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Research Article

Assessment of Constraints Identification and Profitability Analysis of Major Crops Pumped Irrigation in West Shewa and East Wollega, Western Oromia, Ethiopia

Shelema Refera*, Gudeta Genemo

Bako Agricultural Engineering Research Center, Bako, Ethiopia

Abstract

West Shewa and East wollega Zones have a promising climatic condition for irrigation, considering irrigation potential of zones irrigation pump has been distributed for small holder pumped irrigation to increase major irrigated crops production and productivity. Thus, this study was tailored to assess the constraints and financial profitability of major pump irrigated crops with a view to update information that are already documented in the literature. This research contributes to a better understanding of the financial profitability of pumped irrigated agricultural crops. Multistage and purposive sampling method was used to select the farmers for the surveys. The sample has covered irrigation pump user on proportion to size basis. The primary data were generated through conducting a well-designed farm level survey. The survey was conducted covering 237 Small holder pumped irrigator. A profit function approach was used to examine profitability of major pumped irrigation in study areas. The major problems of pumped small holder irrigation were technical issues, economic barriers, socio-institutional factors and environmental pressures. Financial profitability has been estimated for Wheat, cabbage, Tomato, potato, Onion and green pepper and Onion had the highest Net farm income of 47569.30ETB followed by Tomato which has NFI of 40651.85ETB. Although the returns from onion were high as compared to the other crops considered, tomato were widely grown by the farmers in the study areas. Thus, concerned bodies should support pumped irrigation farmers to expand onion and tomato production by reducing other irritated crops in order o increase farm income from pumped irrigation. Irrigation researchers should work on water productivity increment.

Keywords

Constraints, Irrigation, Major Crops, Pump and Profitability

1. Introduction

Irrigated agriculture in Africa is under renewed attention in relation to food security and poverty reduction [10]. It is widely acknowledged to play a major role in improving productivity, reducing poverty and sustaining rural livelihoods. It enables households to generate more income, increase their resilience and, in some cases, transform their livelihoods [11]. Irrigation has contributed significantly to poverty alleviation, food security, and improving the quality of life for rural populations [12]. Ethiopia is one of the abundant water-receiving

*Corresponding author: shelemerefera2014@gmail.com (Shelema Refera)

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countries in the east African region [6], which has approximately 12 river basins with an annual runoff of 122 billion m^3 and with 2.6 billion m^3 of ground water. The country's perennial dependence on food aid has been then attributed largely to an over-reliance on rain fed smallholder agriculture. The post GTP-1 report shows that only 2 million hectares (30-35%) of the 4.25 million hectares of irrigable land is currently developed through traditional, small, medium, and large-scale irrigation schemes [4]. Given the surface and ground water potential of the country, promoting adoption of household level irrigation technologies is vital for improved production and food security at household level [7, 8]. Irrigated agriculture can reduce poverty through increasing production and income, protecting against risks of crop loss due to erratic and insufficient water supplies, promoting greater use of yield enhancing inputs and creation of additional employment [5]. The adoption of small-scale irrigation technology had unprecedented advantages for smallholder farmers to reduce poverty. It increases use of available water sources to get higher income and improves the livelihood of farmers [2]. Small-scale irrigation (SSI) is considered one of the options for increasing agricultural production and productivity in Ethiopia. It is characterized by the use of simple technologies to access water for irrigation. Gravity irrigation systems are usually the simplest and cheapest. However, their use is limited to specific topography and hydrological conditions such that not all smallholder farmers can implement such technology. Most farmers rely on pumping to supply their water needs and are often designed on the basis of minimum investment cost, with little or no thought given to the effect that this might have on operating costs over many years [1]. The cost of running the irrigation systems is also on the increase due to high investment and high operating costs arising from high cost of fuel. West Shoa and East wollega zone Oromia regional state is one of the areas where small scale irrigation practices are taking place mainly for the production of cash crops. According to west Shoa zone irrigation development authority office report, the total area cultivated for irrigation in 2018 was 3964.6 hectares with modern irrigation, 30,780.85 hectares with traditional and 8507.58 hectares covered with motorized pump with total 218,348 beneficiaries [3]. In addition, here are traditional irrigation 48,000 hectare while modern irrigation 1,620 hectare. Total 63,016 ha including other method of irrigation and rain fed irrigation hectare 15,309 in general 78,325 ha can be used for irrigation potentials in east wollega zone.

However, small scale irrigation pumped irrigation profitability was known across different crops. Thus, study examined the profitability of irrigated crop production as well as identifies different cropping systems among small scale farmers. Hence, the main objective of this paper was to identify small holder pumped irrigation and analyze the profitability of pumped irrigation crops in study area.

2. Materials and Method

In this study, both primary and secondary data were utilized. To obtain primary data, structured questionnaire with both closed and open-ended questions were developed. The survey work for the collection of primary data was done in the month of April-May 2023 Moreover, secondary data were obtained through group discussions with concerned expertise of each targeted district of Irrigation Development Authority and annual report of the districts.

2.1. Sampling Techniques and Sample Size Determination

Multistage and purposive sampling method was used to select the farmers for the surveys. The sample has covered irrigation pump user on proportion to size basis and research objectives.

Frist stage: Small scale irrigation pump user woreda were purposely selected based on their number of irrigation users by water pump on the river directly, number of hectares irrigated and based on their proximity for the ease of data collection. For this four woreda (Bako Tibe, Dandi, Ejersa lafo and Toke kutaye) from west shewa zone and four woreda (Diga, Sibu Sire, Guto Gida and wayu Tuka) from East wollega were selected. From each woreda three kebele were selected.

Second stage: After identifying the potential small scale irrigation pump user woreda and kebele, the respondents 'farmers were selected randomly and [9] formula was used to determine the sample size. The relationship between level of precision, sample size and population.

To determine the required sample of each small holder pumped irrigation (sample size), purposive sampling techniques were applied for sample selection and the number of required sample of each small holder pumped irrigation was given Yemane formula by;

$$n=\frac{N}{1+Ne^2}=\frac{3255}{1+3255(0.07)2}=192$$

Accordingly, from 3255 motor pump users for the selected 8 woreda, the total sample size determined was 192. But as sufficient and cost efficient from 8 woreda (24 kebeles) to represent non respondent the sample size was inflated to 237 for the purpose of interview.

Table 1. Number of sampling respondent of irrigation pump users from two zone.

Zone	Woreda	Total Pump User	Selected user as respondent
West Shewa	Bako Tibe	818	29
	Dandi	738	31
	Ejersa Lafo	334	32
	Tokkee Kuttayee	150	31
	Sibu Sire	263	30
East Wollega	Diga	220	30
	Wayyu Tuqa	124	25
	Guto	568	29

Source: Own survey result, 2023

2.2. Methods of Data Analysis

To describe the demographic of sample producers and resources of producers' a descriptive statistics and profitability analysis were used.

Profitability analysis is of detailed calculation of per hectare basis cost of production and return. The total cost (TC) is composed of total variable cost (TVC) and total fixed cost (TFC).

Variable costs

1) Cost of human labor: Human labor cost is one of the major cost components in the production process. It is generally required for different operations such as land preparation, sowing and transplanting, weeding, fertilizer and insecticides application, irrigation, harvesting etc. In order to calculate labor cost, the recorded man-days were multiplied by the wage per man-day for a particular operation.
2) Cost of inputs: In the production process, farmers use different types of inputs such as seeds, fertilizers, insecticides and etc. The inputs can be supplied from home/own sources and purchased from the markets. In our study, for calculating the cost of inputs, the sum of actual costs of individual inputs used by the farmers from both own and purchased was considered.

Fixed Costs

Land use costs

Land use cost was calculated on the basis of opportunity cost of the use of land during irrigation period. So, cash rental value of land has been used for cost of land use.

Profitability of irrigated crop production

The financial returns of different irrigated crops have been estimated using the set of financial prices. The financial prices are market prices actually received by farmers for outputs and paid for purchased inputs during the period under consideration in this study. The financial returns are estimated on the basis of full costing of inputs and variable costing of inputs. The cost items identified for the study were includes cost of human labor (both family supplied and hired, wherein the cost of family supplied labor is estimated by imputing market wage rate), seed, fertilizers (DAP, Urea and NPS), pesticides and insecticides, fuel cost (Benzile and Nefta) and other cost (pump maintenance, land preparation, harvesting cost and etc) and TFC includes land rent (if owned land is used then the imputed value of market rate is applied).

Gross return

Gross return was calculated by multiplying the total amount of product by respective per unit prices.

Gross margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of production. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on TVC basis.

Net return

Net return was calculated by deducting the total production cost from the gross return. That is, Net return = Gross return – Total production cost.

3. Result and Discussion

The result revealed that 8% of the irrigation pump user Nill (uneducated), 19% were Primary school, 22% were Secondary school, 2% were diploma holder and 0.4% were degree holder from west shewa zone. From East wollega the result reveal that 5% of the irrigation pump user nill (uneducated), 27% were primary school, 16% were secondary school, 0.4% were diploma holder. These shows the majority of the respondent have education status of primary (46%) and secondary school (38% These shows the majority of the respondent have education status of primary (46%) and secondary school (38%). According to the respondents, 51% of the respondents in West Shewa replied that they use furrow irrigation system and 49% of the respondents in East Wollega replied that they

use furrow irrigation system. In general, from 237 respondent interviewed in two zone, majority of irrigation pump users were used for furrow irrigation method.

Major Crops irrigated by Smallholder Pumped Irrigation

The common irrigated crops by sample householder pumped irrigation in the selected districts are Wheat, Head cabbage, Tomato, potato and Onion (Table 1).

Table 2. *Irrigated Crops per districts.*

Districts	Crops Irrigated						
	Wheat	Head cabbage	Tomato	Potato	Onion	Green pepper	Maize
Bako Tibe	0	7	26	3	10	8	0
Dandi	29	6	4	19	5	3	3
Ejersa Lafo	21	5	2	6	10	4	0
T/kutaye	3	2	4	9	9	0	12
W/tuqaa	9	1	2	8	5	3	16
G/giddaa	18	4	12	2	0	9	17
Diggaa	8	0	28	16	16	4	6
S/sire	2	3	19	2	5	2	19
Total	90	28	97	65	60	33	73

Source: Own survey result, 2023

Land ownership and its utilization by Smallholder Pumped Irrigation

One of the most important factors that influence crop production in both rain fed and irrigation is availability of land. The major sources of total land operated under irrigation by the sampled households during survey period were divided into owned land, rent in and share in farm land. The analysis of survey data show that the average total land sizes allocated for different crops with irrigation by sampled respondents was about 0.95 hectares and owned by the sample respondents was 0.61 hectare and about 0.50 hectares rented in. (Table 2).

Table 3. *Land ownership and its utilization by sampled respondents Smallholder Pumped Irrigation.*

Land tenure	N	Min	Max	Mean
Total land size allocated for irrigation (ha)	237	0.0625	4.5	0.95
Owned land (ha)	220	0.0625	4.50	0.61
Rent in (ha)	41	0.090	1.50	0.50
Share cropping in	6	0.0625	0.5	0.74

Land size allocated for six different crops stated in above Table 4 indicate that on average about 0.68, 0.21, 0.48, 0.43, 0.39 and 0.38 hectares are allocated for wheat, cabbage, Tomato, potato, onion and green pepper respectively (Table 4).

Table 4. *Land size allocated for Wheat, cabbage, Tomato, potato, Onion and green pepper.*

Crop type	N	Min	Max	Mean
Wheat	87	0.125	4	0.68
Head cabbage	28	0.125	0.5	0.21
Tomato	100	0.125	2.25	0.48
Potato	66	0.0625	2	0.43
Onion	55	0.125	1	0.39
Green pepper	33	0.125	1.5	0.38

Source: Own survey result, 2023

3.1. Constraints of Small Holder Irrigation Pump in West Shewa and East Wolega, Western Oromia, Ethiopia

Major constraints for irrigation pumps in the study area categorized as technical issues (damage, maintenance), economic barriers (high cost of pumps/fuel/repair, lack of credit, market

issues), socio-institutional factors (low skills, poor management, lack of awareness, policy gaps, water rights conflicts), and environmental pressures (water scarcity, disease and pests' problems) that collectively hinder efficient operation of pumped irrigation (Focus Group Discussion, 2023). Survey result reveled that, shortage of water and unfair distribution of water (25%), disease and pests' problems (18%) and luck of improved seeds (10%) are the major constraints of pumped small holder scale irrigation.

Table 5. Pumped irrigation small holder related constraints.

No.	Constraints	Percent	Rank
1	Limited knowledge on irrigation operation	7	6
2	Disease and pests problems	18	2
3	Conflict on water b/n users	10	4
4	Water scarcity	25	1
5	Poor physical land structure for irrigation	6	7
6	Lack of improved irrigation seed supplier	14	3
7	Lack of extension service for farmers on water mgt	3	10
8	Problems of canal damages	5	8
9	Increment of pump initial pump cost	8	5
10	Marking constraints for irrigation product	4	9

Source: Own survey result, 2023

3.2. Profitability of Major Irrigated Crops of Smallholder Pumped Irrigation

The results of profitability for the different irrigated crop by Smallholder Pumped Irrigation are presented in the following table 6.

Onion had the highest Net farm income of 47569.30ETB followed by Tomato which has NFI of 40651.85ETB. Although the returns from onion were high as compared to the other crops considered, tomato were widely grown by the farmers in the study areas.

Table 6. Cost and returns of Smallholder Pumped Irrigation.

	Crop irrigated											
Parameter at average	Wheat		Cabbage		Tomato		Potato		Onion		Green peper	
	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha
Investment cost of pump	24720	24720	24720	24720	24720	24720	24720	24720	24720	24720	24720	24720
Fertilizer	6070.9	8927.8	2632.4	12535.5	6166.1	12846.1	5397.4	11244.6	5797.13	12077.3	3713	9771
Cost of seed	4656.6	6847.9	908.1	4324.4	2803.5	5840.6	6105.2	12719.2	5580	11625	5620.3	14790.2
Chemicals (pesticides and insecticides)	895	1316.2	2354.7	11213.1	8536.4	17784.2	845.4	1761.3	2475.4	5157	1559.5	4104
Fuel (benzene	2790.7	4103.9	2271.5	10817	3603.1	7506.5	2343.2	4881.7	4013.3	8361	2594	6826.3

Parameter at average	Crop irrigated											
	Wheat		Cabbage		Tomato		Potato		Onion		Green peper	
	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha	Actual data	Per Ha
and Nefta)												
Labor	2430	3573.7	1794.7	8546.4	6835.3	14240.2	1512.5	3151	3718.1	7746	1956.2	5148.02
Cost of land	2,718.7	3998.1	2,494.4	11878.2	7683.7	16007.7	1909.7	3978.6	2670.8	5564.2	2762.5	7269.73
Other costs	2325.8	3420.3	1108.1	5276.7	2662.5	5546.8	1545	3218.7	1637.3	3411.2	1050	2763.1
Total production cost	21,887.8	32187.9	13,563.9	64590.2	38,290.7	79772.3	19658.6	40955.4	21732.5	45276	19255.6	50672.7
Production value	34,892.8	51312.9	18,997.4	90464	78948.6	164476.25	41,944	87383.3	69301.8	144378	55143.2	145113
Net return per year	13005	19125	5433.4	25873.7	40651.8	84691.3	22,285.4	46428	47569.3	99102.7	35887.6	94441

Source: Own survey result, 2023

4. Conclusion and Recommendation

West Shoa and East wollega zone Oromia regional state is one of the areas where small scale irrigation practices by pump are taking place mainly for the production of cash crops. Although the profitability major crops pumped irrigation was not known. Therefore, this study was initiated to analyze major crops pumped irrigated. Multistage and purposive sampling method was used to select the farmers for the surveys. The sample has covered irrigation pump user on proportion to size basis. The primary data were generated through conducting a well-designed farm level survey. The survey was conducted covering 237 Small holder pumped irrigator. A profit function approach was used to examine profitability of major pumped irrigation in study areas. From survey result the major problems of pumped small holder irrigation were technical issues, economic barriers, socio-institutional factors and environmental pressures. The major sources of total land operated under irrigation by the sampled households during survey period were divided into owned land, rent in and share in farm land. The analysis of survey data show that the average total land sizes allocated for different crops with irrigation by sampled respondents was about 0.95 hectares. Financial profitability has been estimated for Wheat, cabbage, Tomato, potato, Onion and green pepper and Onion had the highest Net farm income of 47569.30ETB followed by Tomato which has NFI of 40651.85ETB. Therefore, Oromia, Zonal and woreda irrigation Authority, should consider and solve listed problems of small holder pumped irrigation such as shortage of water and unfair distribution of water in the districts, disease and pests' problems irrigated crops and luck of improved seeds and also Irrigation researchers should work on water productivity increment in the study area. From number crops produced with motor pump, onion and tomato returns highest benefit so farmers can invest in a motor pump for producing onion and tomato to keep their comparative advantages. Land size of irrigated major crops were less than a hectare, small holder motor pump farmers should advise, as they are benefited from a motor pump through renting system.

Abbreviations

FAO	Food and Agricultural Organization
TVC	Total Variable Cost
TFC	Total Fixed Cost
DAP	Ammonium Phosphate
NPS	Nitrogen, Phosphorus, and Sulfur

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Author Contributions

Shelema Refera: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Software, Writing – original draftt, Writing – review & editing

Gudeta Genemo: Investigation, Supervision, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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