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Full Length Research Paper

Evaluating the impact of small-scale irrigation practice on household income in Abay Chomen District of Oromia National Regional State, Ethiopia

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Being the backbone of the Ethiopian economy, agricultural practice has been traditionally dominated for centuries by small-scale farmers. Even though small-scale irrigation is practiced in the study area, its impact on household income is not analyzed systematically for further policy action. This study was conducted to evaluate the impact of participation in small-scale irrigation on household income in Abay Chomen district. In this study, two-stage sampling technique was used to select 167 target respondents. The primary data were collected using an interview schedule and conducting of focus group discussions and key informant interview. Various documents, such as published journals, policy documents, were reviewed to collect secondary data. Propensity score matching method of impact evaluation has been employed. The Propensity Score Matching model result revealed that participation in small-scale irrigation had a significant effect on household income. Since participation in small-scale irrigation have significant effect in improving household income, the government, especially Irrigation Development Office of the district should attempt to hamper factors that hinder participation in small-scale irrigation and enhance factors that initiate participation to improve participation in small-scale irrigation and hence household income in the study area.

Key words: Household income, participation, propensity score matching, small-scale irrigation

INTRODUCTION

In spite of agriculture status as the backbone of the Ethiopian economy, agricultural practice has been traditionally dominated for centuries by small-scale farmers and its performance has long been adversely affected by shortage of rain and water that left many to sustain their lives on famine relief support (Abebe et al., 2011). From the total production, about 97% of Ethiopia's food crops are produced by rain-fed agriculture, whereas only 3% is from irrigated agriculture (FAO, 2015). Due to high dependency on rain-fed agriculture, other

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topographic and low adaptive capacity along with other related factors, Ethiopia ranks the ninth most susceptible country in the world to natural disasters and weather-related shocks (Tongul and Hobson, 2013). But the small-scale irrigation (SSI) contributes to poverty alleviation by enhancing productivity which leads to an increase in income and promoting economic growth and employment (Garcia-Bolanos et al*.,* 2011). Irrigation also changes the lives of the rural households by increasing their production and productivity. A rapid increase in the area covered by irrigation, especially small-scale water use, provides farmers with opportunities to raise output on a sustainable basis and contribute to the reliability of food supplies (FAO, 2012). This indicates that there should be new means of production through irrigation water application by smallholder farmers rather than strongly relying on rain-fed agriculture. Hence, increasing the opportunity and reducing the hindrance to irrigation participation needs to be made because irrigation is one means by which agricultural production can be increased to meet the growing food demands in Ethiopia, since agriculture still plays a critical role in the economy.

There are different traditional and modern irrigation technologies that can be applied in Sub-Saharan Africa (Kay, 2001). Out of these, a wide range of well-established traditional technology options available for use by smallholders include bucket watering, water harvesting, swamp irrigation, spate irrigation, flood plain irrigation using seasonal water and shallow aquifers, as well as groundwater irrigation. All irrigation technologies have the potential to raise the productivity of water and labour (Abebe et al., 2011). Trickle and sprinkle irrigation along with piped supplies technologies are particularly relevant to smallholder farmers in developing countries because they are constrained in many ways, which makes them a priority for development efforts (Mwangi and Kariuki, 2015).

Ethiopia is a rich country in water resource and most of the time it is termed as a water tower of East Africa because of its abundant water resource availability (Adugna, 2014). It has a huge potential of water resource which accounts for 122 billion meter cube annual surface runoff and 2.9 billion meter cube groundwater, though it is characterized by uneven spatial and temporal distributions (Tesfa and Tripathi, 2015). However, Ethiopia is using very little of its abundant water resource potential for irrigated agriculture (ATA, 2016). Even though there is no similar evidence about the potential it have from different sources, Ethiopia has a high irrigation potential. The estimated total irrigable land potential in Ethiopia is 5.3 Mha assuming use of existing technologies, including 1.6 Mha through rain water harvesting and ground water (Awulachew, 2010).

Recent source indicates that, the total area of irrigated land in Ethiopia increased from 885,000 ha to 2.4 million ha from 2011 to 2015 with a plan of increasing irrigated land to 4 million by 2020 (ATA, 2016), including the 658,340 ha of land developed with high and medium irrigation schemes (NPC, 2015). Nevertheless, there is a plan to expand the high and medium schemes to about 954,000 ha by the end of the GTP-II (2019/20). Evidence also shows that, in Ethiopia, farm size per household is 0.5 ha and the irrigated land per households' ranges from 0.25 - 0.5 ha on average (MoA, 2011).

The population of the world is increasing and hence the food demand, but not the supply side. Sources indicate that compared to 2009, by 2050, 70% more food production is required to meet the global food demand and 100% for developing countries (Dubois, 2011). This shows that the growth in food demand for developing countries is very high as compared to developed countries, and this phenomena is the same for Ethiopia. The population of Ethiopia has been increased and it is above one hundred million currently (United Nations, 2017). To feed this highly increasing population, extensive system of increasing the agricultural product may not satisfactorily work since the supply of land is constant. The impact of participation in small-scale irrigation is significant in the world, because irrigation plays a fundamental role in world food provision. However, until recent years, it has performed below expectations in Sub-Saharan Africa (Garcia-Bolanos et al., 2011).

The farmers in Abay Chomen district fails to produce when there is shortage of rainfall despite its plenty of water resource potential that can be applied to agriculture. The farmers in the study area, Abay Chomen district, has been affected by the extreme events of climate change such as drought, flood and hailstone that lead the farmers to crop failure in different years (DOoARD, 2016). Nonetheless, irrigation can change the life of rural households (Abebe et al., 2011) and this can help the farmers overcome the problem of shortage of rainfall and crop failures due to hailstorm and flood. In addition to this, according to Dereje and Desalegn (2016), small-scale irrigation (SSI), both directly and indirectly, has a great impact on enhancing farmers' livelihoods through different dimensions, such as diversification of crops grown, as well as increased agricultural production, household income, but the impact of the irrigation on household income is not analyzed systematically in the study area, even though impact evaluation is the major policy issue. Because there was no study conducted on irrigation impact analysis conducted in the study area, therefore, the objective of this study is to analyze the impact of irrigation practice on household income in Abay Chomen district.

RESEARCH METHODOLOGY

Description of the study area

Abay Chomen District is one of the 9 districts in Horro Guduru Wollega zone of Oromia Regional State of Ethiopia, containing 19 kebeles, located at 9° 31' 42" to 9° 59' 48" N latitude and 37° 10'

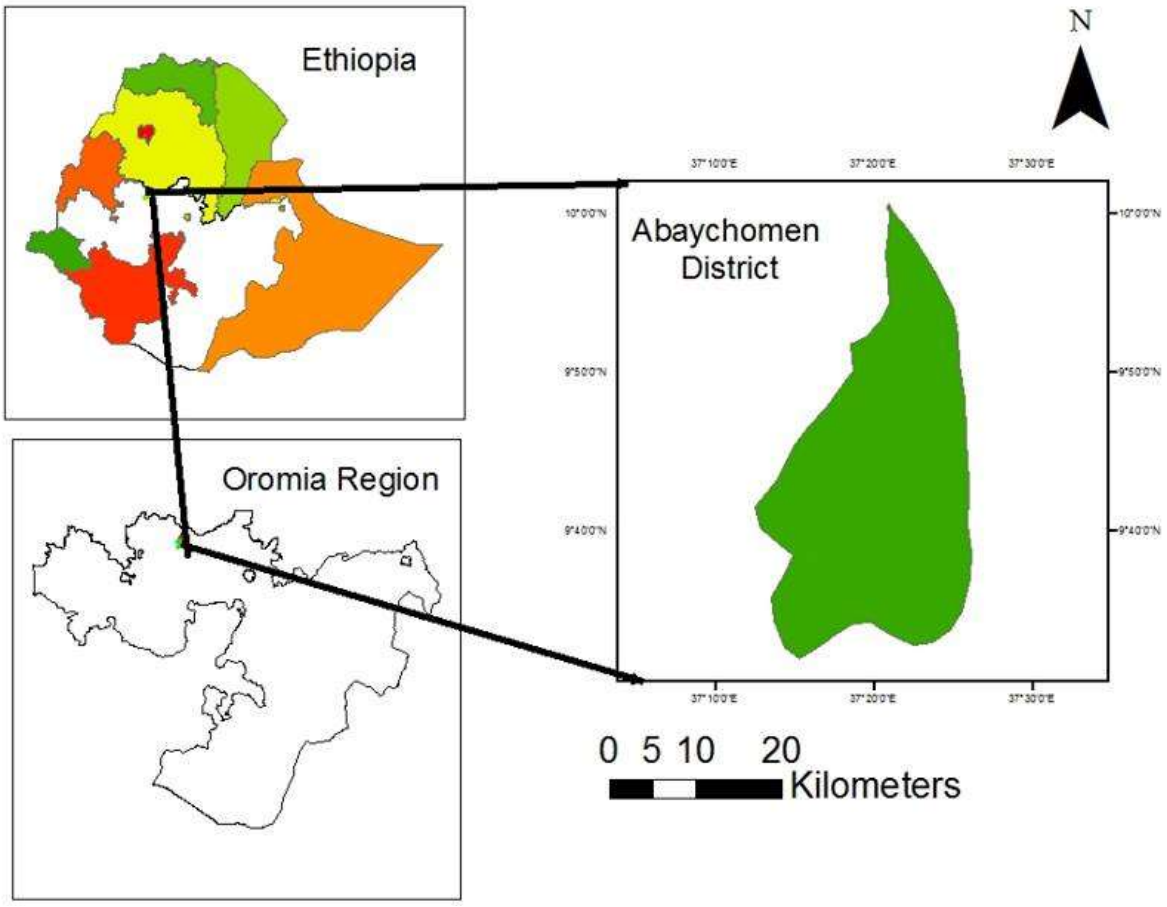

Figure 1. Location Map of Abay Chomen District, Oromia, Ethiopia.
Source: Own design with the help of GIS expert.

03" to 37° 28' 44" E longitude and the capital of the district Fincha town is 289 km northwest of Addis Ababa. The District is bordered on the east by Ababo Guduru district, on the southeast by Guduru district, on the south by Fincha River, on the south west by the Jimma Geneti district, on the northwest by Amuru Jarte district and on the north by the Abay River which separates it from the Amhara region. The area receives high rainfall in one season of the year. The total area of the District is estimated to be 801.7 km^2; approximately 45, 37, 4, 3 and 11% of the total area are cultivated land, non-cultivated, water bodies, settlements, and woodlands and forests, respectively (Tegbaru, 2014) (Figure 1).

The Ethiopian population projection was conducted by national CSA (Central Statistical Agency) for 2017, based on 2007 national census. The national Central Statistical Agency reported a total population for Abay Chomen district to be 64,672, of whom 33,263 (51.43%) were male and 31,409 (48.57%) were female; 15,232 or 23.55% of its population were urban dwellers (CSA, 2013).

The altitude of the study area range from 1,061 to 2,492 m above sea level (masl) with two agro ecological zones, mid-highland and low land. The northern part of the district (low land), which is mainly situated at altitude ranging from 1,138 to 1,687 masl in the Nile River Basin, is owned by Fincha Sugar Factory and is entirely being used for irrigated sugarcane (*Saccharum officinarum* L.) production. At altitudes ranging from 2,213 to 2,492 masl (mid- highland), smallholder farmers practice mixed farming systems that integrate both crops and livestock (animals used for traction, meat and milk). These areas are under intensive cultivation and maize (*Zea mays* L.), teff (*Eragrostis tef* (Zucc.) Trotter), bread wheat (*Triticum aestivum* L.), niger seed (*Guizotia abyssinica*), barley (*Hordeum vulgare* L.) and faba bean (*Vicia faba* L.) are the major crops grown by rain-fed agriculture (CSA, 2013). Crops most commonly produced by irrigated farming are maize, potato, green pepper and tomato (DOoARD, 2016). Areas situated at altitude ranging from 1,061 to 1,138 and 1,687 to 2,213 masl are mainly woodlands and forests, and non-cultivated escarpments (Tegbaru, 2014).

The recent years meteorological data of the nearby representative stations, Fincha Sugar Factory and Shambu Meteorological Stations showed that the mean annual minimum and maximum temperatures of the district are 13.4 and 27.2°C, respectively, and the mean annual rainfall is 1,399 mm (Tegbaru, 2014). The area has a uni-modal rainfall pattern for about 5 months from mid May to October and the highest intensity of rainfall is recorded in the month of July. The area is characterized as hot to warm moist lowland and tepid to cool moist mid-highlands based on the classification of agro-ecological zones of Ethiopia (Alemayehu, 2006).

Sampling method and sample size

The household was the basic sampling unit. In this study, a two-stage sampling technique was used to generate the required primary data. In the first stage, three kebeles from 16 non-urban, mid-high land farmer kebeles in the district were selected randomly.

In the second stage, by stratifying the households into participant and non-participant, a probability proportional to sample size sampling procedure was employed to select 167 sample households. From the total sample, 80 participants and 87 non-participants were randomly selected, after preparing sample frame of participants and non-participants in the selected kebeles. But five observations (three participants and two non-participants) were excluded from the analysis due to missing values and 162 sample (77 participants and 85 non-participants) were used in the analysis. This sample size is assumed to represent the population, since the district is more or less homogeneous in terms of climate, resource endowment and other factors related to the issue of the study.

To determine the representative sample from the study area, the formula for sample size determination adjusting degree of precision to 0.07 due to shortage of resource, following Cochran (1977) has been used. Also, the sample size from each kebele was determined by proportionality formula.

Therefore, sample size is determined by Formula 1:

$$n = \frac{Z^2 * (p)(q)}{d^2} \quad (1)$$

where n = sample size; Z = standard normal deviation (1.81 for 93% confidence level); P = 0.5 (The proportion of the population participating in irrigation, that is 50%) due to unknown variability; q = 1-P =0.5 (50%). The two equal proportions (p and q) is based on sampling rule after Cochran (1977) for unknown variability of the population; d = desired degree of precision, (0.07) in this case.

Types of data, data sources and methods of data collection

For this study, quantitative and qualitative data from primary sources and secondary information were used. The source for primary data was the sample farmers in Abay Chomen district and the source for secondary data are local offices, higher governmental organizations, different publications and policy documents. To obtain primary data, semi structured questionnaire, with both closed and open-ended questions was used as a tool to collect data from sample households. For the sake of conducting this study, important variables on economic, social and institutional factors related with the households in the study area were collected. The variables involve both qualitative and quantitative nature. Qualitative data was collected on variables such as sex, accessibility of different service, whereas distance to the market, number of oxen, education level are some of the quantitative variables considered for constructing the propensity score.

For collection of primary data, enumerators, with at least secondary education that can speak local languages were recruited. Necessary care was taken in recruiting the enumerators. They were given an intensive training on data collection procedures, interviewing techniques and the detailed contents of the questionnaire. The households' questionnaire was translated into local language (Afaan Oromoo), to convey the questions effectively to the rural interviewees and it was pre-tested, filled by the trained and experienced enumerators. Strict supervision was made by the researcher during the course of the survey. Secondary information was collected from documents and publications of different organizations and relevant local offices as well as journal documents. Moreover, available documents such as policies, strategies, guidelines and reports relevant to irrigation has been reviewed.

Methods of data analysis

There are several methods by which impacts can be evaluated under non-experimental or quasi-experimental approaches. These include randomized selection methods, propensity score matching, regression discontinuity design, difference-in-difference and instrumental variable estimation methods (Khandker et al., 2010).

The difference in difference design for empirical analysis of causal effects has a long history in and outside econometrics and it is one of the most heavily used empirical research designs to estimate the effects of policy changes or interventions in empirical microeconomics nowadays (Lechner, 2010). Difference in difference could be an attractive choice when using research designs based on controlling for confounding variables or using instrumental variables is deemed unsuitable, and at the same time, pre-treatment information is available (Albouy, n.d.). It has the advantage that the basic idea is very intuitive and thus easy to understand for an audience with limited econometric education. Compared for example to matching methods, it has the further advantage that there is no need to control all confounding variables, since we have double difference. In many applications, time is an important variable to distinguish the treated and control groups in difference in difference (Roberts and Lemmon 2007). Difference in difference has the assumptions such as the model in equation (Outcome) is correctly specified, the error term is on average zero and error term is uncorrelated with the other variables in the equation (Albouy, n.d.). This method is best applied under the mentioned assumptions and merits.

Regression discontinuity (RD) is one of the rigorous non-experimental impact evaluation approach that can be used to estimate program impacts in situations in which candidates are selected for treatment based on whether their value for a numeric rating exceeds a designated threshold or cut-point (Jacob and Zhu, 2012). It is based on the cut-off point in observable characteristic, often called the rating variable. RD techniques are considered to have the highest internal validity (the ability to identify causal relationships in this research setting), but their external validity (ability to generalize findings to similar contexts) may be less impressive, as the estimated treatment effect is local to the discontinuity (Baum, 2013). The treatment is not randomized, but there is some process that deterministically dictates whether a unit is treated or not, cut-off point. In this design, units receive treatment based on whether their value of an observed covariate is above or below a known cut-off (Calonico et al., 2013). But when using instrumental variable for causal inference, one must assume the instrument is exogenously generated as if by a coin-flip (Lee and Lemieux, 2010). This implies that in the instrumental variable method there is a randomized variable that is correlated with the treatment.

Propensity score matching (PSM) has two key underlying assumptions (Baum, 2013). The first one is conditional independence; there exists a set X of observable covariates such that after controlling for these covariates, the potential outcomes are independent of treatment status. The other one is common support, for each value of X, there is a positive probability of being both treated and untreated. It is used when it is possible to create a comparison group from a sample of non-participants closest to the treated group using observable variables. Both groups are matched on the basis of propensity scores, predicted probabilities of participation given some observed variables. Propensity score matching consist of four phases most commonly: estimating the probability of participation, that is, the propensity score, for each unit in the sample, selecting a matching algorithm that is used to match beneficiaries with non-beneficiaries in order to construct a comparison group; checking for balance in the characteristics of the treatment and comparison groups; and estimating the program effect and interpreting the results (Caliendo and Kopeinig. 2005).

For several underlying conditions, the propensity score matching method was used in this particular study. Propensity Score Matching (PSM) is used when it is possible to create a comparison group from a sample of non-participants closest to the treated

group using observable variables. Both groups are matched on the basis of propensity scores, predicted probabilities of participation given some observed variables. Propensity score matching consist of four phases most commonly: estimating the probability of participation, that is, the propensity score, for each unit in the sample; selecting a matching algorithm that is used to match beneficiaries with non-beneficiaries in order to construct a comparison group; checking for balance in the characteristics of the treatment and comparison groups; along with estimating the program effect and interpreting the results (Caliendo and Kopeinig, 2005).

In this study, the propensity score matching has been used for analyzing the impact of irrigation practice on household income for several reasons. Firstly, there was no baseline data on participants and non-participants as it is common in many research works conducted on impact evaluation. Second, the participants in small-scale irrigation may be self-selected to participate. Furthermore, the available field data was based on a cross-sectional survey. Finally, it is possible to identify some features, in this case socio-economic, institutional and physical characteristics, to match the participants and non-participants.

The interest of this study was to determine the average treatment effect on the treated (ATT) of irrigation practice. But the estimation of this effect is impossible based on the before and after because of absence of baseline data and it needs substituting the counterfactual mean of treated, by the mean outcome of untreated (Caliendo and Kopeinig, 2005). Even though it is possible based on the 'with and without' data, it will be a biased estimator under selectivity biasness. To solve this problem, PSM was used because it provides an appropriate solution (Rosenbaum and Rubin, 1985). It accounts for sample selection bias due to observable differences between treatment and comparison groups. It controls for self-selection by creating a statistical comparison group by matching every individual observation of the treatment group with individual observations from the control group with similar observable characteristics.

There are different matching algorithms that can be used to determine the treatment effect on the treated in PSM. But the most common matching algorithms used in PSM include: nearest neighbor matching, radius matching and kernel matching. These matching methods use different means of matching the treated to the control group to determine the average effect of a given program participation or intervention.

The matching algorithms were tested to be used in the estimation of the impact of participation in small-scale irrigation and the best of the three was selected after undertaking the test for the three most common PSM algorithms. But there is no clear rule for determining which algorithm is more appropriate in each context. However, a key issue that has been considered was that, the selection of the matching algorithm implies a bias/efficiency trade-off. For instance, by using only one nearest neighbor we guarantee that we are using the most similar observation to construct the counterfactual. This minimizes the bias, since the characteristics between both units will be, in general, very similar. However, using this technique ignores a lot of information from the sample, since many untreated units are not used for the estimation. Therefore, the reduction in the bias comes with an increase in the imprecision of the estimates caused by a higher variance, that is, a decrease in efficiency. On the other hand, when using many neighbors, the estimator is more efficient since it exploits a larger quantity of information from the untreated pool, but at the expense of increasing the bias by using poorer matches.

The choice of the matching algorithms was based on the most important tests to reduce the bias and inefficiency simultaneously. These tests include mean bias, number of matched sample, value of pseudo R square, and number of the balanced covariates. When considering the mean bias, the one with lowest mean bias is better matching algorithm. Based on number of samples matched, the one with the highest matched number of observation is the best and selected. When coming to the value of the pseudo R square after matching, the matching algorithm with the lowest pseudo R square is the best matching algorithm. On the other hand, the matching algorithm with the highest number of balanced covariates is more appropriate. Hence, based on the overall test of these criteria, the kernel caliper matching algorithm was selected and used in the determination of the effect of participation in irrigation on household income.

EMPIRICAL RESULTS AND DISCUSSION

Impact of small-scale irrigation on household income

This part of the work is concerned with the impact evaluation of participation in small-scale irrigation by farmers on household income. The impact evaluation in this particular case of study was conducted by the use of propensity score matching (PSM) method of impact evaluation mainly because of the absence of baseline data. PSM consists of four phases: estimating the probability of participation, that is, the propensity score, for each unit in the sample; selecting a matching algorithm that is used to match beneficiaries with non-beneficiaries in order to construct a comparison group; checking for balance in the characteristics of the treatment and comparison groups; along with estimating the program effect and interpreting the results (Stuart, 2010). Therefore, the above main issues are now presented.

Estimation of propensity score

Any model relating a binary variable to a set of predictors can be used. In this study, the propensity scores are constructed using the logit regression, because it is the most common model for propensity score estimation as stated in Stuart (2010). The overlap condition was determined for the total observations, and in order for the propensity scores to correctly estimate the probability of participation, the characteristics included in the propensity score estimation has been well-considered and were exhaustive. However, it is very important that characteristics which may have been affected by the treatment are not included in the estimation of propensity score. Table 1 shows the value of the covariates related with the estimation of propensity scores for the individual observations, that is, the probability of assigning the observation to participate in small-scale irrigation.

The common support region (overlap condition) for the estimated propensity score is constructed based on the summary statistics of the participants and non-participants. Therefore, the common support region was determined by taking the maximum of the minimums and minimum of the maximums for the two groups' propensity scores. Based on this technique, the common support region was found to be between the value of propensity

Table 1. Logit model coefficients in estimation of propensity score.

Variable	Coefficient	Std. Err.	Z	P >Z
Age	-0.0062	0.0441	-0.14	0.888
Oxen	1.4673	0.6202	2.37	0.018
Land size	0.1289	0.4213	0.31	0.76
Market distance	-2.1502	1.3051	-1.65	0.099
Farm distance	-0.9093	0.2943	-3.09	0.002
Family size	-0.1404	0.3643	-0.39	0.7
Total livestock	-0.0953	0.1022	-0.93	0.351
Education level	-0.1390	0.2543	-0.55	0.585
Road distance	-0.7965	4.3357	-0.18	0.854
Sex	1.4452	3.5461	0.41	0.684
Market information	5.4115	1.8820	2.88	0.004
Training	1.2627	1.4234	0.89	0.375
Credit access	1.3298	1.5127	0.88	0.379
Non-farm activity	1.4716	1.5546	0.95	0.344
Constant	4.9869	4.0031	1.25	0.213

Number of observation = 162; LR Chi^2 (14) = 194.37; Prob > Chi^2 = 0.0000; Log likelihood = -14.906577; Pseudo R^2= 0.8670.
Source: Own estimation from Survey Data (2017).

Table 2. Summary of common support region for estimated propensity score.

Variable		Obs	Mean	Std. Dev.	Min	Max
Propensity score	Non-participants	85	0.055007	0.166728	1.21e-16	0.9587823
	Participants	77	0.934874	0.159041	0.1237672	1
	Common support	137	0.5474796	0.274977	0.1237672	0.9587823

Source: Own estimation from Survey Data (2017).

score of 0.1237672 and 0.9587823 (Table 2). As a result of the overlap condition, 25 observations (8 non-participants and 17 participants) were found to be out of the common support and hence they were excluded from the observations used to analyze the impact of participation in small-scale irrigation on household income (treatment effect on the treated).

Selecting a matching algorithm

Once the propensity scores are estimated, units in the treatment group (beneficiaries) are then matched with non-beneficiaries with similar propensity scores, or probability of participating in the program. There are a number of matching algorithms which can be employed in undertaking the impact evaluation to get the effect of the treatment. The most common matching algorithms used in PSM include: nearest neighbor matching, radius matching and kernel matching. These matching methods use different means of matching the beneficiaries to the control group to determine the average effect of certain program participation or intervention.

The test for three common matching algorithms in PSM with different criteria was used to test among the matching algorithms and within the matching algorithm under different scenarios (different caliper distance and number of nearest neighbor). The simultaneous test of the matching algorithms, the mean bias, the number of matched observations, the number of balanced covariates and the value of the pseudo R square for best nearest neighbor matching are 8.1, 102, 14 and 0.062; for radius matching are 8.9, 102, 14 and 0.081, for kernel matching are 3.7, 101, 14 and 0.051, respectively (Table 3). Based on these values of the test, the matching algorithm with the lowest mean bias, lowest pseudo R square, approximately equal number of matched observations and equal number of balanced covariates compared to other matching algorithms, kernel matching is found to be the best, in addition to the fact that this matching algorithm consists of more information in estimating the effect which reduces the variance. Therefore, kernel caliper matching was selected because it represents the best matching algorithm. Hence, kernel

Table 3. Tests on propensity score matching algorithms

Matching algorithm	Mean bias	Pseudo R square	No. of matched observations	No. of balanced covariates
Nearest neighbour	8.1	0.062	102	14
Radius matching	8.9	0.081	102	14
Kernel matching	3.7	0.051	101	14

Source: Own estimation from Survey Data (2017).

matching algorithm was selected as the best matching algorithm under PSM and it was used to estimate the impact of participation in small scale irrigation on household income.

Checking for balance

Once units are matched, the characteristics of the constructed treatment and comparison groups should not be significantly different; this implies that the matched units in the treatment and comparison groups should be statistically comparable. Balance is tested using a t-test to compare the means of all covariates included in the propensity score in order to determine if the means are statistically similar in the treatment and comparison groups. This test (t-test) is preferred when the evaluator is concerned with the statistical significance of the results (Solivas et al., 2007). If balance is not achieved, that is, the means of the covariates are statistically different, a different matching option or specification should be used until the sample is sufficiently balanced. In this case, the balance for the covariates is tested for balance in the mean of covariates across the participants and non-participants and it revealed that the balanced test of the covariates is satisfied by t-test. In addition to the above statistical test, and for the balance of covariates to be trustworthy, the absolute standardized differences of means of covariates should be less than 25% and the overall absolute mean bias should be between 5 and 2% (Rubin, 2001). These criteria has also been satisfied because the individual covariates mean difference between participants and non-participants is less than 25% and the overall absolute mean bias is 3.7% which is between 5 and 2%. The result of the test is given in Table 4.

From the result of testing for balance of the covariates between the treated and comparison group, it shows that there was no significant difference between the two groups on the covariates after matching because the t-test shows absence of significant difference. Therefore, the covariate balance criteria are satisfied.

Estimation of the effect of treatment and interpretation of results

Estimation of the impact of a certain technology intervention is based on the above mentioned steps of propensity score matching when we do not have the baseline data. Following the estimation of propensity scores, the implementation of a matching algorithm, and the achievement of balance, the intervention's impact may be estimated by averaging the differences in outcome between each treated unit and its neighbor or neighbors from the constructed comparison group. The difference in averages of the subjects who participated in the intervention and those who did not can then be interpreted as the impact of the program. The impact evaluation of the average treatment effect on the treated of participation in small-scale irrigation for this study was conducted using kernel matching. Bootstrap method was used to estimate standard errors for matching estimator to account for the fact that the propensity score is also estimated. Table 5 shows the impact of participation in small-scale irrigated farming on household income.

After estimating the treatment effect, sensitivity analysis, Rosenbaum bound estimation was conducted between the gamma values of 1 and 3, by adding 0.25 on 1 and continuing up to 3, to test whether the treatment effect on the treated is sensitive to the hidden bias (unobservables). The sensitivity analysis is conducted at gamma 1, 1.25, 1.5…3. The analysis result indicated that the average treatment effect on the treated is not sensitive to an increase in hidden bias (unobservables) up to 200%.

From Table 5, the average treatment effect on the treated is about ETB 7741 and it is significant at 10% significance level. This finding is consistent with certain studies conducted on impact of participation in irrigated farming on household income using propensity score matching (Nicoletti, 2011; Dillon, 2011; Hadush, 2014; Shiferaw and Mengistu, 2015). Therefore, irrigation practice in the study area should be encouraged and the problems hindering small-scale irrigation practice should be attempted to be solved by government and any other stakeholders. The estimation was conducted by the three matching algorithms radius matching, kernel matching and nearest neighbour to show that the estimation is robust. Kernel matching and nearest neighbour matching showed almost similar results but the result from radius matching was insignificant.

CONCLUSION AND RECOMMENDATION

This study examined the impact of small-scale irrigation

Table 4. Test of balance of covariates after matching.

Variable	Unmatched	Mean		%Bias	%Reduct	t-test	
	Matched	Treated	Control		|bias|	t	p>t
Age	U	39.51	44.13	-36.5		-2.32	0.022
	M	40.25	40.66	-3.2	91.2	-0.09	0.925
Oxen	U	3.61	1.60	177.6		11.35	0.000
	M	2.88	2.81	5.9	96.7	0.11	0.909
Land size	U	3.31	2.36	53.7		3.43	0.001
	M	2.66	2.65	0.4	99.3	0.01	0.992
Market distance	U	0.96	1.14	-29.9		-1.90	0.059
	M	0.84	0.84	-0.1	99.7	-0.00	0.998
Farm distance	U	6.46	15.22	-227.6		-14.32	0.000
	M	7.53	7.83	-7.8	96.6	-0.27	0.788
Family size	U	5.60	5.74	-7.7		-0.49	0.627
	M	6.06	6.05	0.8	89.2	0.02	0.984
Livestock	U	12.75	10.32	36.7		2.34	0.021
	M	10.34	10.81	-7.1	80.5	-0.21	0.832
Education	U	5.78	1.78	120.2		7.76	0.000
	M	4.88	5.05	-5.2	95.7	-0.15	0.882
Road distance	U	0.33	0.46	-83.4		-5.29	0.000
	M	0.40	0.40	-0.6	99.3	-0.02	0.987
Sex	U	0.05	0.08	-12.1		-0.76	0.445
	M	0.00	0.00	0.0	100.0	-	-
Market Information	U	0.90	0.22	183.1		11.55	0.000
	M	0.50	0.48	5.3	97.1	0.11	0.916
Training	U	0.78	0.38	88.8		5.62	0.000
	M	0.56	0.53	7.8	91.2	0.20	0.846
Credit	U	0.57	0.20	82.0		5.24	0.000
	M	0.25	0.27	-5.1	93.8	-0.14	0.886
Non-farm act.	U	0.17	0.19	-5.0		-0.32	0.750
	M	0.19	0.20	-2.6	49.3	-0.07	0.946

Overall balance indicators of covariates					
Sample	**Pseudo R^2**	**LR Chi^2**	**p>Chi^2**	**Mean bias**	**Median bias**
Unmatched	0.868	194.64	0.000	81.7	67.9
Matched	0.051	2.25	1.000	3.7	4.2

U-Umatched, M-Matched
Source: Own estimation from Survey Data (2017).

practice on household income by the farm households in Abay Chomen district. The study used descriptive statistics and propensity score matching for data analysis obtained from sample households' interview concerning small-scale irrigation in the study area. The sample of 162 of the farm households selected by multi-stage

Table 5. Impact of participation in irrigation on household income.

Variable	Sample	Treated	Controls	Difference	Std. Error (bootstrapped)	T-stat
Annual Income	Unmatched	50753.48	30175.35	20578.13	4203.18	4.90***
	ATT	34834.22	27092.88	7741.33	4157.89	1.86*

* and *** indicates significant at 10 and 1% significance level, respectively. ATT: Average treatment effect on the treated.
Source: Own estimation using kernel matching from Survey Data (2017).

sampling technique were used in the analysis excluding five samples with missing values.

The estimation of propensity score was conducted by using the commonly used logit model. The choice of matching algorithm was based on different criteria, mean bias, pseudo R square, number of matched observations and number of balanced covariates. Based on these criteria, kernel matching was selected and used for the analysis because it has been found relatively the best fitting alternative. After testing, the balance of covariates after matching the estimation of the treatment effect on the treated was conducted using kernel matching. The estimation result revealed that the impact of small-scale irrigation practice on household income was significant. The result indicated that the mean income of participant households in small-scale irrigation practice was significantly higher than those households not participating in small-scale irrigation in Abay Chomen district.

The study revealed that there is positive significant impact on the income of participant household income as a result of participation in small-scale irrigation. Therefore, the government and any concerned stakeholder should work on how to expand the utilization of small-scale irrigation in Abay Chomen district, so that it would directly improve the income of farming households and indirectly contribute to the economic development of the country as a whole.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Factors affecting performance of youth and women's agricultural cooperatives: A case of some selected cooperative societies in Eastern Cape, South Africa

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Rural youth and women are the major victims of poverty caused by deprivation. As a group, they lack access to land, financial capital and participation in decision processes in the family and community levels. One way of overcoming this challenge is through the formation of cooperative societies. As cooperative societies are saddled with the responsibility of providing needs to their members and enhance the quality of their member's livelihoods, they are however, lacking the financial muscle in providing adequate loans and access to credit which hinders their performance. This study therefore examined the impact of entrepreneurial spirit on the performance of youth and women cooperatives in Eastern Cape, South Africa. In achieving this goal, data were collected from 70 cooperators by means of the random sampling technique. Data collected using the questionnaire were analyzed using descriptive and inferential model of regression. Evidence from the study revealed that youth and women cooperators are involved in different empowerment activities. Findings also suggest that the empowerment activities have a positive influence on entrepreneurial spirit of youth and women cooperators.

Key words: Agricultural cooperatives, youth, women, performance, Eastern Cape.

INTRODUCTION

South African agriculture is of a dual nature, with a well-developed commercial sector comprising about 46,000 commercial farmers occupying 86% of agricultural land, while small-scale communal farmers occupy the remaining 14% of farmland (National Department of Agriculture (Agricultural Statistics, 2005). According to the Nyeleti Network (2011), small-holder agriculture consists of 300 000 to 400 000 predominantly black farmers; there is however a lack of sufficient data regarding the smallholder sector, which when combined

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farm an estimated 14 million hectares of agricultural land and are concentrated principally in the former homeland areas of the country, thus marginalized into regions of poor productive land, with little or no infrastructural support, and water resources. The smallholder farmers generally have low levels of production efficiency. Smallholder farmers' production inefficiency is related to various factors, including their lack in sufficient farm management skills for example natural resource management, production and infrastructural management and other factors.

Van der Walt (2005) reveals that back in 1844 a group of 28 unemployed community members from Canada saw an opportunity to pool together their limited resources in an attempt to form a cooperative with the aim of benefiting from it and better improving their livelihoods, although this was not the first cooperative to be established but it is seen as the first modern cooperative since the current principles guiding cooperatives were developed by this group. The current principles that guide all co-operatives were adopted by the International Co-operative Alliance (ICA) in 1963, a modification of the principles established by Rochdale and Craig (1980); advocates that the group was founded on three principles; equality, equity and mutual self-help. At the annual conference of the ICA in 1963, seven principles to govern all co-operatives were adopted.

According to Conn (2003), all co-operatives are expected to uphold each principle. Today, co-operatives are commonly defined as "an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise" and this definition applies to all cooperatives regardless of type, community or membership size or geography. Although there may be a number of challenges faced by the collective operation but co-operatives may be a tool to initiate the development in rural areas.

Statement of the problem

Since the early 20th century, agriculture co-operatives have played an important role in the development of the commercial agriculture sector in South Africa. With government's support for commercial farmers through subsidization, co-operatives have served commercial agriculture as suppliers of inputs to farmers and as marketing agents of their commodities through various marketing. However, small-scale farmers in South Africa did not have access to the services of these co-operatives under the previous apartheid government policies, which restricted black farmers' activities to the former homelands.

According to Chibanda (2009), the governments in less-developed countries have often promoted the use of cooperatives as organizations that could enhance the development of their small-scale farmers. Likewise in South Africa since 1994, government has been supporting the growth of cooperatives especially among historically disadvantaged black communities as a strategy to alleviate poverty and create jobs. But government did not consider the cooperatives Act of 1981 as a suitable vehicle for the development of cooperatives in the new economic and political era. As a result, a new co-operative Act was formed based on international cooperative principles.

Previous studies conducted on co-operatives in South Africa as well as in other African countries suggest that co-operatives have dismally failed because they struggled to raise adequate resources. A study conducted by Machethe (1990) on poor performing and failed cooperatives in the former homelands of South Africa suggests that members did not clearly understood the purpose of a cooperative, their obligations and rights, or how to manage their business as well. In addition Van der Walt (2005) on his study on cooperative failures in Limpopo province also indicated that poor management, lack of training, conflict among members (due mainly to poor service delivery), and lack of funds were the main causes while Van Niekerk (1988) blamed the failure of cooperatives in South Africa's communal areas largely on poor management.

In South Africa, cooperatives are seen as a means of economic development and likely to increase agricultural production. Agricultural cooperatives help in the procurement of farm inputs to their members at reasonable costs and are useful in dispensing farm products to their members at least prices. Due to the declining productivity in small holder farmers in agriculture, the government accepted the idea of using agricultural cooperatives as a means of increasing food production and security. According to Simelane (2009) this has come in form of provision of cooperatives credit, supply of inputs, group ownership and farm practice.

Although the government has been supporting with inputs and other services, the performance of co-operatives in Eastern Cape has been debatable, since the number of co-operatives that are dormant is increasing over time (DTI, 2004). There are more than 3000 registered cooperatives in the Eastern Cape, however little is known about the organisation and functioning of these cooperatives. According to a research that was done (DTI, 2004), the co-operative sector face problems like market access, training and skill, and mainly access of funds were they can expand their working technologies.

Despite the support that cooperatives receive, it does not appear that they are making a significant impact in agriculture and other sectors in the Eastern Cape Province. This is a major problem if cooperatives are to survive and fulfil their mandate or objectives. Limited research has been conducted on cooperative

performance in South Africa. Thus, this study seeks to identify factors hindering performance of cooperatives in the Eastern Cape Province. Furthermore, it seeks to make suggestions towards enhancing the development and performance of cooperatives as a whole.

The main aim of this study was to examine the impact of entrepreneurial spirit on the performance of youth and women cooperatives in Eastern Cape, South Africa and the objectives was 1) to examine the socio economic status of youth and women cooperators; 2) to identify the entrepreneurship activities that cooperatives offer to the members; 3) to assess factors affecting performance of youth and women agricultural cooperatives and 4) to give policy recommendation on the identified factors affecting cooperative performance.

Based on the topic, the overall purpose of this study was to enhance our understanding of the nature of cooperative societies and their performance. Thus, the research intended to identify the key challenges that the cooperatives face and to make conditions of eliminating them. The findings of this study will help policy makers and cooperative practitioners to see the need to support these ventures which will create employment and improve the lives of rural poor.

MATERIALS AND METHODS

Description of the study area

This study was undertaken in the Eastern Cape particularly in Mnquma Local municipality (Figure 1). The municipality falls in the zone of two historically conflicting races, which are the blacks and whites. The racial difference and conflict later manifested themselves in laws favoring whites to access key means of production whereas blacks were resettled in the former homeland reserves of Ciskei and Transkei with limited access to means of production (Nel and Davies, 1999). According to Nel and Davies (1999), Ciskei and Transkei reserves came to be known as *"homelands".* The formation of these two reserves for the resettlement of thousands of people compounded differences, particularly in terms of the small size landholdings allocated, increased rural densities and limited access to state support and infrastructure. Consequently, the former homelands are characterized by extreme overcrowding and frequent environmental collapse. Land appropriation and uneven development regarding service provision characterize the municipality. According to Stats SA (2011), Mnquma Local Municipality has a population of 252 390 which is 10.7 percent of the total population of Amatole District Municipality. The municipality covers an area of 3270 square kilometers (Mnquma Municipality, 2004). The average population density is 77 persons per kilometre square (Stats SA, 2004). The majority of the population (81 percent) resides in villages, 0.1% on farms and 18.9% is in urban areas. Social services and government grants are the largest sources of cash income in the municipality, constituting 50% of the Gross Geographic Product. The main language is IsiXhosa spoken by 96.1%, followed by English 1.4%, then 2.5% other languages (Mnquma Municipality, 2004). The long term mean temperature is 18°C and annual rainfall range between from 600 mm and 800 mm, with 60 to 75% of the rainfall being received in summer (November to April) (ECDA, 2006). Summer temperatures range from 22°C in higher altitude areas to 27°C in lower altitude areas while winter temperatures range between 3 and 10°C.

Research design

The study applied a cross-sectional research design to collect data. This method was chosen because it is better and more effective for obtaining information about the current status or the immediate past of the case under study. It is also appropriate and suitable to use data collection tools such as questionnaires, interviews, focus group discussions (FGD), field observations, and document analyses. The data collection work was undertaken in 2015.

Sampling technique and Sample size determination

This section discusses the sampling technique and how the sample size was derived in the study. According to Mugenda and Mugenda (2003), a sample of 10 to 30% is good enough if well-chosen and if the elements in the sample are more than 30. But, in this research, a sample of 77 co-operators was chosen, from the whole population those involved in cooperative societies so that the population is fairly representative. The sample was drawn from the population with the enterprise. The sampling frames were, therefore, the list of the population that is found in Eastern Cape Province.

Data collection instrument

The study made use of the primary data which will be collected by means of semi-structured questionnaire. The data that was collected through questionnaires is made up of co-operative composition and formation, economic, institutional and governance factors affecting co-operative performance (Table 1).

Once prepared, the questionnaires were discussed with extension officers and relevant personnel; it was then be pre-tested to ensure validity and reliability of the data that is to be collected. After the approval of questionnaires, face to face interviews were conducted by the researcher with members to generate all the data that was required. The questionnaires were mainly open-ended and closed questions written in English; that allowed the respondents to elaborate and support their answers, as this was an exploratory type of research. Though they were written in English, they were not going to be posted or sent to the respondents, but they were administered by the researcher and a colleague, interpreting them in Xhosa where there was a need.

Data analysis

Upon the completion of data collection, two methods were used. The two methods were descriptive and multiple regression analysis. Before this, the data was firstly recorded in Microsoft Excel for ease of analysis and then it was imported to a statistical package known as SPSS v.21 for analysis. Descriptive analysis was used to describe general information about co-operatives that is the formation and registration. Regression analyses were used to test the relationship between institution, governance and economic factors on co-operative performance.

Descriptive analysis

Descriptive analysis was used to characterised and understand the structure of selected co-operatives. Descriptive statistics included age, gender and level of education for the leader; organisational structures and systems; and systems (business management, and development).

Figure 1. The Eastern Cape Province map showing the study areas.
Source: Google maps, 2014.

Logistic regression model

In order to assess factors affecting cooperative performance, a logistic regression model was used in the following type:

Y = F (age of respondents, gender of respondents, Household size, age of cooperative, size of a cooperative, management ability, entrepreneurship spirit).

Where, Y = Annual profit/Growth in Sale/Number of employees'.

The model is specified as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_{8,\ldots\ldots} X_n + \mu) \quad (1)$$

The equation (1) can then be specified as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu \quad (2)$$

Where,
β_0 = Intercept; β_1, β_2, …… β_8 = Regression coefficient; X_1, X_2, ... X_8 = Independent variables and μ = error term.

Definition of variables and hypotheses

In this study, performance status was taken as the dependent variable which is explained by different demographic, socio-economic and institutional factors. Variables definition and hypothesis are given in Table 2.

RESULTS AND DISCUSSION

Descriptive statistics

Socio economic status of youth and women cooperatives

Socio economic profile of youth and women cooperatives is displayed in Table 3. The socio economic characteristics entail the fundamental background of cooperative members. Therefore, these are characteristics set to describe the correlation of socio economic characteristics factors such as age, gender, household size, age and size of a cooperative, management ability, entrepreneurship spirit and access to credit in relation to performance.

Age of respondents

The household heads 'age can be used as a proxy to

Table 1. Basic information of selected cooperatives.

Cooperative type	Cooperative year of establishment	Total members at the time of the study
Vegetable cooperative 1	2003	7
Vegetable cooperative 2	2005	16
Vegetable cooperative 3	2002	6
Vegetable cooperative 4	2005	4
Vegetable cooperative 5	2004	4
Honey Bee cooperative	2012	13
Livestock cooperative	2002	13
Poultry cooperative 1	2001	8
Poultry cooperative 2	2011	6
Total		**77**

Source: Field survey, 2014.

Table 2. Hypothesized relationship between the dependent variable and the expected outcome.

Response variable	Predictor variable	Expected outcomes
Profit **Sales** **Employees**	Age of the head (Actual number of years)	+
	Gender of the farming household head (Male =1, Female = 0)	+/-
	Marital status of the farming household head (Single = 1, Married = 2, Divorced = 3)	+
	Farming household size (Number of persons)	+
	Age of a cooperative	+
	Size of a cooperative	+
	Education level of the farming household head (Number of years spent at school)	+
	Leadership skills (Yes = 1, No = 2)	+
	Membership participation (Yes = 1, No= 2)	+
	Access to credit (Yes =1, No = 0)	+
	Access to training (Yes = 1, No = 0)	+
	Access to market (Yes = 1, No = 0)	+/-

Source: Authors own conceptualization.

explain the farmer‘s experience in farming. In other words, age of the household head is a very crucial factor since it reflects whether the household benefits from the experience of the older person or based on their decisions on the risk taking attitudes of younger farmers (Makhura et al., 2001). Age of the household head refers to the number of years a member has lived until the day of this study’s interview. Following the descriptive statistics results, the average age of the respondents was 25 with a standard deviation of 4.23 and a minimum and maximum age of 20 and 33 respectively.

Gender

Prakash (2003) revealed that gender is an important factor due to its influence on traditional farming. However, when it comes to farm performance it is difficult to predict. Gender of a member refers to the condition of being either male or female. Results for gender of the respondents show that 82.79% were males and 17.21% were females. This means that the overall sector cooperative sector in Eastern Cape Province is a male dominated.

Level of education

The level of education attained by a household head is important in farming given that it plays a crucial role in the adoption of new technologies. Also, the level of education is expected to enhance efficiency (Manciya, 2012). Similarly, according to Bembridge (1987), education contributes to the knowledge acquired by farmers which

Table 3. Demographic and socio economic characteristics of members.

Variable	Minimum	Maximum	Mean	Std Deviation
Age	20	33	25	4.23
Household size	2	21	6.73	3.04
Education level (years)	0	17	9	3.65
Age of cooperative	1	10	4.3	1.74
Size of cooperative	2	16	8.6	3.21
	Description		**Percentage (%)**	
Leadership skills	Yes		61.5	
	No		38.5	
Membership participation	Agree		71.3	
	Disagree		28.69	
Gender	Male		82.79	
	Female		17.21	
Marital Status	Single		27.9	
	Married		63.9	
	Divorced		8.2	
Access to credit	Yes		30.3	
	No		69.7	
Access to Training	Yes		18.9	
	No		81.1	
Access to market	Yes		64.8	
	No		35.2	

Source: Field survey, 2014.

they can effectively put to use in their farming operations. As far as educational level of the respondents is concerned, the results show that the average educational level of the respondents is 9 with a standard deviation of 3.65 and a minimum and maximum of 0 and 17 respectively.

Household size

Availability of labour to carry out “labour-intensive” agricultural operations is greatly influenced by household size. The household size values have an influence on marketing since they affect consumption and production (Randela, 2005). Larger household size discourages selling because the household needs to supply household consumption before it decides to sell. It becomes even more difficult to produce and sell where the household is comprised of either very old or very young members who cannot assist with farming. In this study, household size was considered as the number of individuals who resides with the respondents. The respondents have an average family size of 6.73 and a minimum and maximum of 2 and 21 respectively.

Age of cooperative

According to the data collected for this study, the response given by the respondents show that the average age of the cooperatives was 9 years and a minimum and maximum of 1 and 10 years respectively.

Size of cooperative

According to the data collected for this study, the response given by the respondents show that the average size of the cooperatives was 8.6 and a minimum and maximum of 2 and 16 person respectively.

Marital status

The marital status of household head is usually used to determine the stability of a household in African families.

It is normally believed that married household heads tend to be more stable in farming activities than unmarried heads. If this holds true, the marital status of household heads will affect agricultural production and hence, marketing. The findings indicated the majority of 63.9% are married. The remaining 27.9% and 8.2% are respondents who are single and divorced respectively.

Occupation

From the study, occupation of respondents is important since income helps them to purchase some items for farming. Employment in off-farm and non-farm activities is important for diversification of sources of farm households' livelihoods (FAO, 1996). It enables households to modernize their production by giving them an opportunity to apply proper inputs and reduce the risk of food shortage during periods of drought. Occupation refers to the job by which person earns a living. The results show that 62.3% of the respondents of the study were engaged in both agriculture and non-agricultural activities followed by 27.9% and 9.8% who engaged only in agriculture and non-agricultural activities respectively. From members who engaged in both agriculture and non-agricultural activities, 65.9% of them engaged in crop farming followed by 17% who are government employees. The remaining 9.1% and 8% are respondents who engaged in trade and other activities respectively.

Leadership skills

Leadership is an important function of management which helps to maximize efficiency and to achieve organizational goals. Leadership defined as a process by which an executive can direct, guide and influence the behavior and work of others towards accomplishment of specific goals in a given situation. The results of good managers' leadership skills show that 61.5% of the sample respondents did not believe that their managers have good leadership skills about their cooperatives and only 38.5% of the respondents believed in good leadership of their managers.

Members' participation

Participation is an important indicator in improving farmers' understanding of their cooperative's organization. Member's participation is the act of taking part in any activity of the society such as attending the general assembly meeting, involvement in the development of business plan, election process, decision making, exercising leadership responsibilities, monitoring and evaluation of activities related to cooperatives by all members. Members were asked agree and disagree questions regarding their participation in the cooperatives to know their participations in different activities. The results presents that 71.31% of the interviewed sample respondents agreed that they participate in the activities of the cooperatives whereas the remaining 28.69% of them said they do not participate in every activity of their specific cooperative societies.

Access to training

Training as one of the principle of cooperatives is described as a process of teaching and learning a skill or job. Training is defined as the systematic way of developing skills, knowledge and attitudes demanded by an individual to perform adequately a given task on the job. Cooperative training is defined as those training activities that are organized to improve job performance of the cooperative staff and of government employees engaged in support and supervision of cooperatives. The survey result indicates that from 70 respondents, only 18.9% of them are members who got training whereas 81.1% of the respondents have never got any training since they joined cooperatives. The organizations that provided training to these few members are NGOs, cooperative promotion agency and extension officers.

Access to market

According to the data collected for this study, the response given by the respondents show that 64.8% of them agreed that they have access to market whereas the remaining 35.2% do not have access to market. From the same result, 64.6% of the respondents who had access decide their target market to be direct consumers followed by 35.4% of the respondents whose target markets are traders respectively.

Access to credit

Credit is a device for facilitating transfer of purchasing power from one individual or organization to another. It provides the basis for increased production efficiency through specialization of functions within the cooperative sector. As presented in this study, the results suggest that only 30.3% of the respondents have access to credits and the remaining 69.7% of them lack access to credits. From the 37 respondents who got credits, 56.8 and 43.2% of them said they got credits from micro-finance and others village financial institutions respectively.

Access to transportation service

The results of the respondents show that only 35.2% have access to transportation services and the remaining

Table 4. Distribution of responses by empowerment activities offered by cooperatives.

Empowerment activity	Mean	Decision
Training	4.201	Agree
Skills acquisition	3.688	Agree
Credit service delivery	3.224	Agree
Product input supply	3.433	Agree
collective processing of produce	3.014	Agree
Job opportunities for members	3.787	Agree
Total mean	3.009	Agree

Source: Field survey, 2014.

64.8% of the respondents lack access to transport services. From 43 respondents who have access to transportation services, 44.2% of them transport their products by person followed by 32.6 and 23.3% who use tractor and car transport.

Empowerment activities that cooperatives offer to the members

Table 4 shows the results of the likert scale analysis. The results were deduced from 5 point scale with a weighted mean of 3.0. This means that any empowerment activity variable that is less than 3.0 was considered negative (disagree) while those above or equal to 3.0 were considered to be positive.

The results indicate that the grand mean of 3.009, implying that most of co-operators agreed that indeed cooperative societies offer the above mentioned empowerment activities. Some of these activities include training (4.201); skills acquisition (3.688); job opportunity to members (3.787); product input supply (3.433); credit service delivery (3.224) and collective processing of produce (3.014). These results are in line with those of Smith and Wills (2012) findings that youth and women join cooperative societies so they can have access to credit, training and other socio economic empowerment activities.

Econometric model results

Factors affecting cooperative performance

Logistics regression model was used to identify factors affecting cooperative performance. The model was estimated using STATA (version 13). The variables such as age of household head, gender, household size, age of cooperative, size of a cooperative, leadership skills, member participation, access to credit, training and market were discussed in the previous section and were considered and tested for their significance. The multinomial logistic results of the factors affecting cooperative performance are presented in Table 5. The results show the estimated coefficients and exponential betas of independent variables in the model. Chi-square values for the three models illustrates that they adequately describes the data. Also, R^2 shows about 56% of the variations.

The variables that predict annual growth in profit include membership participation and gender of household head although it had a negative impact. The model explains 15% of the variation in annual growth profit. This model results imply that, women cooperatives will reduce the odds of having high profits by 0.40 times as compared to male counterparts. Membership participation on the other hand had a positive impact on annual growth in profit and it increases the odds by 1.17 times.

Conclusions

The purpose of this study was to assess factors affecting performance of youth and women cooperatives in South Africa. Cooperative performance was measured using profit, sales and number of employees. The results from data analysis indicated certain factors which are critical to the success of cooperative performance. These factors include household size, cooperative size. Most of the cooperatives were found to be at the start-up stage mainly due to lack of access to financial services, poor infrastructure, lack of access to extension services and poor training.

Recommendations

Based on the literature reviewed and also the results obtained, it suggests that the success of cooperatives depends on a series of factors which include the provision of farm inputs, access to financial service and socio-economic factors. Therefore, the following recommendations which are not exhaustive but crucial

Table 5. Logistic Regression results of the impact of various explanatory variables on cooperative performance.

Variables	Annual growth in profit		Annual growth in sales		Growth in number of employees	
	B	Exp (B)	B	Exp (B)	B	Exp (B)
Intercept	-1.17	0.31	-1.12	0.33	-1.30	0.27
Age of household Head	0.02	1.02	0.02	1.02	-0.05	0.95**
Gender	-0.92	0.40*	-0.57	0.56	-0.32	0.72
Household size	0.10	1.10	0.14	0.14*	0.04	1.04
Age of cooperative	-0.04	0.96	-0.01	0.99	0.003	1.00
Size of a cooperative,	-0.06	0.94	-0.05	0.95	0.22	1.24*
Leadership skills	0.004	1.00	0.01	1.01	0.001	1.00
Membership participation	0.16	1.17*	0.14	1.15*	0.24	1.27**
Access to credit	-0.39	0.68	-0.11	0.89	-1.15	0.32**
Access to training	0.04	0.01*	0.05	0.33*	0.14	0.31*
-2 log likelihood	271.90		275.92		269.03	
chi-square	24.75		24.87		68.49	
Negelkerke R	0.326		0.351		0.561	

*,**,*** refers to significance at 10, 5, and 1% level, respectively.
Source: Results from SPSS (Version 20) generated from field survey, 2014.

are made in order to improve the performance of cooperatives in Eastern Cape Province:

1. The cooperative societies should integrate adult education as part of their empowerment programmes. This will boost the literacy level of youth and women co-operators and increase their chances of getting social and economic inclusion.
2. Cooperatives should seek more innovating programmes either by government or private organizations that will boost their economic status.
3. The extension services in the study are is unavailable. Therefore there is great need to enhance the capacity of agricultural extension personnel through addressing the following areas: mobility, communication, training, incentives and operational resources for efficient dissemination of information on new technologies such as the mechanization programme. This will then lead to increase in production of co-operatives.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests in this article.

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Determinants of food insecurity among rural households of South Western Ethiopia

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This study seeks to determine households' determinants of food insecurity among rural households in Woliso district, South Western Ethiopia. The main objective of this study is to identify factors influencing food insecurity in the study area. The study used household-level survey data collected from 122 sample households in Woliso district, and systematic random sampling technique was employed to select the sample households. Calorie acquisition by households was used to categorize the sample households into food secure and food insecure. Accordingly, results of descriptive analysis show that about 25.4 % and 74.6 % of the sample households were found to be food insecure and food secure, respectively. Comparison of percentage of food insecurity was also conducted between two-groups for some discrete variables, and results revealed that food insecurity significantly varies between the two groups. Results of the logit model showed that household's education level, dependency ratio, amount of amount of land and amount of fertilize have significantly influenced the level of food insecurity in the study area. Policy interventions aimed to change food security situation in the study area need to be diversified by focusing on enhancing family planning programs, promoting access to basic education to rural households and efficient functioning of land markets.

Key words: Food insecurity, calorie acquisition, logit model, Woliso district.

INTRODUCTION

Food security is one of the major world agenda in 2018 in several contexts. Worldwide, in 2017 about 124 million people in 51 countries faced food security crisis (FSIN, 2018). According to FSIN (2018), conflict and insecurity are the major drivers of food insecurity in eighteen countries, and the number of food-insecure people across the world has been increasing over time. Likewise, food security situation in Ethiopia deteriorated sharply in 2017. In Ethiopia, the number of food-insecure population was increased from 5.6 million in December 2016 to 8.5 million in August 2017 (ACAPS, 2018). An estimated 3.6 million children and women in Ethiopia were acutely malnourished in 2017 (IFRC, 2018).

The main causes of food insecurity in Ethiopia are prolonged drought, conflict and insecurity, crop disease, etc. According to FAO (2018), in Ethiopia, prolonged drought conditions are severely affecting the livelihoods in most southern and southeastern pastoral and agro-pastoral areas of SNNPR, southern Oromia and southeastern Somali Regions, where cumulative seasonal rainfall was up to 60 percent below average. In these areas, pasture and water availability have declined to

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extremely low levels, severely affecting crop production and livestock conditions, leading to large scale animal deaths. More than one million people are displaced in Ethiopia, most of whom have been displaced by conflict starting in September 2017 and many of whom are displaced along the Oromia-Somali regional border (FEWS, NET and WFP, 2018). In the near-time, this displacement has disrupted households' ability to engage in their typical livelihoods activities, such as seasonal cultivation and raising of livestock, and has resulted in food security crisis in the region where conflict has been reported to be most severe. Another factor driving the food security crisis in Ethiopia is the fall armyworm outbreak, which affects large parts of the country; especially maize-producing parts of SNNPR, Western Oromia, Amhara, Gambela, and Benshangul Gumuz (ACAPS, 2018; FEWS, NET and WFP, 2018). According to ACAPS (2018), food security situation in Ethiopia remain acute in 2018 with the reduced output of 2017 harvests, decreased food access as a result of poor purchasing power, and the exhaustion of coping mechanisms.

The problem of food insecurity greatly varies among households residing in the same country. In Ethiopia, some households frequently face the problem of food insecurity, even in areas where there are no aforementioned drivers of food insecurity. Although a number of efforts have been done to achieve food security at the household level in the rural areas of Ethiopia, it has remained as a challenging goal even today. In Ethiopia, the poor performance of food security at household level is associated with poor institutional forms and dependency on rain-fed agriculture, which is highly vulnerable to drought which leads to loss of rural household's lives and livelihoods in every three years (Abduselam, 2017).

Most of previous studies have focused on wider level. For instance, study conducted by Lemesa et al. (2017) reviewed literature to seek an answer for the question "why does food insecurity persist in Ethiopia?" They found that macro-economic challenges like increasing food prices and unemployment determine the prospect of food security in the country. Therefore, according to them, there is an urgent need to transform access to agricultural technology by farmers and employment opportunity. However, interrelated causes of household food insecurity require an analysis at a household level. Therefore, this study aims to examine determinants of food insecurity among rural households of South Western Ethiopia by taking sample households from Woliso district.

REVIEW OF LITERATURE

Food insecurity is an evolving concept. There are many definitions of food insecurity, which is a clear indication of differing views and approaches to the problem. FAO defined food insecurity as "a *situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life"* (FAO, 2008; Marion, 2011).According to this definition, factors that may lead to a situation of food insecurity include non-availability of food lack of access, improper utilization and instability over a certain time period. In other words, food availability, access, stability and utilization form the four pillars of food security. The four pillars must be fulfilled simultaneously in order to realize food security objectives. Determinants of each pillar are as shown in Figure 1.

Based on duration, food security analysts have identified two types of food insecurity, which are chronic and transitory (FAO, 2008). Chronic food insecurity is long-term or persistent, and occurs when people are unable to meet their minimum food requirements over a sustained period of time. Contrarily, transitory food insecurity is short-term and temporary, and occurs when there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status. While chronic food insecurity results from extended periods of poverty, lack of assets and inadequate access to productive or financial resources, transitory food insecurity is caused by short-term shocks and fluctuations in food availability and food access, including year-to-year variations in domestic food production, food prices and household incomes. There is also a concept of seasonal food insecurity which falls between chronic and transitory food insecurity (FAO, 2008). It occurs when there is a cyclical pattern of inadequate availability and access to food. This is associated with seasonal fluctuations in the climate, cropping patterns, work opportunities and disease.

Household food insecurity in Ethiopia has been studied by many researchers, who came up with different findings. Endalew et al. (2015) reviewed food security situation in Ethiopia and causes of food insecurity, and found that about 10% of Ethiopia's citizens are chronically food insecure and this figure rises to more than 15% during frequent drought years. According to them, the deteriorating food security situation in Ethiopia is caused by multifactor, which include population pressure, drought, shortage of farmland, lack of oxen, deterioration of food production capacity, outbreak of plant and animal disease, poor soil fertility, frost attack, shortage of cash income, poor farming technologies, weak extension services, high labor wastage, poor social and infrastructure facility and pre-and post-harvest crop loss. To address food security issue in Ethiopia, they suggested that household heads and members of the households should engage in different income generating activities for means of living and coping mechanism. In addition, the government should incorporate different research outputs to design programs that can tack food

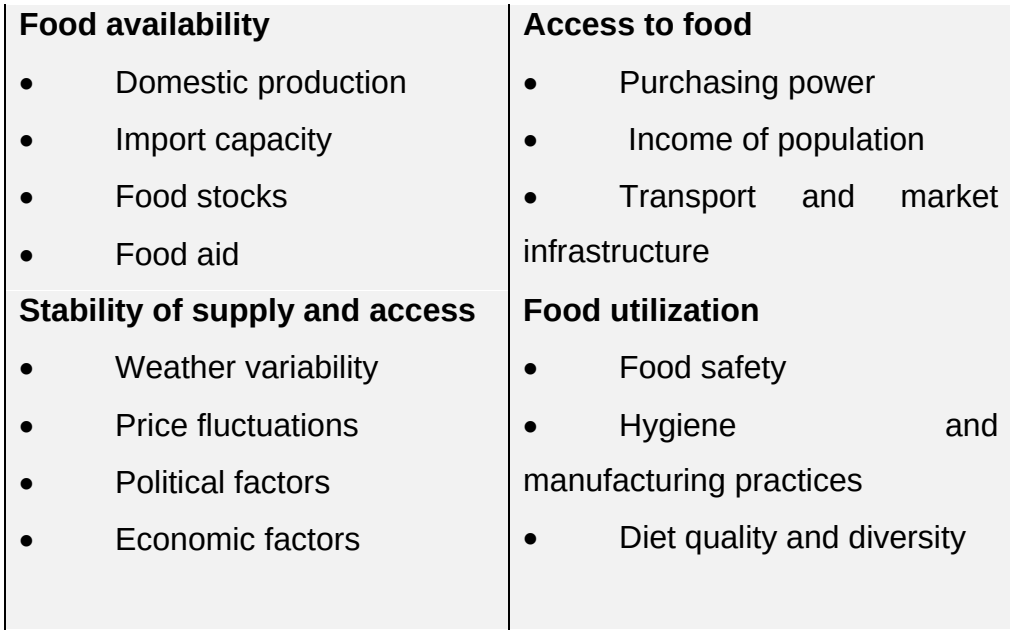

Figure 1. Determinants of each pillar.
Source: FAO (2008) and Marion (2011).

insecurity. Using empirical analysis, Beyene and Muche (2010) examined determinants of household food security among rural households in the Ada Berga district in Central Ethiopia. Household calorie acquisition was analyzed to measure the status of household food security. They estimated the logit model to identify variables which can significantly influence household food security in the study area. Accordingly, they found that variables like experience in farming activities, off-farm and non-farm incomes, land and livestock holdings, as well as soil and water conservation practices significantly influence household food security. Besides, difference in fertilizer use has a positive impact on food security, in which food security was improved as the intensity of fertilizer use increases. Result of the study further indicated that development interventions aiming at income diversification, improved fertilizer supply; increasing land and livestock productivity will enormously contribute to the attainment of food security in the study area. The study conducted on food insecurity in rural areas of Eastern Ethiopia also indicated that socio-economic factors can influence food insecurity (Bogale and Shimelis, 2009). According to Bogale and Shimelis (2009), socio-economic variables like family size, annual income, amount of credit received, access to irrigation, age of household head, farm size, and livestock owned have significant influence on food insecurity in rural areas of Dire Dawa, Eastern Ethiopia. Their findings implied that improvement in food security situation in the study area requires building household assets, improving the functioning of rural financial markets and promoting family planning.

In general, the reviews of empirical studies of household food security/insecurity in Ethiopia show the existence of difference in findings, which are associated with difference in study areas. Therefore, their findings may not apply in different contexts. Moreover, most of previous empirical studies done on the problem were stick to similar methods. This study is an attempt to fill the aforementioned gaps using different methods, focusing on determinants of food insecurity among rural households of Woliso district, South Western Ethiopia.

MATERIALS AND METHODS

Data collection

This study depended mainly on primary data, which was collected from sample farm households using questionnaire. The questionnaire was administered to heads of farm households through interviews by trained enumerators. In the absence of the head of the household, other members of the household such as grown up child who can provide the required information was interviewed. For the interview, trained enumerators were deployed, and continuous supervision was made by the researcher to correct possible errors in the interview. The primary data needed for the study mainly focused on households' demographic and socio-economic characteristics, their food consumption and expenditure, asset ownership and crop production, technology adoption and access to different services, and households' perception toward food insecurity. It is known that households do not keep records of data on different aspects. So, the household survey entirely depended on recall method.

The target population of this study is farm households living in Woliso district, South Western Ethiopia. There are 22, 888 farm households in Woliso district (SWSZANRO, 2018). The study used a simplified formula provided by Yamane (1967) to determine the

sample size at 95% confidence level and 5% degree of variability (Israel, 2002). In addition, 5% level of precision is used in order to get the sample size which represents a true population. According to Hussey and Hussey (1997), no survey can ever be believed to be free from error or provide 100% surety and error limits of less than 10% and confidence levels of higher than 90% can be regarded as acceptable. The sample size determination formula provided by Yamane (1967) is as follows (Israel, 2002).

$$n = \frac{N}{1 + N(e)^2}$$

where n is the sample size, N is the total number of farm households in Woliso district, which is 22,888. e is the level of precision or sampling error, which assumed to be 9% for this study.

$$n = \frac{22{,}888}{1 + 22{,}888(0.09)^2} \cong 122$$

Therefore, this study randomly selected 122 farm households from the target population, and systematic random sampling based on a given interval between houses was employed during household selection.

Data analysis

The data analysis was started with the conversion of monthly, weekly and daily consumption data into kilocalorie (kcal) in order to realize objective of the study. The converted data was further changed into household adult equivalent (AE). Following this, the amount of energy in kcal for sampled households was recorded. Next, kcal of each sample household was compared with the minimum subsistence requirement per AE per day. The government of Ethiopia has set the minimum subsistence food requirement per AE per day at 2200 kcal (MoFED, 2010/2011). Households which consume below this minimum requirement were grouped as food insecure whereas those which consume above the threshold were grouped as food secure. Thus, the response variable (food insecurity status) is a dichotomous, which takes a value of y = 0 if a household is food secure and the value y = 1 if the household is food insecure. Here, we are interested in estimating the probability that a household is food insecure, given the explanatory variables. This probability can be expressed by logistic distribution function as (Gujarati, 2004):

$$P(y_i = 1|X_i) = \Lambda(\beta_0 + \beta X_i) = \frac{e^{(\beta_0 + \beta X_i)}}{1 + e^{(\beta_0 + \beta X_i)}}$$

where $P(y_i = 1|X_i)$ is the probability that household i is food insecure, given the explanatory variables, Λ is the logistic cumulative distribution function, X_i is the column vector of explanatory variables and β is the row vector of slope of coefficients to be estimated.

If $z_i = \beta_0 + \beta X_i$, the aforementioned function can be re-expressed as:

$$P(y_i = 1|X_i) = \Lambda(z_i) = \frac{e^{z_i}}{1 + e^{z_i}}$$

As z_i ranges from $-\infty$ to $+\infty$, $P(y_i = 1|X_i)$ ranges between 0 and 1.

If $P(y_i = 1|X_i)$ is the probability that household i is food insecure, then the probability that the household is food secure, $1 - P(y_i = 1|X_i)$, can be expressed as:

$$1 - \mathrm{P}(\mathrm{y_i} = 1|\mathrm{X_i}) = \frac{1}{1 + \mathrm{e}^{\mathrm{z_i}}}$$

Thus, $\frac{P(y_i=1|X_i)}{1-P(y_i=1|X_i)} = \frac{1+e^{z_i}}{1+e^{-z_i}} = e^{z_i}$

The expression $\frac{P(y_i=1|X_i)}{1-P(y_i=1|X_i)}$ represents the odds ratios in favor of food insecurity. It means the ratio of the probability that a household will be food insecure to the probability that he/she will be food secure.

By taking the natural log of odds ratio, we obtain the following result known as logit model:

$$L_i = \ln\left(\frac{P(y_i = 1|X_i)}{1 - P(y_i = 1|X_i)}\right) = Z_i = \beta_0 + \beta X_i$$

L_i, the log of the odds ratio, is called logit.

Based on empirical literatures reviewed, six explanatory variables were identified, and the final logit model was specified as follows:

$$Z_i = \beta_0 + \beta_1 HHSex + \beta_2 HHE_i + \beta_3 DR_i + \beta_4 Mkt_i + \beta_5 Pest_i + \beta_6 Fert_i + \beta_7 Land_i + \beta_8 Livestock_i + U_i$$

where $HHSex$ represents sex of household head, HHE is education level of household head, DR is dependency ratio, Mkt is access to market, $Pest$ is pesticide use, $Fert$ is amount of fertilizer, $Land$ is amount of land and $Livestock$ represents livestock ownership.

After specification of the logit model, diagnostic tests were conducted to detect the problem of hetroscedasticity and multicollinearity. Moreover, to assist the regression analysis, two-group percentage of food insecurity-comparison test was done for discrete variables with two categories, such as sex, land owning, fertilizer usage, improved seed usage, pesticide usage, herbicide usage, road access, market access, credit access and ceremonial practice.

RESULTS AND DISCUSSION

Descriptive analysis

For examining the food security status of sample households, calorie acquisition by households is taken as an indicator. The amount of energy attained by a household is compared with the minimum subsistence requirement per AE per day (that is, 2200 kcal). Accordingly, the result shows that 25.4% (31) and 74.6%

Table 1. Food security status and calorie intake of sampled household.

Variable	Total (N=122)			Food insecure (N_1=31)			Food secure (N2=91)			Mean difference	t-value
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean		
Calorie intake	14,785	1,500	3,160	1,500	2,199	2,027	14,785	2,250	3,541	1,514	2.999***

*P<0.1, **P<0.05, ***P<0.01.
Source: Sample Household Survey (2018).

(91) of the sampled households were found to be food insecure and food secure, respectively.

Table 1 shows that the mean energy intake of food insecure households is 2,027, whereas that of food secure household is 3,541. The mean comparison test (t=2.9992***) confirms that there is significant difference between food insecure and food secure households with respect to calorie intake. Socio-economic characteristics of farm households are important determinants of their food security or insecurity status (Babatunde et al., 2007).

Table 2 compares the percentage of food insecure households between two categories of discrete variable under consideration. This comparative analysis helps us to identify which category is more vulnerable to food insecurity in the study area. Table 2 shows that of female headed households 57% are food insecure, whereas only 18% are food insecure for male headed households and the difference (39%) is significant at 1% level of significance. This implies female headed households are more vulnerable to food insecurity as compared male headed households. This difference is associated with customary rules and practices that often have restrictive effects for women through limiting their access to resources and their roles in food production, preparation, processing, distribution, and marketing activities, which generally affects women's food security and nutrition. Zakari et al. (2014) also found that male-headed households are more food secure compared to female headed households, which is consistent with result shown in Table 2.

Food insecurity and educational deprivation are highly correlated, and they create vicious circle in rural community of many developing countries (DFID, 2005). In the same way, from Table 2, we understand that illiterate households are more food insecure than literate households, revealing that education contributes to food security especially through influencing productivity. This finding is consistent with the result of study conducted by Mutisya et al. (2016). Using longitudinal data analysis, Mutisya et al. (2016) found that the probability of being food insecure decreased by 0.019 for a unit increase in the average years of schooling for a given household. In addition, Mutisya et al. (2016) explained that investment in education of households, in the long-run, contributes to reduction in the prevalence of food security.

Livestock ownership plays a key role in contributing to food security through enabling direct access to livestock products, providing cash income from sale of livestock and livestock products for purchasing food, and contributing to increased crop yields as result of improved productivity from the use of manure and traction. The result of the present study shows this fact; livestock ownership patterns play significant role in determining household food security. Table 2 shows that households without livestock are more food insecure than those with livestock. This result is consistent with the result of study done by Ali and Khan (2013). Ali and Khan (2013) found that livestock ownership has a positive impact on rural household food security in Pakistan.

Modern agricultural technologies, such as fertilizer, improved seed, pesticide and herbicide, as shown in Table 2, result in difference in food security between those who use them and who do not use them. Households who use each of these farming inputs is more food secure than those who do not use them. According to Popp et al. (2013) and Kughur (2012), the use of pesticide and herbicide provides economic benefits to the farmers through protection of crop quality and yield; especially it can prevent large crop losses, thus increasing agricultural output and farm income.

Similarly, previous empirical studies have indicated that the use of fertilizer has significant effect in achieving of food security. For instance, Stewart and Roberts (2012) have evaluated long-term studies, and the result shows that the average percent of yield attributable to fertilizer inputs ranges from 40 to 60% in temperature climates. Specially, yield attributable to fertilizer tends to be much higher in the tropics, which ensures food security in the areas considered by the studies.

Improved seed is also a key input for improving agricultural productivity; thus enhancing household food availability and increasing household income. Table 2 confirms that improved seed very is important in attaining food security in the study area. Rural households that use improved seed are food secure, whereas 81% rural households who do not use improved seed are food insecure, and the difference between the users and non-users of improved seed is significant. This result is consistent with a study by Bekele (2017), finding that improved seed beneficiaries earn 41.8% higher income than non-beneficiaries. In addition, he suggested that sustainable access to improved seeds by food insecure households can ensure them to improve their food

Table 2. Comparison of food insecurity by different socio-economic variables.

Variable	Categories	Food insecure (%)	Percentage difference	t-value
Sex of household head	Female	57	39	14.982***
	Male	18		
Education	Illiterate[1]	86	81	3.939***
	Literate	5		
Land ownership	No	80	57	2.968***
	Yes	23		
Livestock ownership	No	90	71	5.513***
	Yes	19		
Fertilizer usage	Non-users	95	84	10.785***
	Users	11		
Improved seed usage	Non-users	81	81	17.933***
	Users	0		
Pesticide usage	Non-users	69	66	11.224***
	Users	3		
Herbicide usage	Non-users	85	85	21.486***
	Users	0		
Market access	No	78	73	12.296***
	Yes	5		
Credit access	No	71	68	11.747***
	Yes	3		
Road access	No	81	77	14.232***
	Yes	4		

*P<0.1, **P<0.05, ***P<0.01.
Source: Sample Household Survey (2018).

security status.

Access to market and road play a crucial role in achieving global food security by increasing access to food. More importantly, farmers can boost agricultural output productivity and availability through getting access to agricultural input markets, such as improved seed and fertilizer. Besides, farmers can increase production if they have access to feasible market for their agricultural outputs. In Woliso district, as can be seen from Table 2, households that do not have access to market are more food insecure than those who have access to it. In studying the correlation between market access and level of food security in Nepal, Shively and Thapa (2017) have found that each one-hour reduction in travel time required to reach a market center is associated with a 0.2% increase in the non-staple food expenditure share, which is an indicator of food security. Table 2 also reveals that households that have access to road are more food secure than those that have limited access to road. Shively and Thapa (2017) have confirmed this finding, in which they found that food insecurity prevalence falls by 0.5% for each one-hour reduction in travel time to a well-paved road.

Access to credit is also an important instrument for household in purchasing modern agricultural technologies when the household faces budget deficit. It also normalizes consumption at the hard time. The result in Table 2 shows that households that have access to credit are more food secure than those having limited access to it.

Table 3. The Logit model regression result for determinants of food insecurity (Y=1).

Food insecurity	Coefficient	Robust standard error	Z-value	P>|z|	Odds ratio	95% confidence interval of odds ratio
HHSex (cat.)	-0.611	1.376	-0.44	0.657	0.543	[0.036, 8.048]
HHE (cat.)	-5.782	2.712	-2.13	0.033**	0.003	[0.000, 0.626]
DR^2 (cont.)	3.472	2.079	1.67	0.095*	32.188	[0.547, 1892.495]
Mkt (cat.)	-1.657	1.047	-1.58	0.114	0.191	[0.024, 1.484]
Pest (cat.)	0.135	1.120	0.12	0.904	1.145	[0.127, 10.288]
Fert (cont.)	1.283	0.619	2.07	0.038**	3.608	[1.071, 12.145]
Land (cont.)	-3.211	1.502	-2.14	0.033**	0.040	[0.002, 0.765]
Livestock (cat.)	-0.083	1.924	-0.04	0.965	0.920	[0.021, 39.948]
Constant	2.781	1.425	1.95	0.051	16.127	[0.987, 263.496]
Number of observation						122
Wald chi^2 (8)						26.85***
Prob > chi^2						0.0008
Pseudo R^2						0.8715
Log likelihood						-8.129

[1]Illiterate means those that cannot read and write. [2]Dependency ratio is the proportion of the number of household members whose age are less than 15 years and greater than 65 years to the number of household members whose age are in between 15 and 65 years.
(cat.) and (cont.) represent categorical variable and continuous variable, respectively. *P<0.1, **P<0.05, ***P<0.01.

Pseudo $R^2 = 1 - \frac{\mathcal{L}_{ur}}{\mathcal{L}_o} = 1 - \frac{(-8.129)}{(-63.268)} = 1 - 0.1285 = 0.8175$, where $\mathcal{L}_{ur}$ is the log-likelihood function for the estimated model and $\mathcal{L}_o$ is the log-likelihood function with only intercept. The odds ratio is computed from the logistic regression using STATA software.

Source: Sample Household Survey (2018)

Econometric analysis

The Logit model having eight explanatory variables was estimated, and the result of the regression is shown in Table 3. The explanatory variables are identified based on the previous empirical literatures. Some important variables that may affect household's food security status, such as access to road, credit, herbicide and improved seed were omitted from the model because of the problem of multi-collineratity.

From Table 3, we see that out of eight explanatory variables included in the model, four of them were found to be significant. These are household's education level, dependency ratio, amount of amount of land and amount of fertilizer. While the first three explanatory variables have the expected sign, the last one come up with unexpected sign.

The regression result reveals that education level of household head has negative and significant effect on household food insecurity. The odds ratio in favor of food insecurity of illiterate households is 0.3% much higher than that of literate households, indicating that illiterate households are more food insecure than literate households. This reflects improvement in human capital contributes to food security significantly, which is consistent with our descriptive analysis. The possible explanation of this result is that literate households have more chance to apply their knowledge towards the achievement of food security as compared to illiterate households. Similarly, Okyere et al. (2013) found negative and significant association between education level of household head and food insecurity. In their study, they showed that the odds of household heads having primary education are about 2.2 times more likely to be food secure than those with no formal education.

The maximum likelihood estimate shows that dependency ratio significantly influences food insecurity, and there is positive association between them. As it is observed from Table 3, the odds ratio in favor food insecurity will increase by a factor of 32.188 as the dependency ratio increases by one unit. In other words, the probability that a household becomes food insecure will increase as the number of dependent members of the household increases. This finding is obvious because the dependents contribute less labor and income to the family, which reduces the amount of food available to each of the family member. This reiterates the findings of others in which a household with large size, composed of mainly non-productive members is more likely to be food insecure due to high burden levied on active labor (Beyene and Muche, 2010). Moreover, the positive relation between dependency ratio and food insecurity implies that family planning policies, which have an impact in reducing dependent household size, will increase the probability of a household to be food secure.

In contrast to the result shown in the descriptive

analysis, amount of fertilizer is negatively correlated with food security. This finding contradicts previous findings, who stating that there is a positive association between the amount of fertilizer applied in farming and achievement of food security (Beyene and Muche, 2010; Stewart and Roberts, 2012).

Majority of people in developing countries depend on agriculture as their subsistence of life. Therefore, access to land for rural people is essential for food security and economic development in developing countries. The logit model regression result points out that size of farm land holding is found to have a negative and significant impact on food insecurity. That is, the odds ratio in favor food insecurity will decrease by a factor of 0.04 as size of farm land increases by one hectare. Households with large farm land produce more for household consumption and for sale; thus have higher chance to be food secure than those having relatively small size of farm land. This finding supports result shown by Table 2, and is consistent with studies done by Beyene and Muche (2010), Muraoka et al. (2014), indicating a negative association between farm land size and food insecurity.

CONCLUSION AND POLICY IMPLICATIONS

This study has examined determinants of food security among rural households in Woliso district, South Western Ethiopia. Even though the descriptive result supports the importance of chemical fertilizer in enhancing food security, the econometric result invalidates the positive association between fertilizer use and improvement in food security. This indicates policies and strategies working on the use of chemical fertilizer should focus on long-run effect of chemical fertilizer on food security. On the other hand, the result supports the worth of human capital development in improving food security in the study area. Therefore, rural development policies should encourage access to basic education to improve the food security situation by revealing the strong association between education and food security. Moreover, the study found positive relation between dependency ratio and food insecurity, implying family planning policies should be enhanced in order to reduce food insecurity. Finally, like many empirical studies, this study also found out that there is significant relationship between size of farm land and achievement of improved food security. This implies that land markets should work efficiently to make land-constrained rural households to access additional land for cultivation. Generally, the results of this study suggest that attaining food security in the study area requires adoption of mixed policies and strategies, which can influence significant variables. Future research works should pay attention to the present empirical evidences in the study area, to investigate issues which have not been addressed by this research. Moreover, it will better if the future research works examine the problem using panel data analysis.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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