International Journal of Research Studies in Agricultural Sciences (IJRSAS)
Volume 8, Issue 7, 2022, PP 9-15
ISSN No. (Online) 2454–6224
DOI: http://dx.doi.org/10.20431/2454-6224.0807002
www.arcjournals.org

Assessment Of Performance Of Small Scale Irrigation Practices In Debre Berhan Around Beressa River, Ethiopia.

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Abstract: *The development of irrigation scheme is hopped to increase agricultural production, establish basis for industrial expansion, create employment opportunities, aid in control of floods and sediments, enhance the preservation of fish, wild life and bring about a transition from the traditional subsistence agricultural practices to a more commercial enterprise. In North shoa zone near Beressa River there are small irrigation practices. Hence, understanding, assessing and observing is carried out on the areas irrigation practiced and not practiced. The main objective of this study was to evaluate the performance of small scale irrigation practices in Debre Berhan around Berressa River. In this study both primary and secondary data from different sources were gathered and analyzed. The data that I have collected was systematically organized and analyzed using descriptive Statistics. The data analysis was carried out using percentage and frequency distribution. Low maintenance of canals with sedimentation, growing of weeds in canals, presence of plastics in canals result low efficiency of canals resulting low performance of irrigation practices. One of the critical things which had a negative impact on irrigation performance was the users use the same irrigation interval for each type of crop and growth stage. Rotational water delivery system was adopted by most irrigation users. Irrigation users who were near to the main canal use demand delivery system as a result the crops could get a required amount of water at the right time..*

Keywords: *Assessment, Beressa River, Irrigation practice, Performance, Small scale*

1. INTRODUCTION

Irrigation has been a favored sub sector for public, private and aid donor investment. Ethiopia is richly endowed with water resources which if properly used and developed could greatly enhance the national economy and provide improved standard of living consistent with the objective of its long range plans to provide a better life for people .Hence, this requires an immediate employment of irrigation practices through developing surface and underground water resources. Although it needs further detailed investigation, according to the current knowledge, the country has about 124.4 billion cubic meter (BCM) river water, 70 BCM lake water, and 30 BCM groundwater resources (Belete *et al.*, 2014). The water resources potential and its utilization rate are in comparable in the country. There are huge amounts of both surface and ground water resources but the utilization of it is in infant rate. It is clearly marked that the economic development of the country is never go far without utilization of water resources properly. But under current situation, the country is not used their water resources properly due to different political, natural, technical and economic factors. On the other side, the water sector development programs are performing well to increase the utilization potential and at the same time there are different eye opening future opportunities to develop the water resources development and utilization (Ayalew, 2018). Irrigation water is supplied to supplement the water available from rainfall and the contribution to the soil moisture from the ground water (Michael, 1978).

According to Haile and Kassa (2015), the policies and strategies of Ethiopia strongly support irrigation developments especially small scale irrigation (SSI) through the Water Sector Development Programs (WSDP) and Ethiopian Irrigation Development Plan (IDP). This irrigation development is mainly expressed in the development of small scale irrigation (SSI) schemes by the government, donors and Non-Governmental Organizations (NGOs). Ethiopia has high agricultural production potential but people are not used and still need rainfall for growing crops. In North shoa zone near Beressa River there are small irrigation practices. But low maintenance of canals with sedimentation, growing of weeds in canals, presence of plastics in canals result low efficiency of canals which is low performance of irrigation practices. One of the critical things which had a negative impact on irrigation performance was the users use the same irrigation interval for each type of crop

and growth stage. Hence, understanding, assessing and observing is carried out on the areas irrigation practiced and not practiced, as a result to recommend the farmers that can improve the performance of irrigation practices. The objective of this study was: to know the benefit or yield from the small scale irrigation practices, to identify major problems on small scale irrigation practices, to recommended appropriate strategies that will improve the performance of small scale irrigation practices.

2. MATERIAL AND METHODS

2.1. Description of the Study Area

Debre Berhan town is located in Amhara National Regional state, North Shoa Administrative zone at about 130 kilo meters north east of Addis Ababa. The geographic extent of Debre Berhan ranges from 090 35' 45'' to 090 36' 45'' north Latitude and from 390 29' 40'' to 390 31' 30'' east longitude. The area has average elevation between 2800 and 2845m.a.s.l.Debre Berhan town is naturally endowed with a river called Beressa, which divides the town in to north and south parts. Beressa River is the main river crossing the town and has its source on the western side of the great rift escarpment at about 30 kilometers east of the Debre Berhan town. The river flow north-west wards and it joins Jema River which forma the tributary of the Blue Nile. Therefore, this study was conducted on small scale irrigation practices that were around this river.

2.2. Data collection

In this study both primary and secondary data from different sources were gathered and analyzed. The primary data were collected through interview on selected respondents, office experts of agriculture and water resources management, by using questionnaires, and observation of selected sites. In addition to primary data secondary data regarding the small scale irrigation practices were collected from different sources such as Agricultural office and other documentary sources.

Sampling method and sample size

In this research I have used random sampling method. Since there were large numbers of irrigation users around the study area, we have taken only seven sites and from each site we were tried to collect data which are associated to the performance of small scale irrigation practices. Due to time constraint and large area in which irrigation practices takes place, I have taken representative samples. Each site contains the following irrigation users. Site one contains 2, site two contains 1, site three contains 24, site four contains 1, site five contains 20, site six contains 1, site seven contains 2 irrigation users and the total sample size is 51.

2.3. Method of data analysis

The data that I have collected was systematically organized and analyzed using descriptive Statistics. The data analysis was carried out using percentage and frequency distribution. The benefits which are derived from the small scale irrigation practices was analyzed using comparative performance indicators, like how much profit they get in birr per given hectare, average yield in a given area in hectare for each crop per quintal is provided. Generally the result is presented in the form of tables.

3. RESULT AND DISCUSSION

Irrigation Interval

Irrigation interval means by how much days or weeks that the crops get water. Different crops have different irrigation interval. The crop water requirement is varied depending on growth stage, environments and crop type. Even the same type of crops at the same growth stage, their crop water requirement is not the same because the environment or atmosphere is one factor. In dry period crops require much amount of water and in cold season, crops require less amount of water. The adoption of appropriate irrigation scheduling practices could lead to increased yields and greater profit for farmers, significant water savings, reduced environmental impacts of irrigation and improved sustainability of irrigated agriculture (Smith et al., 1996). As we try to assess, the farmers use the same irrigation interval for each type of crop. As shown (Table 1), about 1.96% and 5.88% of respondents said that their irrigation interval at early stage is between 3-4and 4-5days respectively. But as most users said that who are confirmed by 92.16% of the respondents their irrigation interval at early stage is between 5-6 days, as they said that the crop has no faced any problem until 5-6 days. About 60.78% of the respondents said that the irrigation interval of the crop after early stage is within 7days interval. But about 39.22% of the respondent said that, after early stage it is enough to irrigate the crops with in 15days interval (Table 1).

Table1. *Irrigation interval at early stage and other stages*

Irrigation interval	Frequency	Percentage (%)	Irrigation	Frequency	Percentage (%)

			interval		
3-4days	1	1.96	Within 7days	31	60.78
4-5days	47	92.16	Within 15days	20	39.22
5-6days	3	5.88	Total	51	100
Total	51	100			

Irrigation season

As indicated in (Table 2), 96.08% of model farmers irrigate their land only once per year. As their response, because their irrigable area is near to Berressa River which is full during rainy season as a result the land is covered with water, and also the irrigable area should be free in some season to get good production in irrigation practice. Therefore, they irrigated only once per year. But about 3.92% of the respondent irrigates their command area twice per year. But irrigation three times and four times per year is not completely adaptable. Even though most irrigation users irrigate their area only per year, it is possible to irrigate more than once per year. The reason behind why they irrigate only per year due to lack of awareness and traditional way of irrigation practice is adaptable throughout their irrigation activity.

Irrigation water delivery system

There are three methods for delivering water to farms, known as continuous, rotational and demand. In continuous method each farm receives its right fully shares of the supply in relation to the area of each holding in an interrupted flow. That is, water is always available, although it may not always be necessary to use it; and so its actual use may be, and often is, intermittent. With the rotational method water is in effect moved from one area to another en block, and each user receives a fixed amount of water at defined interval of time. This kind of rotation can be applied between just two or more farmers, between two or more groups of farmers, or between defined portions of an entire irrigation scheme. The demand delivery method is particularly favored by farmers because the water is delivered at the farm outlets in the quantity and at the time requested.

As indicated in (Table 2) the most applicable water delivery system is rotational system as 52.94% of the respondent said. Thus, the low productivity is due to the imbalance between the time of water requirement of the crop and the water application. This leads to negative implication on the performance of irrigation practices. But users who are near to the main canal (users who are the first that they get water) about 47.06% of the respondents use demand water delivery system. According to their response due to the balance between the times of water requirement of the crop and water application, the yield is good in demand water delivery system. In addition to this, the total absence of continuous water delivery system is the main problem in the area that result low productivity of irrigable crops, because the crops do not get appropriate amount of water when they require.

Table2. *Irrigation Season and water delivery system*

Irrigation Season per year	Frequency	Percentage (%)	Types	Frequency	Percentage (%)
Once	49	96.08	Rotational	27	52.94
Twice	2	3.92	Demand delivery	24	47.06
Three times	0	0	Continuous	0	0
Four times	0	0	Total	51	100
Total	51	100			

Types of crops grown in the area

As indicated in (Table 3) most irrigable areas are covered with carrot as that 94.12% of the respondent said. But the area can also grow other crops (source, kebele 09, irrigation expert). The reason that why the farmers cultivate carrot, as most respondents the possibility of covered large command area within small amount of carrot seeds, but to cover the command area by other crops cost to buy seeds and the production status is low. In some extent Abesha gomen and Garlic also cultivated as 3.92% and 1.96% of the respondent said respectively. But Potato, Cabbage and other crops are not usual to cultivate in the area.

Types of irrigation methods

An adequate water supply is important for plant growth. When rain fall is not sufficient, plants must receive additional water from irrigation. So that there are various methods can be used to supply irrigation water. Each method has its advantage and disadvantage. This should be taken into account when choosing the method which is best suited to the local circumstances. All farmers use furrow type of irrigation method. This is due to the topographic feature of the area and the crop that they cultivate. Since the area is flat and the crop that they cultivate is carrot which requires furrow type of irrigation method Table 3). This leads the performance of irrigation practices are in a good manner because the farmers use appropriate irrigation type depending on the crop type and the topography of the land

Table3. *Cultivated crops and types of irrigation methods*

Crops	Frequency	Percentage (%)	Type	Frequency	Percentage (%)
Carrot	48	94.12	Furrow	51	100
Cabbage	0	0	Basin	0	0
Potato	0	0	Border	0	0
Garlic	1	1.96	Drip	0	0
Abesha Gomen	2	3.92	Sprinkler	0	0
Total	51	100	Total	51	100

Source of water for irrigation

In order to irrigate the given area we can get water from different sources. Some of them are river, canal water, well, ponded water, spring, or by using motor pump and other sources. Farmers get the water from two sources, that are canal water and by using motor pump from river. But as 58.8% of the respondents said that canal water is the most applicable and the next source of water is by using motor pump as 41.2% of the respondents said. The other sources, well, spring and ponded water are not applicable in this area (Table 4).

Table4. *Source of water for irrigation*

Sources	Frequency	Percentage (%)
Canal water	30	58.8
Well	0	0
Spring	0	0
Pond	0	0
Motor pump	21	41.2
Total	51	100

Agricultural Inputs

There are different types of inputs that are needed in agricultural activity to increase the crop production. Inputs are applicable when we use in a recommended way, unless we use them in appropriate way, they are not effective. In agricultural activity we may use inputs in single or in combination depending on the condition or the required. Among different types of inputs some of them are DAP, Urea, Compost or natural fertilizer, improved seeds and others. As indicated in (Table 5), the most inputs that the farmers use is DAP and Urea in combination which contain 86.28%. Farmers who use improved seeds are7.84%. As they respond that using improved seeds are better to increase their irrigation performance but the reason why they do not use improved seeds is due to cost and inaccessible. Among irrigation users only 1.96% use natural fertilizer. But using this natural fertilizer is good to increase fertility of the land and at the same time enhance the production status of the crop, this leads to increase the performance of irrigation practices which are performed by farmers.

Table5. *Inputs that are used in their irrigation farming*

Inputs	Frequency	Percentage (%)

DAP	2	3.92
DAP and Urea	44	86.28
Compost(natural fertilizer)	1	1.96
Improved seeds	4	7.84
Total	51	100

Major problems of small scale irrigation in the area

As shown in (Table 6), about 13.73% of the respondents said that there is fall in market price due to over production, this leads to decrease their benefit. As 43.14% of model farmers said that, the most problem in the market is existence of similar product in the market. Most of the time farmers produce similar product in the same season and go into the market, as a result the price to sell those products is cheap.

In addition to problem of market, there are other problems which can be hindering the users benefit. As about 25.49% of the respondents said that, high cost and untimely delivery of inputs is one of a problem that decreases their benefit. Now a day the cost of inputs such as DAP and Urea is very high, as a result the crops did not get the required amount of inputs when they require. About 9.80% of the respondents said that there is shortage of inputs. Especially motor pump users said that, in order to pump the water from the river they cannot find motor pumps easily because they are expensive. 1.96% of the respondents said that, there is inadequate transportation service to transport their product to the market. As they said that, due to transportation problem they sell their product on the irrigated area in a cheap cost. As 5.88% of the respondents said that, lack of irrigation profession in the kebele is one of a problem for the decrease of their benefit or production (Table 6). Because knowing of how to use water in accordance of the crop type and the growth stage is vital for good productive irrigation.

Table6. *Problems that hinder farmers benefit*

Problems		Frequency	Percentage (%)
Market	Fall in market price due to over production	7	13.73
	Existence of similar product in the market	22	43.14
High cost and untimely delivery of inputs		13	25.49
Shortage of inputs		5	9.80
inadequate transportation service		1	1.96
Lack of irrigation profession		3	5.88
Total		51	100

As indicated in (Table 7), bout 5.88% of the respondents said that there is managerial problem. This problem is occurred due to lack of knowledge about how to use the water properly in appropriate time which the crop required. As about 66.67% of the respondents said that the major problem which is faced currently is land. Since the land is very fragmented, they cannot found good benefit that they required. As the users said, if they get enough land, they can use irrigation and produce much yield. Even though there is availability of water which is Berressa River, about 3.92% of the respondents who are far from the main canal said that, there is a problem of shortage of water for irrigation. This shortage of water is happened due to the condition of the canal. The canal is filled with different waste materials such as, plastics, boulders and unnecessary materials that hinder the passage of water to the down irrigation users. About 23.53% of the respondents said that, currently market problem is one factor for the decrease of their benefit. Because in some case the market is good, and in other time there is inflation when similar products exist in the market. As the result the benefit which is derived from the small scale irrigation practice is lowered.

Table7. *Major problems*

Problems	Frequency	Percentage (%)
Managerial	3	5.88
Land	34	66.67
Water	2	3.92
Market	12	23.53
Total	51	100

Water user association

Water user association is an association in which the farmers organized together for efficient use of water without any conflict. The actual size of a WUA often depends on the irrigation system. For example, a WUA may be responsible for one tertiary block that is subdivided into smaller units of Water User Groups (WUGs), or one WUA may be responsible for the entire system (Aarnoudse et al., 2018). As shown in (Table 8), about 56.86% of the respondents said that there is specific water use association. This water association is organized together with two and more users who are the same boundary of the farm land. But 43.14% of the farmers said that, there is no specific water use association.

Table8. *Water user association*

Answers	Frequency	Percentage (%)
Yes	29	56.86
No	22	43.14
Total	51	100

Yield and profit status of the irrigation users

Yields are one indicator to evaluate the performance of irrigation practices, because the expected out puts are measured by the yielding capacity of the crops which are resulted from the irrigation practices. In our studying area the farmers cultivate major crop which was carrot and in some extent garlic by 1.96% from model farmers. The yield of each irrigable area is an indication of the profit status of irrigation users. From the total area of 1.4832ha of irrigable land 300quintal of carrot is produced and from 0.25ha of irrigable land 30quintal of garlic is produced (Table 9). As indicated in (Table 9), about 5.88% of the respondents said that their profit status is high. This is due to the farmers use inputs and water properly, eliminate weeds at early stage, and etc. Even though those small farmers get high profit, about 94.12% of the respondents said that the profit status is medium, as they try to tell us. This medium profit status is mainly due to problems of weeds around their irrigation farming.

Table9. Yield and profit status

Types of crop	Area (ha)	Yield in quintal	Profit status	Frequency	Percentage (%)
Carrot	0.008	5	Very high	0	0
	0.036	20	high	3	5.88
	0.06	30	medium	48	94.12
	0.25	42	low	0	0
	0.3363	70	Very low	0	0
	0.38	73	total	51	100
	0.4129	80			
Total	1.4832	300			
Garlic	0.25	30			

Condition of irrigation conveyance structures

Conveyance structures are in which used to deliver irrigation water from the source to the irrigable area. Especially, they are canals and thus may be lined or unlined. In the study area the canals are unlined, specifically earthen. The condition of the canals were not well, that means they were filled with different

materials such as sediments, leaves, grasses, plastics, stones, and other unnecessary materials. Not only these problems but also ,around the diversion structures the canals are broken as a result there was leakage of water before it reaches to the main canal. As we were tried to observe canals were not maintained by irrigation users as a result they could not deliver water efficiently to the irrigable area. This might be having negative impact on the performance of irrigation practices in the area.

4. CONCLUSIONS

The researcher believes that, this study is not enough to make generalization regarding to evaluate the performance of small scale irrigation practices which are found near Berressa River because this study was conducted on a specific area in a small surrounding. There are also other factors which the researcher did not see in this study but, believed that can help to evaluate the performance of small scale irrigation practices and affect the development of small scale irrigation practices. Therefore, further investigation should be made in order to reach at sound generalization. Moreover, based on the findings, the researchers suggest the following strategies that could improve the performance of small scale irrigation practices.

Increasing knowledge of farmers to irrigate more than once per year.

Improving the marketing system: Returns to irrigation are affected by the marketing channel, in part because the main irrigated crop (carrot) is harvested at similar times by farmers. An effective marketing system will facilitate irrigation adoption. Hence, the concerned bodies like governmental extension services, farmers' cooperatives and non-governmental market organizations should support the further development of the efficient marketing systems in the study area. This may include provision of marketing facilities, information provision and monitoring of costs and returns in the supply chain.

Ensure access for imported inputs: In the study area, these inputs are used below the recommended level because of their high cost and shortage of supply. Access and proper utilization agricultural inputs are important for sustainable agricultural productivity and improvement. The government, cooperative organizations and private organizations should give attention on the supply of these inputs on time and in adequate amount. Further studies of the marginal returns to these inputs compared to their costs could facilitate development of approaches to increase input use, when appropriate.

Strengthening water user association

Developing knowledge of irrigation users about irrigation interval because each type of crop, at each growth stage has different water requirement.

Increasing awareness of farmers to cultivate different type of crops rather than cultivating one type of crop to increase their benefit status.

Developing knowledge of irrigation users on maintenance of irrigation conveyance structures in order to distribute enough amount of water to irrigable area.

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Citation: *Miniebel Fentahun Moges (2022). "Assessment Of Performance Of Small Scale Irrigation Practices In Debre Berhan Around Beressa River, Ethiopia" International Journal of Research Studies in Agricultural Sciences (IJRSAS), 8(7), pp. 9-15 DOI: http://dx.doi.org/10.20431/2454-6224.0807001*