

Small-Scale Irrigation and Household Income: Evidences in Southern Tigray, Ethiopia

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Abstract

Agricultural production in Ethiopia is mainly rainfed, which is characterized by its erratic and often inadequate nature. To solve the challenge, it is crucial to shift and expand irrigation agriculture. The aim of this study is to analyze the role of small-scale irrigation on household income improvement in ayba and atsela kebelles of southern Tigray. To achieve its objective, this study used descriptive statistics such as mean, standard deviation, frequency of appearance and Propensity Score Matching (PSM) econometric model. The ATT show that the farm income is highly affected when the smallholder farmers are participated in small-scale irrigated farming. In conclusion, this empirical finding suggests that access to irrigation was improved income of treated households in a significant way. Therefore, to make considerable improvement on household income actions should be taken by household heads, government of Ethiopia, national and international organizations to increase households' participation in irrigation activities.

Keywords: Income, small-scale irrigation, Household

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1. INTRODUCTION

1.1. Background of the study

Agriculture contributes key role to the economic growth of many low-income countries. It is often the leading sector of the economy as source of income, employment and foreign exchange. More than half of the less developed countries population gets their food from own-production. Agricultural output also is used as an input for industries so it can stimulate the growth of industrialization. Improving agricultural productivity thus contributes to income growth (Nega, 2013).

Agriculture in Ethiopia is heavily dependent on rainfall, which is highly varies both spatially and temporally. In many parts of Ethiopia, agricultural development is hampered by recurrent droughts, which over the years have increased both in frequency and severity in many parts of the country. In the past 30 years, the drought incidence has become common pattern every two to three years (Iticha, 2019). This, therefore, calls for different interventions, irrigation being one of the options, which could help in adapting strategies to cope up with the challenging drought. Tigray is one of the most land-degraded states of Ethiopia. The region is characterized by subsistence farming households raising predominantly cereal and vegetable crops for local consumption and sale. Crop production in the region has failed to keep pace with population growth due to recurrent droughts, environmental degradation and wars, including the most recent conflict with Eritrea (Kinfe Asayehegn, 2015)

Irrigation in Ethiopia contributes to increase farmers' income, household resilience and buffering. Irrigation contributes to livelihood improvement through its direct and indirect benefits. The direct benefits of irrigations are; high productivity, lower risk of crop failure, and higher and year-round farm and non-farm employment, increased income, food security, and poverty reduction. Irrigation enables smallholders to adopt more diversified cropping patterns, and diversify income base sources. Indirectly irrigation benefits as a potential to become 'nuclei of growth' which are attractive for inward investments in other infrastructure and services such as banking to facilitate this growth (Beyan A., 2004)

The government of Ethiopia has placed great emphasis on the development of irrigation facilities so as to increase agricultural production and productivity. This may help farmers overcome the cost problem for modern irrigation construction and overcome the problem of shortage of moisture for production. In line with this goal, the government also has planned to undertake a medium and large-scale irrigation study and designing activities and making them ready for concerned relevant stakeholders (Hirko et al., 2018).

According to the Bureau of Water Resources (BoWR, 2016), the Tigray Region (northern Ethiopia), where the study took place, has an irrigation potential of 36.4% (about 340,000 ha of the estimated 933,000 ha cultivable land owned by small holder farmers. Moreover, there was little or no documentation on the economic benefits of small-scale irrigation technologies for women-headed households. Therefore, the aim of this study is to analyze the role of small-scale irrigation on household income improvement in ayba and atsela kebelles of southern Tigray.

2. RESEARCH METHODOLOGY

2.1. Data Collection and Sample Size

This study was based on both primary and secondary data collected from households in ayba and atsela Kebele of Emba Alaje district in Southern Zone, Tigray Regional State, Ethiopia. For the primary data collection, on participant and non-participant households' socio-economic and demographic features, interview by enumerators with a pre-tested semi structured questionnaire was used. While for the secondary data, government institutions, non-governmental offices, community-based organizations, research centers were used as main sources.

This study used a multi stage sampling technique of purposively selecting the Ayba and Atsela Kebele, due to the implementation of the small-scale irrigation scheme, followed by two-stage random sampling. In the first stage, the name of households was obtained from the Kebele office and stratified into two groups of Irrigation user and non-users. In the second stage, 70 non-irrigation user households and 67 irrigation users in the kebeles were randomly.

2.2. Methods of Data Analysis

To achieve its objective, this study used both descriptive statistics and econometric analysis. By applying descriptive statistics such as mean, standard deviation, frequency of appearance etc. one can compare and contrast different categories of sample units (in this case farm households) with respect to the desired characters so as to draw some important conclusions. To explore the impact of the small-scale irrigation on household income, the Propensity Score Matching (PSM) econometric model was used.

3. RESULTS AND DISCUSSION

3.1. Income Source of sample Households

From the survey results, in (Table 1) the minimum and maximum net income from crop production of the total sample respondents was 1600 and 71300 ETB respectively. The mean crop income for the irrigation users was found to be 35027.39 ETB whereas the average income from crop for that of non-users was 11366.43 ETB. The mean comparison for the two groups showed that there is a statistically significant difference between two groups in terms of crop income at 1 percent significance level. This shows that irrigation-users had a better crop income than those non-irrigation user households. In Ethiopia, **(Dereje Mengistie and Desale Kidane, 2016)** found that the use of irrigation technology significantly improved crop income. **(Dananto & Alemu, 2014)** also have the same submission on the positive and significant impact of irrigation technology use on crop income.

Income from livestock and livestock products is the major source of income for the sample households next to crop production. The mean livestock income for the irrigation user's household is found to be 17,446.03 ETB whereas the mean livestock income for that of non-users was 7304.71 ETB. The mean comparison for the two groups showed that there is a statistically significant difference between the two groups in terms of livestock income at 5 percent significance level. This shows that irrigation users had a better livestock income compared to their non-user counterpart **(Teka & Teklehaimanot, 2021)**.

Table 1 presented that, the annual average income of irrigation users obtained from safety net program, petty trade and remittance was 1135.8, 1549.2 and 1470.1 ETB respectively, while the annual average income of non-irrigation users from safety net program, petty trade and remittance was 1042.8, 1387.14 and 892.85 ETB respectively. However, there is no significant difference in safety net program, petty trade and remittance income sources activities between irrigation users and irrigation non- users.

The total annual income of irrigation user and non-user households respectively were 56920.87 (± 23154.36) and 26138.6 (± 30258.95) ETB respectively (Table 1). The result of t-test shows that, there is statistically significant at 1% significance level. In conclusion, this empirical finding suggests that access to irrigation was improved income of treated households in a significant way.

Table 1: Distributions of Sample Household Head by Sources of Income

Sources of Income			Irrigation-user		Non-irrigation user		t-value	P-value
			mean	SD	Mean	SD		
On Farm Income	Crop income		35027.39	15620.79	11366.43	5939.06	11.81	0.0000***
		Livestock income	17446.03	29603.47	7304.71	14593.64	2.55	0.0116**
Off-farm income	PSNP income		1135.80	2427.00	1042.80	2517.50	0.21	0.82
Non-farm income	Petty trade income		1549.20	3283.10	1387.14	3241.44	0.29	0.77
	Remittance income		1470.10	3756.69	892.85	2594.40	1.05	0.29
Total household income			56920.87	23154.36	26138.60	30258.95	6.66	0.0000***

Source: Own survey result, 2019 **, *** means significant at 5% and 1% significance level respectively

3.2 Estimated Average Treatment Effect

3.2.1 Annual Household Income

The impact estimation result presented in (Table 2) provides supportive evidence of statistically significant effect of participation in small scale irrigated farming on annual farm income. On average, participation in small scale irrigated farming had impact on annual farm income of the participant households by Birr 33,295.11, 31,275.6, and 31,007.89 in Nearest-neighbor, Radius and Kernel matching methods respectively. This difference was statistically significant at 1% significance level respectively per household. One of the critical explanations for this is that the farm income is highly affected when the smallholder farmers are participated in small-scale irrigated farming. Because, participation in small-scale irrigated farming increases the opportunity to produce two times a year on the same farm and crop diversification, which increase annual income. This result is consistent with the findings of previous studies (Asrat & Anteneh, 2019; Kuwornu & Owusu, 2012). These all studies indicated that access to irrigation schemes has led to significant increase in household income.

Table 2: Total Household Income

Matching method	Treated.	control	ATT	Std. Err.	T
Nearest-neighbor matching	67	20	33295.11	5407.45	6.157***
Radius matching	64	52	31275.6	6763.12	4.624***
Kernel matching	67	63	31007.89	2840.58	10.916***

Source: Own survey result 2019, *** means significant at 1% significance level respectively

4 CONCLUSIONS

This study examined the impact of small-scale irrigation on household income. The study used propensity score matching to explore the impact of small-scale irrigation on household income in the study area. The sample of 137 farm households selected by multi-stage sampling technique were used in the analysis. The impact analysis of participation in small-scale irrigation on household income by propensity score matching using of Nearest-neighbor matching, Radius matching and Kernel matching algorithm revealed that there was a significant difference on the income of households between irrigation-user and non-irrigation-user due to participation in small-scale irrigated farming. The average treatment effect on the treated was ETB 33295.11, 31275.6 and 31007.89 respectively and it was significant at 1% significance level. The study findings shows that small-scale irrigation significantly increases households' income from crop and vegetable production. This leads households to have access to more diversified food, health, and education services and improved housing. Therefore, Participation in irrigation helps the households to generate additional income in the study area.

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Authors' contribution

Dr. Kebede Manjur was major adviser in this thesis and he contributes in idea generation and guidance all the time from the very beginning of proposal writing to the final thesis write up.

Dr. Gebrehiwot Woldegebrial was co-adviser in this research and he contributes in overall paper design and giving constructive suggestions.

Mr. Moges Girmay he was involved in literature search, figures, development of overall research plan, study design, data collection, data analysis, data interpretation hypothesis generation and idea development, he provided the validated questionnaires;

Mss. Workie Sahlu was involved in data collection, data analysis, data interpretation, supervision and data analysis and revision of the paper; and she Wrote the paper.

Conflict of interest

we declare we have no any conflict of interest.