

Assessment of Constraints and Opportunities of Small- Scale Irrigation Practices in South Tigray, Ethiopia

Hintsa Libseka* Kidane Welde Kiflom Degef
Alamata Agricultural Research Center: P.O.Box 56, Alamata, Ethiopia
* E-mail of the corresponding author: hintsaar@gmail.com

Abstract

Improper irrigation management practices play a vital role in decreament of agricultural productivity. The findings of this paper were focused on technical performane assessment of small scale irrigation systems. The technical performance of the small scale irrigation schemes in relation to the water harvesting structures and delivery canals of all schemes were assessed technically in order to check whether they meet their objective and to distinguish their problems. Survey were undertaken to investigate the technical performance of the water harvesting structures and challenges on irrigation water utilization and management. Farmers, professional experts and other stakeholders were participated on the investigation of the technical performance of small scale irrigation schemes. Sedimentation, structural failure, untreated upper watershed, poor irrigation water management, lack of knowledge, lack of technical training, free grazing, lack of market access and transport problems are the bottleneck problems to the small scale irrigation schemes. 57.4 % of the small scale irrigation scheme beneficiaries are practicing both full and supplementary irrigation systems. The irrigation rounds per year are 24.6%, 55.7 % and 19.7% for three, tw and one times respectively. The irrigation intervals for cabbage, onion and maize are 12, 15 and 24 days respectively. Problems related to crop productions are shortage of technical training on irrigation water management, recurrent drought, free grazing, lack of market access, transport problems, flood hazard and disease and pest. These problems are getting beyond the beneficiaries capacity and they cannot able to maintain. Any concerned governmental and non-governmental body has to support the farmers by making maintenance and provision of necessary trainings and accesses.

Keywords: irrigation, irrigation structure, performance indicators schemes, water management

1. Introduction

According to Bekele, A. E. (2014) and Smout, I., and Shaw, R. (nd). Small-scale irrigation defined as irrigation, usually on small plots, in which small farmers have the controlling influence, using a level of technology which they can operate and maintain effectively. The fundamental role of irrigation will persist to play on global food facility – even though investment of irrigation is improbable to continue at the same level as in the recent past (FAO, 2003). Irrigation has created enormous impacts like; better opportunity for production, better income, reduction of risks and hence more optimism and hope to generate benefits for poor rural communities (Awulachew, S. B., and Merrey D. J. nd). Operation of irrigation practices can progress the poverty level, a study conducted by Hussain, M et al (2006) shows that the poverty level in irrigated, irrigated plus rain fed and rain fed only are 29, 23 and 37 percent respectively.

Regardless of the importance of irrigation practices it is mandatory to improve the efficiency and utilization of irrigation water. Improvements of irrigation include the following five categories abstraction, distribution, application, use and disposal. Up on dealing with these categories it will be easy to identify the various stages the major interactions which affect water use efficiency (Bos, M. G., et al. 2005). The operational performance as well as the socio-economic performance of irrigation has to be improved. Field experts can use their own knowledge and skills to regulate water distribution without any complex and comprehensive performance assessment. But through this practice scarcely any improvement in performance can be expected (Bandara, K.M.P.S., 2006.). Therefor it is necessary to introduce and employee the performance indicator parameters for further improvement. Performance indicators, was apply for evaluation irrigation performance assessments and showed useful result (Zaccaria, D. S. 2011)

Main Limitations of small scale development in Ethiopia are poor scheme management, imperfect market, insufficient technical skill, Socio-institutional constraints and financial shortages (Bekele, A. E. (2014). For efficient water management, all activities in the irrigation network should be monitored and checked, technical requirements should be met, training and extension should be enhanced, evaluations should be performed on a daily and seasonal basis and the results should be delivered to the relevant individual and institutions with an efficient monitoring and evaluation system. One of the most important reasons for not reaching the targeted performance level in irrigation systems is that it emphasizes the physical infrastructure, neglecting the social dimension on the other hand (Kuscu, H et., al. 2009). Farmers and the community are not willing for scheduled maintenance of small scale irrigation schemes unless they get financial support from external body (García-Bolaños, M. et al 2011).

The irrigation practices of small scale irrigation schemes in Southern Zone of Tigray are not based on

crop water requirement and irrigation scheduling of the crops, which are basic for water and crop productivity improvement. Studying of the opportunities and constraints of the existing small scale irrigation schemes is the basic step for improvement of irrigation productivity. Therefore, it is imperative to make a base line survey on the current performance of all the schemes based on small scale irrigation diversion performance indicators to set recommendation on irrigation water use efficiency and productivity of the schemes using the available water.

2. Methodology

Study area

This study was conducted in four representative small scale irrigation schemes of south Tigray, Ethiopia. The technical performance of the small scale irrigation schemes in relation to diversion structures and delivery canals of all schemes were assessed technically in order to check whether they are meeting their objective and to distinguish their problems. Development of questionnaires and conducting of field survey were undertaken accordingly to investigate the technical performance of the water harvesting structures and challenges on irrigation water utilization and management. Farmers, professional experts and other stakeholders were participated on the investigation of the technical performance of small scale irrigation schemes.

In order to collect the necessary data for assessment of technical performance of small scale irrigation schemes a total of 61 respondent or farmers were actively participated from the small scale irrigation schemes namely Betmera, Atsela, Falla and Timuga. The number of respondent and thier proporsion from each scheme was described in table 1. Sample size of respondent was determined from the available number of total beneficiary in each scheme. The survey was analyzed using statistical analysis SPSS16 software.

Table 1 Sample population of the respondent across ASSP irrigation schemes

S.N.	Name of schemes	Number of respondent	Percentage (%)
1	Betmera	11	18
2	Atsela	13	21.3
3	Falla	19	31.2
4	Timuga	18	29.5
Total		61	100%

There are numerous indicators to evaluate the technical performance of small scale irrigation schemes among this structural performance and irrigation water managements are the main indicators. Structural indicators are performance of the structure of diversion and canal system where as irrigation water management indicators are also deals about the whole management of irrigation water in the field. This all parameters were assessed and evacuated their status.

3. Results and discussion

Structural performance indicators

The result of assessment of structural indicators of the small scale irrigation schemes shows many problems like sedimentation, structural failure of both diversion and canal, malfunctioning of gets and small canal size unable to accommodate the flowing water through the canal. Table 2 shows the specific problem corresponding to each irrigation schemes.

Table 2 structural problem corresponding to each irrigation scheme

Problem	Scheme names			
	Betmera	Atsela	Falla	Timuga
Siltation of diversion system	Heavy	Heavy	medium	medium
Siltation of canal part	light	light	Medium	Heavy
Failure of canal system	light	Heavy	Light	light
Malfunctioning weir gets	Heavy	Heavy	Heavy	Heavy
Unlined canal system	Not a problem	heavy	Not a problem	Not a problem
No maintenance	Heavy	Heavy	Heavy	Heavy
Small size of canal	light	Heavy	light	Heavy
Untreated upper watershed	Heavy	Heavy	Heavy	Heavy

As can be seen from table 2, there are numerous problems in each the small scale irrigation schemes in the southern zone of Tigray, Ethiopia. All of the assessed small scale irrigation schemes in southern zone of Tigray, Ethiopia shows different problems. The scheme which was constructed in Betmera, tabia, Alaje wereda leads the problem of sedimentation; the diversion was completely filled by siltation. All part of the diversion like the barrage, apron, get and the canal near the diversion was completely buried by siltation. The farmers are using the direct flowing water from the stream as irrigation water sources and they diverted the flowing water below the constructed diversion and joined to the canal system. The scheme which was constructed Atsela tabia, Alaje wereda have also different problems. The diversion structure was break and the canal system was not lined so

that much of the available water in stream was lost as seepage and percolation. Schemes in Falla, Ofla and Timuga, Raya Alamata were also have problems of siltation and malfunctioning of canals and diversion structures.

Irrigation water management indicators

Irrigation water management indicator deals the assessment of technical performance of small scale irrigation schemes. This assessment was undertaken based on the determination of irrigation water management problems and deals about irrigation round, type of irrigation system, farmer’s water application system and other problems related to crop production.

Irrigation system: In order to be effective on irrigation water management it is necessary to use the water for both supplemental irrigation system at the end of summer when crops become moisture stressed or full irrigation system producing crops with the help of full irrigation water throughout its growing seasons. Based on the conducted survey the result of irrigation system of each schemes are presented in table 3.

Table: 3 summary of irrigation system in ASSP funded small scale irrigation schemes

Irrigation system	Betmera		Atsela		Falla		Timuga		Average
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Full irrigation	6	54.5	6	46.2	5	26.3	9	50	42.6
Both full and supplemental	5	45.5	7	53.8	14	73.7	9	50	57.4

The table 3 shows around 57.4% of the beneficiary farmers in all schemes uses both supplemental and full irrigation system while 42.6% of the farmers uses the small scale irrigation for full irrigation only. Farmers have to use irrigation water for both supplemental and full irrigation system to increase their productivity and to secure food insecurity but the system of using both supplemental and full irrigation was not well practiced especially in schemes of Betmera and Atsela.

Irrigation round: In order to secure food insecurity the beneficiaries of irrigation schemes have to produce their irrigated land at least three times and above per year. According to the respondent perception and believe the average irrigation round of each small scale irrigations are presented in table 4.

Table: 4 Irrigation round of ASSP funded small scale irrigation schemes

Irrigation round per year	Betmera (%)	Atsela (%)	Falla (%)	Timuga (%)	Average (%)
One times	18.2	30.8	21.1	11.1	19.7
Two times	54.5	53.8	52.6	61.1	55.7
Three times	27.3	15.4	26.3	27.8	24.6

The result in table 4 shows the irrigation schemes which were found in Timuga, Betmera and Falla have better practices of using three times irrigation round per year relatively while the scheme which was found in Falla have low practice of using three times. When we see the two times irrigation round per year Timuga takes the lead which is 61.1% of the beneficiaries of the scheme produce two times per year and followed by Betmara (54.5%), Atsela (53.8%) and Falla (52.6%) consecutively. 30.8% of the target area in Atsela irrigation schemes was producing once a year and 11.1% of Timuga are also produce once a year.

Farmer’s water application system: Farmer’s water application system deals about the system of water distribution to irrigated farms, amount and frequency of water application. The result which was collected from the respondent farmers shows that there are different means of water allocation to growers according the crop moisture stress tolerance.

Table: 5 summary of irrigation intervals and frequency throughout growing season of important crops..

Crop type	Irrigation interval			Frequency of irrigation		
	min	max	mean	min	max	mean
Tomato	5	40	14.95	3	15	8.45
Onion	4	40	14.9	3	24	8.63
Potato	7	35	16.61	3	20	8.11
Cabbage	7	21	12.5	4	20	9.14
Pepper	7	17	13.36	5	17	9.36
Maize	10	40	23.66	2	15	5.39

According to the farmers perception cabbage is the most moisture stress sensitive crop which they were irrigate it on average within 12.5 days and followed by pepper, onion, tomato, potato, maize and they can irrigate on average interval of 13.36, 14.9, 14.95, 16.61 and 23.66 days respectively. In the other way maize is a crop which needs on average 3.18 times irrigation water application throughout its growing season and followed by pepper, tomato, onion, cabbage and potato and their number of irrigation throughout growing season was 3.5, 3.52, 4.67, 4.77 and 7.19 respectively. The range of irrigation interval and number of irrigation events throughout the growing season shows a great variation this intern shows beneficiaries of the irrigation schemes are not applying water according the knowledge of crop water requirement and irrigation scheduling of specific

crops.

Problems relating to crop production

During the survey a lot of problems were raised regarding to the crop production system in the small scale irrigation schemes and the watershed. Some of the problems are shortage of technical training on irrigation water management; recurrent drought resulted to decrement of irrigation water in the spring of the schemes, free grazing, lack market access and transport problems, flood hazard and disease and pest. This all problems play a vital theatrical role to the development of productivity and production in the small scale irrigation schemes.

Opportunities

Even though the schemes have numerous troubles there are also a lot of good symptoms of opportunities. All of the small scale irrigation schemes have strong and effective water use association and rules and regulations. The association had select three strong persons to allocated irrigation water to beneficiaries according to the developed rules and regulations by the association and beneficiaries. Even if the beneficiaries have low knowledge on the irrigation scheduling (how and when to apply) they are willing to give priority for sensitive moisture stress and cash crop.

4. Conclusion

- The result of technical performance assessment shows that numerous problems in all small scale irrigation schemes like siltation over diversion and canal, failed diversion, malfunctioning of gets, no maintenance since construction and untreated upper water sheds.
- 57.4 % of the small scale irrigation scheme beneficiaries are practicing both full and supplementary irrigation systems.
- The irrigation round in south Tigray, Ethiopia are 24.6%, 55.7 % and 19.7% for three times, two times and one times of irrigation round per year respectively.
- The irrigation intervals of crops in one growing season on average are 15 days but cabbage had 12 days where maize has 24 days of irrigation intervals.
- Problems related to crop productions are shortage of technical training on irrigation water management, recurrent drought resulted to decrement of irrigation water in the spring of the schemes, free grazing, lack market access and transport problems, flood hazard and disease and pest.
- This all problems are getting beyond the beneficiaries capacity and they cannot able to re-maintain.
- Any concerned governmental and non-governmental bodies, professional experts and administrative leaders starting from wereda up to higher zone and regional level have to support and help the beneficiary farmers to maintain the structural problems of the schemes and to irrigate up to the higher potential.
- Professional experts and other concerned bodies have to work more on providing of training and increase awareness creation to the farmers on the whole irrigation management practices both in full and supplemental irrigation systems.
- This all problems need further intensive work of all stockholders and create scientific considerations to the opportunities listed above to resolve the problems step by step and to increase productivity and production of the small scale irrigation schemes and improve incomes of beneficiaries.

References

- Awulachew, S. B., and Merrey D. J. (nd). Assessment of Small Scale Irrigation and Water Harvesting in Ethiopian Agricultural Development.
- Bandara, K. M. P. S. (2006). *Assessing irrigation performance by using remote sensing*. Wageningen Universiteit.
- Bekele, A. E. (2014). Five Key Constraints to Small Scale Irrigation Development in Ethiopia: Socio-Economic View.
- Bos, M. G., Burton, M. A. S., & Molden, D. J. (2005). *Irrigation and drainage performance assessment: practical guidelines*. CABI.
- FAO, 2003. World Agriculture: Towards 2015/2030. FAO, Food and Agriculture Organization of the United Nations. Earthscan Publications Ltd., London, UK, 432 pp.
- García-Bolaños, M., Borgia, C., Poblador, N., Dia, M., Seyid, O. M. V., & Mateos, L. (2011). Performance assessment of small irrigation schemes along the Mauritanian banks of the Senegal River. *Agricultural Water Management*, 98(7), 1141-1152.
- Hussain, M., Hussain, Z., and Ashfaq, M. (2006). Impact of Small Scale Irrigation Schemes on Poverty Alleviation in Marginal Areas of Punjab, Pakistan. *International Research Journal of Finance and Economics*.
- Kuscu, H., Bölüktepe, F. E., and Demir, A. O. (2009). Performance assessment for irrigation water management:

-
- A case study in the Karacabey irrigation scheme in Turkey. African Journal of Agricultural Research, 4 (2), pp. 124-132
- Smout, I., and Shaw, R. (nd). Small scale irrigation design. WEDC Loughborough University Leicestershire LE11 3TU UK.
- Zaccaria, D. S. (2011). A Methodology to Conduct Diagnostic Performance Assessment and Simulation of Deliveries in Large-Scale Pressurized Irrigation Systems.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:

<http://www.iiste.org>

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

Academic conference: <http://www.iiste.org/conference/upcoming-conferences-call-for-paper/>

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library , NewJour, Google Scholar

