of the PSNP participant were direct support whereas the majority 55 (64%) were public work. All the program participants reported that the agriculture office staffs, program staffs, kebele administration and community leaders were selected to participate the program. 1(1.2%) of the program respondent was participating one-two year, 3 (3.5%) of them were participating three – four years whereas the majority 82(95.3) of the respondent were participating nine year and all the 86 (100%) of respondents said that they are going to be member of the program. 47(54.7) told that the program has access to education and increasing income. While the remaining 39 (45.3%) of the respondent reported that the program has increasing income.

Multicollinearity Test

This section estimates a logistic regression model using selected explanatory variables to examine the impact of PSNP on pastoralist livelihoods, utilizing STATA.13 for econometric analysis. The study addressed multicollinearity by calculating the variance inflation factor (VIF), finding all continuous variables had VIF values less than 10, indicating no serious. multicollinearity issues, thus retaining all four explanatory variables for the logistic regression. Contingency coefficients were calculated to measure the association among dummy variables, and since no coefficients exceeded 0.75, indicating no significant associations, all five dummy variables were included in the logistic analysis.

Econometric Result

Propensity Scores Matching (PSM)

According to (Ravallion ,2009) propensity score matching is a tool that creates a comparison group with the treatment group based on factors that affect peoples' propensity to participate in the program. The results of a propensity score are obtained as the probability scores of individuals from the fitted simple logistic regression model. Logistic regression is applied when the dependent variable is dichotomous. The model is estimated with STATA 13 computing software using the propensity score matching algorithm developed by (Leuven and Sianesi 2003). In the estimation process, data collected from the two groups, namely PSNP participant households and non-participant households, were collective such that the dependent variable takes a value 1 if the household was participant by PSNP and 0 otherwise. Prior to running the regression model, the explanatory variables were tested for the existence of multicollinearity. The values of VIF for continuous variables were found to be small (i.e. VIF values less than 10). To avoid serious problem of multicollinearity, it is quite essential to omit the variable with value 10 and more from the logit analysis. Based on the VIF result, the data have no serious problem of multicollinearity. As a result, all the 4 explanatory variables were retained and entered into logistic regression analysis. The Variance Inflation Factor (VIF) values of the variables in the model, as shown in Tables 12 in the Appendix, are less than the critical values showing that there is no problem of multicollinearity.

Logistic regression model is used to estimate propensity scores of participant and non-participant households. The Pseudo R2 value of 0.3424 (Table 13), indicates that the estimated model performs well for the planned matching exercise. In other words, the low Pseudo R2 value shows that the explanatory variables are not influenced by PSNP participants and hence, selection into treatment was close to random. The estimated coefficients from Logit regression

Table 11: Total annual income and livestock owned per adult equivalent of sample households interviewed

	Total respondent		**Participants**		**Non-participants**		**T-value**
Variables	Mean	Stand d	Mean	Stand d	Mean	Stand d	
Income of HH	20974.36	2501.48	21906.98	2457.29	19828.57	2049.79	-5.65***
TLU	8.88	1.70	8.97	1.72	8.77	1.68	-0.73

Table 12: Data from PSNP participants

Do you know when PSNP started	Frequency	Percentage
No	4	4.7%
Yes	82	95.3%
Total	86	100%
State the types of program component you participated		
Direct support	31	36%
Public work	55	64%
Total	86	100%
Who selected you to participate in the program		
All of them	86	100%
How many years did you participated in the PSNP program		
One – two years	1	1.2%
Three – four years	3	3.5%
Nine – year	82	95.3%
Total	86	100%
Are you ready to continue what has been started by the program		
Yes	86	100%
In your opinion in which of the following parameter did the program has a positive		
Increasing income	39	45.3%
Access to education and increasing income	47	54.7%
Total	86	100%

Table 13: Results of logistic regression model

Variable	Coeff.	Std. Error	Z	P>(Ejie et al. 2021)
Sex	-1.734605	.5646852	-3.07	0.002
Age	.0083188	.0307964	0.27	0.787
Marital status	-.1924424	.4169909	-0.46	0.644
Education	-2.189419	.6375627	-3.43	0.001
Family size	.0301052	.1271816	0.24	0.813
Land owned	-.2522734	.3574477	-0.71	0.480
Extension service	1.102585	.4855677	2.27	0.023
Non-farm	1.139699	.5226965	2.18	0.029
Access credit	1.2348	.5114037	2.41	0.016
Access food aid	1.272352	.5618524	2.26	0.024
Part social capital	-.6742715	.5735895	-1.18	0.240
Distance	-.0348791	.1401572	-0.25	0.803
Number of obs	156			
LR chi2 (12)	73.48			
Prob>chi2	0.0000			
Pseudo R2	0.3424			

(Table 13) indicates that sex and access to education significantly and negatively affect households while extension service, non-farm, access credit and access food aid affects it positively.

Imposing common support region

As noted earlier the amount of a propensity score is between 0 1 before implementing the matching task, three main steps must be followed and these are presented as follows: The first, predicted values of propensity scores should be estimated for all treated and control households. Second, a common support condition should be imposed on the propensity score distributions of household with and without the participant. Finally, observations whose predicted propensity scores fall outside the range of the common support region should be rejected. As shown the following table

Table 14: Distribution of estimated propensity scores

Group	Obs	Mean	Std. Dev	Minimum	Maximum
TT	156	.5512821	.31709	.017861	.9936553
TREATED	86	.7365454	.2325283	.1077723	.9936553
CONTROL	70	.3236728	.258271	.0178611	.9799528

Table 15: Performance of matching estimator

Matching Estimator	Balancing test	Pseudo-R2	Sample size
NN(1)	10	0.132	156
NN(2)	10	0.125	156
NN(3)	10	0.107	156
NN(4)	10	0.95	156
Caliper			
0.01	10	0.040	156
0.025	10	0.062	156
0.05	10	0.121	156
Kernel			
Band With 0.1	10	0.109	156
Band with 0.025	10	0.091	156
Band with 0.5	10	0.087	156

14 the estimated propensity scores vary between .1077 and .993 (mean .736) for participant or treatment households and between .0178 and .979 (mean = .323) for non-participant (control) households. The common support region would then lie between .1077 and .979. In other words, households whose estimated propensity scores are less than .1077 and larger than .979 are not considered for the matching exercise.

Choosing the best matching estimator

Table 15 presents the estimated results of tests of matching quality based on the above-mentioned performance criteria. After looking into the results, it has been found that caliper matching 0.01 is the best estimator for the data. As such, in what follows estimation results and discussion are the direct outcomes of the caliper matching 0.01. After households' propensity scores are estimated, the second step is to use the most commonly used matching methods such as the nearest neighbor, kernel and radius matching depending on the term of a closeness criterion used to identify the impact of interventions. In this study, three of the most common matching methods were used to identify the impact of PSNP on household income and livestock owned. The final choice of a matching estimator was guided by different criteria such as equal means test referred to as the balancing test, pseudo-R2 and matched sample size **(Dehejia and Wahba, 2002)**. Specifically, a matching estimator which balances all explanatory variables (i.e., results in insignificant mean differences between the two groups), bears a low R2 value and also results in large matched sample size is preferable.

Balancing

Table 16 shows the estimated results of tests of matching quality based on the selected best estimator caliper matching (0.01). The balancing test of covariates after the matching showed insignificant difference in the variables between participant and non-participant.

Treatment effect on the treated

Table 16: Result of balanced test of covariates caliper estimator

Variable	Mean Treated control		%bias	t-test	
				T	p>(t)
_pscore	.64746	.64773	-0.1	-0.000	0.996
Sex	.64286	.61905	4,8	0.22	0.824
Age	44.881	44.571	4.3	0.18	0.861
Marital status	2.119	2.0476	13.2	0.73	0.465
Education	.16667	.19048	-5.7	-0.28	0.779
Family size	4.5436	4.5438	-0.0	-0.00	0.999
Land owned	.16667	1.4524	34.0	1.63	0.107
Extension service	.57143	.57143	0.0	0.00	1.000
Non-farm	.71429	.61905	19.9	0.92	0.361
Access to credit	.47619	.45238	5.2	0.22	0.829
Access to food aid	.45238	.5	-11.3	-0.43	0.677
Part social capital	.14286	.09524	12.5	0.67	0.506
Distance	11.548	11.31	15.0	0.70	0.488

Table 17: Average treatment effect on the treated ATT for annual income and tropical livestock unit

Outcome Variable	Sample	Treated (Participant)	Control (non-participant)	Difference	SE	t-stat
Total Annual Income	ATT	21923.0769	20600	1323.07692	729.875199	1.81
TLU	ATT	9.06769231	9.02153846	.046153846	.515560283	0.09

The effect of PSNP on pastoralist livelihood in annual income generation and livestock holding were analyzed. The estimated results showed that there is supportive evidence of statistically significant effect on outcome variables. Therefore, the program participants:

- Gains more mean annual income of Birr 1323.07 which in about 6.03% greater than the non- program participants.
- In case of asset formation, Total Livestock holding in TLU is found to be more by 0.461 which is about 0.50% greater than the non-program participants.

4. Conclusion

The result of the logit regression model shown that out of 12 variables included in the model, sex and education were found to have negative effect and statistically significant, extension service, non-farm, access credit and access food aid were found to have positive effect and statically significant, the remaining variable such as marital, land owned, participating social capital and distance to market were found to have negative effect and were not statistically significant, on other hand age, and family size were found to have positive effect and were not statistically significant with impact of Productive Safety Net Program (PSNP) on the livelihood of pastoral households and significant level of 1 and 5 probability levels. Propensity score matching (PSM) was functional to deal with the objective of the study and the results of the logistic regression model was engaged to estimate propensity scores for matching treatment household with control households. The estimation result offers supportive evidence of statistically significant effect of the participant household income measured in terms of Birr. The participant households the opportunity for livestock production and income was increased. Non-participant households have smaller mean annual income and TLU as compared to participant households. It was found that, on average, the participant households have increased the annual income of participating households by 1327.07 birr, in the study area, the participant household annual income increased by 6.03% compared to the non-participant households. Although it was found that, on average, the participant households have increased the number of livestock species owned 0.46 in TLU in the study area, the participant household livestock species owned increased by 0.50% compared to the non-participants.

The study has found evidence that the PSNP in the study area has worked in significantly increasing the household food livelihood. This sends an encouraging signal for program designers, implementers, and funding agents. On the other hand, in future household food security from similar programs could be enhanced by taking the following policy measures:

5. Recommendations

- To increase the graduation rate of participant households, it may be essential to establish a systematic linkage between the PSNP and other livelihood programs, especially those managed by NGOs. Implementing a robust monitoring and reporting system at the woreda (district) and kebele (local) levels will facilitate effective integration and support for households.
- The study indicates that PSNP participants are less likely to pursue education compared to non-participants. Therefore, integrating educational interventions into the PSNP could improve participants' long-term livelihood and overall program impact, as education is a key factor in enhancing household living standards.

- Since participation in the PSNP is associated with increased household income, government and stakeholders should consider expanding the program to include more households. By retargeting additional eligible households, more families can benefit from improved livelihood opportunities.
- The success of the PSNP is positively influenced by access to extension services, non-farm activities, credit, and food aid. Government and non-governmental organizations should prioritize and strengthen these complementary sectors to further boost the program's effectiveness.

Conflict of Interest

Authors declare that there is no conflict of interests involve in publishing this research paper.

References

Andersson, C., Mekonnen, A., and Stage, J. (2011). Impacts of the productive safety net program in ethiopia on livestock and tree holdings of rural households. *Journal of Development Economics*, 94(1):119–126.

Becker, S. O. and Ichino, A. (2002). Estimation of average treatment effects based on propensity scores. *The stata journal*, 2(4):358–377.

Caliendo, M. and Kopeinig, S. (2005). Some practical guidance for the implementation of propensity score matching (iza dp no. *1588). Bonn: IZA. Forthcoming on Journal of Economic Surveys*.

Gilligan, D. O., Hoddinott, J., and Taffesse, A. S. (2009). The impact of ethiopia's productive safety net programme and its linkages. *The journal of development studies*, 45(10):1684–1706.

Mendola, M. (2007). Agricultural technology adoption and poverty reduction: A propensity score matching analysis for rural bangladesh. *Journal of Food Policy*, 32:372–393.

MOA (Ministry of Agriculture) (2014). *Productive safety net programme phase IV programme implementation manual*. Ethiopia, Addis Ababa.

Rosenbaum, P. R. and Rosenbaum, P. R. (2002). *Overt bias in observational studies*. Springer, New York. pp. 71-104.

Rosenbaum, R. and Ravallion, J. (2003). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1):41–55.

Sabates-Wheeler, R. and Devereux, S. (2010). Cash transfers and high food prices: Explaining outcomes on ethiopia's productive safety net programme. *Food policy*, 35(4):274–285.

Sandford, J. and Hobson, M. (2011). *Leaving No one Behind: Ethiopia's Productive Safety Net Household Asset Building Programmes*. World Bank, Washington, DC, USA.

Slater, R., Ashley, S., Tefera, M., Buta, M., and Esubalew, D. (2006). *PSNP policy, programme and institutional linkages*. ODI/IDL Group/Indak.

Wahba, a. D. (2002). Propensity score matching methods for nonexperimental studies. *The Review of Econometrics and Statistics*, 84(1):151–161.