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Indigenous Knowledge Assessment on Irrigation Water Management Practices at Jimma Zone, Ethiopia

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Abstract: *Introduction*: Indigenous knowledge is the distinctive awareness set aside to a particular culture or society. Objective/Aim: This study was aimed to investigate farmers' current irrigation water management practice and their technical performance. *Methodology*: The study used reconnaissance survey and observations were carried out with each Woreda office of Agriculture to gain overview of different irrigation schemes and irrigation practice situations. The collected qualitative and quantitative data's were analyzed with proper statistical method IBM SPSS version 26. The total number of respondents was 122 which were selected based on local conditions from seven (7) woreda irrigation schemes of Jimma Zone. *Results*: The study results revealed that farmers have established several indigenous knowledge of irrigation water management exercise. Based on their knowledge, 73.77% of farmers use furrow irrigation method; 3.28% of them used flood irrigation; 5.74% irrigated their farm with water can, and farmers use soil moisture method and crop leaf wilt techniques to irrigate their crop. The farmers apply irrigation water at morning and night time, 89.34% respondents' uses optimum/ medium amount of water to irrigate by their own traditional ways even with the furrow irrigation methods. In addition to that, 95.9% of the farmers of these different areas were replayed the problems of high amount of water for the crops and soil of the irrigation field. *Conclusion*: Therefore, good management of irrigation water controlled the crop as well as the soil from different outbreak of diseases and soil erosion respectively. Finally, to make the indigenous knowledge more actual farmers should be assisted either by governmental or other non-governmental organizations providing improved agricultural technologies and better access.

Keywords: Indigenous Knowledge, Irrigation Practice, Irrigation Scheme, Small-Scale, Technical Perceptions, Water Management

1. Introduction

Irrigation sectors in Africa have not yet played a major role to cover the imbalance between food demand and supply for a number of reasons. [1] Irrigation serves as a cultural and social tool that can help a society develop along a desired trajectory. In the era of the Green Revolution, irrigation served as the keystone of agricultural growth and investments were justified in economic terms but which also had far-reaching social and cultural impacts. These ancillary impacts of irrigation development were generally viewed as desirable for creating a modern society as subsistence farmers shifted to higher value crops and were drawn more firmly into the market economy. Irrigation development has a unique role to play in helping indigenous communities meet their cultural objectives because of its blend of economic and socio-cultural impacts. [2] Irrigation has a positive and significant impact on household food security. Consequently, concerned bodies that working on small-scale irrigation development should continue investment in irrigation. [3] Traditional irrigation system has been practiced in the high lands of Konso (Ethiopia) for centuries. [4] The traditional small scale irrigation is simple water diversions. It is very old practice in Ethiopia and has been in use for decades in the highlands where small scale farmers could divert river, spring water

seasonally for a limited dry season cropping. [5]

Local knowledge and customary water management practices can strengthen environmental flow planning, implementation, and sustainable outcomes. [6] Understanding the community culture is essential for finding sustainable solutions for natural resource problems, such as water resources. [7] Indigenous knowledge in agriculture can improve the water crisis situation and alleviate water stress from dry and semi-arid areas. [8] Indigenous knowledge is the local or traditional knowledge system used by farmers. Therefore indigenous knowledge on irrigation water management means using of local or traditional knowledge system to manage irrigation water. [9]

Indigenous knowledge is generated and transmitted by communities, over time, in an effort to cope with their own agro-ecological and socio-economic environments.[10] Indigenous knowledge is the basis for local level decision-making in food security, human and animal health, education, natural resource management and other vital economic and social activities.[10] Therefore, this study was carried out to assess irrigation practice under small scale farmer's; to identify farmers technical perception assessment towards irrigation water management practice; and to determine the indigenous knowledge on irrigation water management different areas of the Jimma zone.

2. Materials and Methods

2.1. Description of the Study Area

The survey was conducted at Dedo, Gomma, Omo-Nada, Kersa, Limu-Seka, Seka-Chekorsa, and Shabe-Sombo which are some woreda's of Jimma Zone where smallholder farmers practice traditional irrigation activities. Jimma Zone is located 350km away from Addis Ababa the Capital City of Ethiopia. It is geographically located between 35°40' E to 37°40'E longitudes and 7°10' N to 8°50'N latitude as indicated on the map and the altitude of the zone ranges from 880 to 3340m.a.s.l. [11] The woredas was selected based on their irrigation practice experience and availability of irrigation schemes.

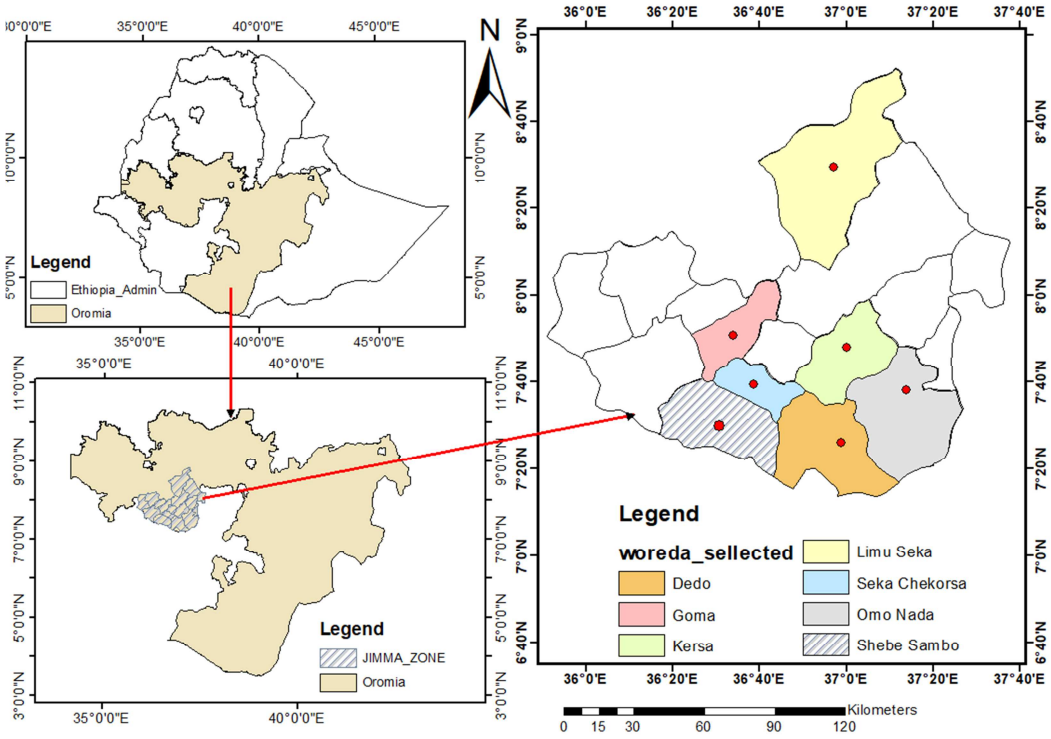

Figure 1. *Locations of the study area.*

2.2. Data Collection

A reconnaissance survey and observation was carried out with overview of different irrigation schemes and irrigation practice conditions. Based on the reconnaissance survey and observation survey area was selected and appropriate semi-structured survey questionnaire was prepared for different schemes and community. The assessment was to include survey questionnaire interview for different users including all level of community and with gender inclusion using stratified random sampling technique. Total number of household to be interviewed and number of areas (schemes) was set based on the local condition.

2.3. Data Analysis

Based on these questioner primary data was collected for the study. The collected qualitative and quantitative data from primary sources was analyzed using appropriated statistical methods IBM SPSS.

3. Results

To identify the current and the best indigenous irrigation water management practices under small scale farmer's condition of Jimma zone, the quantitative and qualitative data were used for the analysis. Stratified random sampling technique was employed to select the respondents.

Table 1. *Demographic characteristics.*

1. Gender	Frequency	Percent	2. Age of household head	Frequency	Percent
Male	110	90.2	15-65	116	95.1
Female	12	9.8	Greater than 65	6	4.9
Total	122	100.0	Total	122	100.0
3. Educational background		Frequency	Percent		
Illiterate		50	41.0		
Read and write		15	12.3		
Primary		48	39.3		
Secondary		8	6.6		
College & above		1	0.8		
Total		122	100.0		

3.1. Demographic Characteristics of the Respondents

Out of the total 122 respondents as stated on Table 1; 110 (90.2%) of them were males and 12 (9.8%) were females. Fifty of them or Forty one percent 50 (41.0%) were illiterate, 46.7% received formal education from primary school up to college level and the rest 12.3% of them were read and write with informal education. About 95.1% of respondents were at the age of 15-65 only 4.9% of them are above 65 years old. This indicates respondents were with high potential age of working on farm as comprehend from their responses. Young farmers are more productive than their older counterparts. [12]

3.2. Irrigation Practice Under Small Scale Farmer's

From the total one hundred of the farmers have their own land and five farmers were rented in from others, the remaining were both rented in and out as indicated in the following Table 2. This indicates that most of the areas of the scheme were irrigated by land owned farmers.

The owned irrigation land around 59.84% of the farmers area were less than 0.5ha and 33.61% of the farmers irrigated land were up to one hectare and the remaining 6.56% of the farmers irrigated land were up to two hectare as discussed in Table 3.

Table 2. *Type of land ownership.*

No. Woreda		Land ownership				Total
		Owned	Rented in	Owned and rented out	Owned and rented in	
1	Dedo	14	1	2	3	20
2	Gomma	5	3	0	1	9
3	Omo-Nada	8	0	0	3	11
4	Kersa	13	0	0	3	16
5	Limu-Seka	30	0	1	1	32
6	Seka-Chekorsa	12	0	0	0	12
7	Shabe-Sombo	18	1	0	3	22
Total		100	5	3	14	122

Table 3. *Own irrigation land in hectare.*

No. Woreda		Own irrigated land				Total
		Less than 0.5ha	0.5 to 1ha	1 to 2 ha	Greater than 2ha	
1	Dedo	9	7	2	2	20
2	Gomma	5	4	0	0	9
3	Omo-Nada	2	8	1	0	11
4	Kersa	14	0	2	0	16
5	Limu-Seka	16	15	1	0	32
6	Seka-Chekorsa	11	1	0	0	12
7	Shabe-Sombo	16	6	0	0	22
Total		73	41	6	2	122

3.3. Farmers Technical Perception Assessment Towards Irrigation Water Management Practice

The method of irrigation which was practiced by 90 (73.77%) of the farmers were furrow irrigation; 4 (3.28%) of them used flood irrigation; 7 (5.74%) irrigated their farm with water can.

Table 4. *Methods of irrigation used.*

No. Woreda		Method of irrigation used				Total
		Furrow	Flood	watering can	Combination	
1	Dedo	15	0	3	2	20
2	Gomma	8	0	0	1	9
3	Omo-Nada	11	0	0	0	11
4	Kersa	14	0	0	2	16
5	Limu-Seka	21	4	1	6	32
6	Seka-Chekorsa	10	0	0	2	12
7	Shabe-Sombo	11	0	3	8	22
Total		90	4	7	21	122

The remaining 21(17%) were used to practice combinations of irrigation methods as listed in Table 4. The amounts of water deliver to irrigation farms were controlled by different methods of practice which are small channels, pumps, and other traditional methods. However, 31.15% of the farmers respond that they weren't practiced any water delivery control mechanisms as mentioned on Table 5. There was a respectable practice of using a water pump on the irrigation schemes which was implemented by 61 (50%) of the respondents and the remaining farmers were used water can and furrows to deliver irrigation water to their field as described on Table 6.

Table 5. *Water delivery amount.*

No. Woreda		How to control amount of water delivery				Total
		small channel	Not controlled	Using pump	Traditionally	
1	Dedo	2	9	6	3	20
2	Gomma	0	2	2	5	9
3	Omo-Nada	2	5	2	2	11
4	Kersa	1	3	6	6	16
5	Limu-Seka	15	6	9	2	32
6	Seka-Chekorsa	1	2	9	0	12
7	Shabe-Sombo	0	10	2	10	22
Total		20	38	36	28	122

Based on the general know how of the respondents medium amount (neither large amount nor small amount) of water application to the field leads to get maximum yield from crops. This was what an irrigation experts call it optimum amount of irrigation water. Therefore 89.34% of the respondents were agreed to that of the application of medium amount of water as indicated on Table 7. Generally, the farmers technical perception towards irrigation water management practice of the Jimma Zone was practiced based on the farmers indigenous know how and with their long years of experience in irrigation.

Table 6. *Mechanisms used for irrigation water delivery.*

No. Woreda		Mechanisms used for irrigation water delivery and management			Total
		Hose	Pump	water can and furrow	
1	Dedo	0	13	7	20
2	Gomma	0	0	9	9
3	Omo-Nada	0	6	5	11
4	Kersa	0	11	5	16
5	Limu-Seka	1	8	23	32
6	Seka-Chekorsa	0	3	9	12
7	Shabe-Sombo	0	20	2	22
Total		1	61	60	122

Table 7. *Methods of irrigation water use to lead maximum yield.*

No. Woreda		Which method leads to maximum yield			
		Applying large volume of water	Medium amount of water	Small amount of water	Total
1	Dedo	2	17	1	20
2	Gomma	1	8	0	9
3	Omo-Nada	0	11	0	11
4	Kersa	1	15	0	16
5	Limu-Seka	5	26	1	32
6	Seka-Chekorsa	1	11	0	12
7	Shabe-Sombo	1	21	0	22
Total		11	109	2	122

3.4. Indigenous Irrigation Water Management of Different Area

The indigenous irrigation water management of the respondents of different areas were discussed regarding to priority use of the irrigation water; the relationships of the water and yield; and problems of applying high amount of water on the field. Therefore,40.98% of the respondents were used the irrigation water for crop production and 35.25% of the respondents used the irrigation water for domestic use based on priority (in addition to production of crops) but only 23.77% of the respondents has different water source for different purposes which is discussed on Table 8.

The relation between water amount and production yield were discussed on Table 9 below on significance 54.1% of the response accepted that of the optimum water application increases the yield of the crop production. Then 13, 8, 7, 9, 3, 11, and 15 farmers from the woredas Dedo, Gomma, Omo-Nada, Kersa, Limu-Seka, Seka-Chekorsa, and Shabe-Sombo respectively used optimum water to their field. However, from the total 31.14% of them respond that yield and water amount has a directly proportional to each other that means as water amount increased yield increased and as water amount decreases yield decreased. And 14.75% don't have any know-how about the relationship of water and yield but they randomly apply water to their field based on the draying of the soil and wilting of the crop leaf.

Table 8. *Purpose of the irrigation water based on priority.*

No. Woreda		Purpose of using irrigation water based on priority			
		Crop production	Domestic use	D/t water source for all purposes	Total
1	Dedo	11	5	7	23
2	Gomma	0	2	7	9
3	Omo-Nada	5	6	0	11
4	Kersa	10	6	0	16
5	Limu-Seka	9	8	15	32
6	Seka-Chekorsa	9	3	0	12
7	Shabe-Sombo	9	13	0	22
Total		50	43	29	122

The problems of applying high amount of water to field were caused yield reduction, outbreak of disease, water logging, quality reduction, and soil erosion & land degradation 45.9%, 22.13%, 7.38%, 7.38%, and 13.11% respectively. But the remaining 4.1% hadn't respond to the problems of applying much water on field crop and soil as discussed on Table 10.

Table 9. *Perceptions regarding water and yield.*

No. Woreda		Perception regarding water and yield				
		Yield increase as water volume increase	Less water less production	Optimum water increase yield	Unknown	Total
1	Dedo	4	2	13	1	20
2	Gomma	1	0	8	0	9
3	Omo-Nada	2	2	7	0	11
4	Kersa	2	2	9	3	16
5	Limu-Seka	9	11	3	9	32
6	Seka-Chekorsa	0	0	11	1	12
7	Shabe-Sombo	1	2	15	4	22
Total		19	19	66	18	122

Moreover, understandings of the respondents of the different areas of the study on best indigenous irrigation water management were mostly approached to good irrigation practices. In the study areas, there is no scientific irrigation scheduling practices practiced. But farmers schedule their irrigation simply by observing soil moisture conditions and crop conditions. These means, the next irrigation was applied when soil starts cracking and plants start to wilt during sunny day condition.

Table 10. *Problems of applying much water to field.*

No. Woreda		Problem of applying much water					Total
		Yield reduction	Outbreak of disease	Water logging	Quality reduction	Soil erosion & land degradation	
1	Dedo	7	7	0	1	0	15
2	Gomma	6	0	0	0	3	9
3	Omo-Nada	6	2	1	1	1	11
4	Kersa	8	2	0	4	2	16
5	Limu-Seka	12	5	8	3	4	32

No.	Woreda	Problem of applying much water					Total
		Yield reduction	Outbreak of disease	Water logging	Quality reduction	Soil erosion & land degradation	
6	Seka-Chekorsa	1	11	0	0	0	12
7	Shabe-Sombo	16	0	0	0	6	22
Total		56	27	9	9	16	117

4. Discussion

There was no drip and sprinkler irrigation methods used in all woredas of this study. However, sprinkler and drip irrigation have higher water use efficiency (70 to 90 percent) than surface techniques (40 to 60%), but require higher levels of initial capital investment. This poses a challenge, given the limited financial capacity of farmers. The most used irrigation method both for large or small scale is still surface water irrigation in Africa except where the irrigation sector is developed and water scarcity is high (Tunisia, Morocco, South Africa, and Egypt) where drip and sprinkler irrigation techniques are applied. [1]

There was a practice of small scale farming in the Jimma Zone. Traditional irrigation schemes built through self-help program carried out by farmers on their own creativity and varies from less than 50 ha to 100 ha. [4] The habit of irrigation water for other purposes was an indicator for irrigation water loss. In agreement to this farmers are not in the position to manage the irrigation water. [13] Poor irrigation water management associated with water scarcity is the major reason for underperformance of most small-scale irrigation schemes. [14] And then water application results of the study are in agreement to the study at Sebeta and Walmera woredas. [9]

5. Conclusion

The results of the assessment indicate that most of the farmers have their own indigenous knowledge on irrigation water management. The irrigation under small-scale farm was practiced by the farmers of the woreda with small areas of field. But due to the smaller area on the scheme some of the farmers were used to rent in from others and because of the sufficient water on the areas there was no conflict between farmers of the scheme. However, the most of the schemes were built long years ago and then the canals will need to maintained with continuous solution by the government.

The other one was the farmer's technical perception towards irrigation water management practice was with a respectable performance. The interviewers responded that, even though drip and sprinkler irrigation systems are the best irrigation method in terms of water saving and production, the systems were not used due to lack of facilities, knowledge and capital of the farmers. So they used optimization of the amount of water to irrigate by their own traditional ways even with the furrow irrigation methods. This was an indicator for their long years' experience on indigenous knowledge of water management. There was best indigenous irrigation water management at different area which was described by the respondents. Therefore, applications of poor irrigation practice leads to yield reduction, outbreak of disease, water logging, quality reduction, and soil erosion & land degradation. The farmers apply irrigation when the soil is dry (soil crack) and/or crop start wiling in order to fulfill the requirement of the crop. Finally, to make the indigenous knowledge more effective farmers should be assisted by governmental and non-governmental organizations giving training, participate in field days and demonstration, providing improved agricultural technologies and providing better access to credit.

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Author's Contribution

Writing-original draft: Hewan Tadesse;

Editing: Etefa Tilahun and Minda Taddesse;

Data collection: Addisu Asefa and Robel Admasu. Then all authors were contributed to the final version of the manuscript.

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Conflicts of Interest

The authors have not declared any conflict of interests.

References

[1] F. Lebdi, "Irrigation for agricultural transformation - Background paper for African transformation report," 2016. [Online]. Available: https://www.jica.go.jp/jica-ri/publication/booksandreports/l75nbg0000004aet-att/l75nbg0000004ai9.pdf.

[2] D. Groenfeldt, "Irrigation Development and Indigenous Peoples," 2005, pp. 1–10.

[3] Y. Jambo, A. Alemu, and W. Tasew, "Impact of small-scale irrigation on household food security: evidence from Ethiopia," *Agric. Food Secur.*, vol. 10, no. 1, pp. 1–16, 2021, doi: 10.1186/s40066-021-00294-w.

[4] G. Shiwenzu, "Rethinking Traditional Irrigation Water Equity in Holetta River, Awash River Basin, Ethiopia," *Sci. J. Res. Rev.*, vol. 1, no. 5, pp. 1–7, 2019, doi: 10.33552/sjrr.2019.01.000525.

[5] M. B. Alemu, "The Socio Economic and Institutional Factors That Affect Traditional Small Scale Irrigation Activity along Chemoga River, Gozamin Woreda, Amhara Region, Ethiopia," 2015. [Online]. Available: http://www.sciencepub.net/report.

[6] E. P. Anderson, S. Jackson, R. E. Tharme, M. Douglas, and J. E. Flotemersch, "Understanding rivers and their social relations: A critical step to advance environmental water management," *Wiley Interdiscip. Rev. Water*, vol. 6, no. 6, 2019, doi: 10.1002/WAT2.1381.

[7] O. H. Utami A S, "Traditional ecological knowledge in irrigation water management in Tanah Datar District West Sumatera Traditional ecological knowledge in irrigation water management in Tanah Datar District West Sumatera," 2022, doi: 10.1088/1755-1315/1059/1/012036.

[8] A. S. Shahraki, T. Panagopoulos, H. E. Ashari, and O. Bazrafshan, "Relationship between Indigenous Knowledge Development in Agriculture and the Sustainability of Water Resources," pp. 1–17, 2023.

[9] M. Temam and N. Abebe, "Indigenous Knowledge Assessment on Irrigation Water Management Practices," vol. 7, no. 2, pp. 14–17, 2022, doi: 10.11648/j.ajmse.20220702.12.

[10] D. T. Mitku and T. F. Adamite, "Indigenous Knowledge Assessment on Irrigation Water Management Practices in Metekel Zone, North West Ethiopian," vol. 7, no. 4, pp. 40–43, 2022, doi: 10.11648/j.ajmse.20220704.11.

[11] G. Tesfaye, K. Fikirie, Y. Debebe, and L. Hailu, "Evaluating Technical Standards of Implemented Soil and Water Conservation Technologies in," vol. 19, no. 4, 2019, doi: 10.19080/ARTOAJ.2019.19.556100.

[12] O. A. Adeniyi, "Marginal effects of farmers' age on their irrigation technology adoption in poverty reduction in Kwara state," *Glob. J. Interdiscip. Soc. Sci.*, vol. 3, no. 4, pp. 53–56, 2014, [Online]. Available: http://www.gifre.org/admin/papers/gjiss/53-56-MARGINAL-vol-3-4-gjiss.pdf.

[13] G. Shiwenzu, "Study of Scientific and Traditional Irrigation Water Management," *Ethiop. J. Environ. Stud. Manag.*, vol. 10, no. 8, pp. 1022–1033, 2017, doi: doi: https://ejesm.org/doi/v10i8.5.

[14] D. Fissahaye, C. J. Ritsema, H. Solomon, J. Froebrich, and J. C. Van Dam, "Irrigation water management : Farmers ' practices, perceptions and adaptations at Gumselassa irrigation scheme, North Ethiopia," *Agric. Water Manag.*, vol. 191, no. 2017, pp. 16–28, 2023, doi: 10.1016/j.agwat.2017.05.009.