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ASSESSMENT OF USERS' SATISFACTION WITH IRRIGATION SERVICE PROVIDED IN HARE IRRIGATION SCHEME, ARBA MINCH, ETHIOPIA

Mamuye Tebebal
Federal Technical and Vocational Education and Training Institute, Department of Research, Technology Transfer and Industry Linkage, Addis Ababa, Ethiopia

Genet Mathewos Messene
Water, Mine and Energy Department, Water Supply Design, Construction and Supervision Core Process, Sidama Zone, Hawassa, Ethiopia,

ABSTRACT

Farmer's perspectives and assessments of irrigation scheme performance are critically inherent for irrigation system management. Hare irrigation scheme is indeed expected to play a vital role to realize food security and enhance farm incomes in the rural households. Yet, insufficient farm returns and social factors corresponding to water distribution problems are transpired. The objective of this study was to assess the level of user's satisfaction with irrigation services provided by the scheme in terms of adequacy of water supply, dependability, equity of water distribution, timelines of water delivery, user's contribution in operation and maintenance activities; operation and maintenance requirements of the system. It was analyzed using Binary Logit model. The study was conducted in the irrigation season from September to December, 2014. The results indicate that, the probability of user's satisfaction in adequacy and equity of water distribution are highly significant at 0.1significance level. Besides, the dependability of water distribution, timelines of water delivery, operation and maintenance requirements of the system are significant at 0.5 significance level. About 35.6 per cent of the beneficiaries have been satisfied with irrigation services. Generally, it was found that, the irrigation service provide to the user is unsatisfactory; the beneficiaries didn't acquire the intended benefits of the scheme. Therefore, capacities building of users, improving water delivery scheduling, reorganizing WAUs, proper operation and maintenances of the system are needed to improve the irrigation scheme efficiencies.

KEYWORDS: Farmer's satisfaction, irrigation service, Binary Logit model, Hare irrigation scheme.

INTRODUCTION

Irrigation has major importance in many countries; however dissatisfaction with the performance of irrigation projects in developing countries is extensive. Despite, their potential as engines of agricultural growth; irrigation projects typically perform far below their potential [1]. Head tail problems, leaky canals and malfunctioning structures because of delayed maintenance, leads low water use efficiency and low yields are some of the commonly expressed problems. A large part of low irrigation performance may be due to inadequate water management, weakness in the organization, improper design and construction at system level [2, 3 and 4]. Rapid increases in the World's population have made the efficient use of irrigation water vitally important particularly in poorer countries, where the greatest potential for increasing food production and rural incomes is often to be found in irrigated areas. It has therefore become a matter of serious concern in recent years, despite their very high costs; the performance of many irrigation schemes has fallen far short of expectations [5].

Ethiopia has huge cultivable lands (30 to 70 Mha), however only about a third of that is currently cultivated (nearly 15 Mha). Current irrigation schemes covering about 640,000 ha across the country [6]. Like other developing countries, Ethiopia's economy depends mainly on agricultural production. However, because of erratic and uneven rainfall distribution, rain-fed crop production without irrigation substantiated is not to be successful mainly in arid and semi-arid areas of the country. On the other hand, the increasing need of production for food security due to population growth at most is necessary and it could be achieved by efficient and effective irrigation management. In many of the developed irrigation schemes, water management activities are undertaken by the farmers, but they lack technical expertise to effectively manage the available water. The poor performance is evident from low productivity coupled with poor efficiency of water use, weakness in the organization and rapid deterioration of irrigation system. Unsatisfactory performance of irrigation system and users satisfaction in the country is associated with little experience in irrigation in the consequence of technical deficiencies in the design of the system, weaknesses in the organization and management of the system. The supply and distribution of irrigation water is most often not adequate, equitable and reliable. Those are primary essential condition that could limit to achieve highest productivities [4]. Availability of water for agriculture is a top priority to the farmer; however less attention is given for quality of irrigation facilities and efficiency of water utilization. Water is distributed to the fields without any comprehensive investigation of irrigation demands and it depends on water availability. This in turn causes inequitable water distribution across the scheme water users [7]. In tropical countries like Ethiopia, one of the three essential requirements of plant growth is water, which needs to be supplemented frequently by artificial application of water. Thus, irrigation is supplementary to rainfall when it is either deficient or comes unevenly or at irrational times. Good irrigation practices include not only questions related to when and how much water is to be applied, but also the application of appropriate irrigation and drainage methods, the placing of cropping patterns, the management of and deprived quality of water.

Hare irrigation scheme was constructed by financial and technical support of Chinese cooperative with Ethiopian government in 1997, and became functional in February 2004 GC. It was intended to serve around 1798 households of Chano Chelba and Chano Mille villages. The scheme actually contributes to enhanced crop production and increased farm incomes to the rural households; and helps to improve the living standard of the community. The farmers are exercising irrigation and has harvested twice per year. However, the user didn't achieve the intended agricultural output of the scheme. Some of the factors that hinder the agricultural outputs includes: insufficient farm returns, social factors, sedimentation and water logging. The designed and actual command area in irrigation was 1336 and 1131.87ha respectively. For the scheme management and water distribution administratively, each block's has its own local committee selected from the two villages, which are responsible for water allocation falling under an overall scheme management committees. Previous support from the Government was inadequate to cover all necessary improvement requirements. Commonly, there is high competition for irrigation water use among the upstream and downstream irrigation units. Most of the community uses surface water sources and rainfall for irrigation practices. Particularly, there is a possible rise in a potential risk of trimmed irrigation efficiency due to inappropriate methodologies such as: the infrastructure of irrigation system lacks the capacity to deliver irrigation water, problems of operating gates and maintenance of canals, flooding and erosion problems. A critical problem facing in the scheme is frequent water related conflicts. In this regard, assessment of users' satisfaction with irrigation provision becomes important to ensure respectable management of the irrigation system.

Farmer's perceptions about the performance of irrigation scheme have principal implications. In this instance the ways to integrate and analyses their view of enactment have been reviewed. Most researchers have conducted studies to assess the performance of irrigation management process using financial and physical indicators [8 and 9]. On the other hand, some researchers have studied in irrigation water management from the farmer's opinion [10 and 11]. In this study, the level of users' satisfaction in the performance of irrigation scheme was assessed with performance indicators such as farmer's satisfaction with water delivery, operation and maintenance indicators in reasonable and integrative outlooks. Therefore, this study was carried out to determine the status of user's satisfaction provided with irrigation service via Binary logit model. Frequent monitoring of the statues of users satisfaction in irrigation service provided will assist to distinguish whether the requirements are being met or not. It also provides information to system managers, farmers and policy makers in a better understanding of how a system can be managed.

MATERIALS AND METHODS

2.1 DESCRIPTION OF THE STUDY AREA

Hare community managed irrigation scheme is situated in Abaya-Chamo Sub-basin, Gamo Gofa Zone, Southern Nations; Nationalities and peoples Region of Ethiopia. The topography of the command area is described as flat to gently sloping plain. The watershed is located between 6o03' and 6o18' North and 370 27' and 370 37'East and has an area of 187 km2. The average elevation is about 1169 m AMSL; and its command area lies between 6o06'40" and 6o06'28" North and 37o 33'53" and 37o36'48" East. The long term average annual rainfall, maximum and minimum temperature in the area are estimated to be 830.1 mm, 33.3oc and 15.3oC respectively. The scheme abstracts water from Hare River. The design capacity of the intake structure is 2 m3/s with a maximum discharge capacity of 2.4 m3/s. The networking system of canals in the irrigated area consists of one main canal with eight branch canals. A small portion of the main canal is rectangular masonry and the major portion is trapezoidal lined and unlined canal. The length of the main canal was about 5.31 km long and totally had 23.85km length of branch canals [12]. Smallholder agriculture is the dominant land use in the watershed; irrigated cash crop is the predominant.

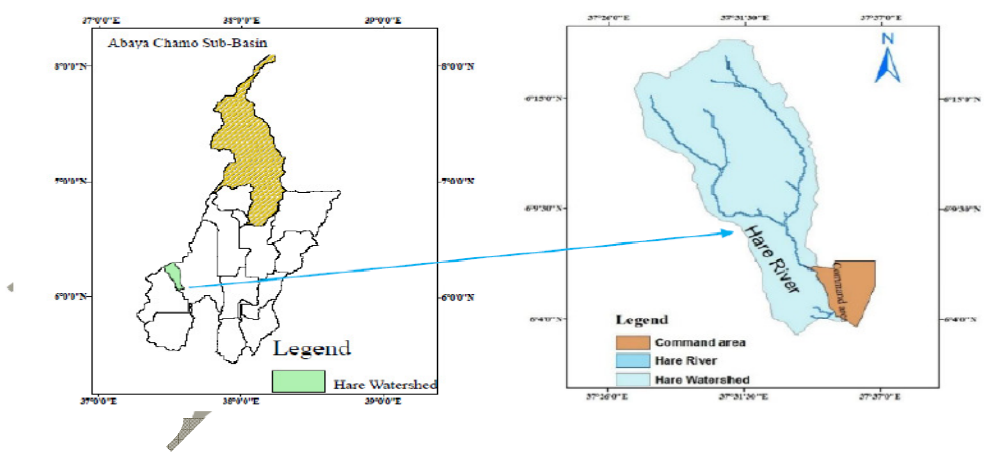


Figure 1: Location map of Hare irrigation scheme **Hare watershed and command**

2.2 METHODS

2.2.1 SAMPLING SIZE AND TECHNIQUES

The main canal length which actually gives service to the beneficiary was 3.89 km. The number of users in the villages and each branch canal's landholding size are not homogeneous. Therefore, in the study, the scheme in the service area was stratified into three segments according to the locations along the main canal (i.e. head, middle and tail), and then proportional sampling was done based on the main canal lengths. The number of respondents in each reach was determined using systematic random sampling techniques. According to Krejcie and Morgan [13] and Creative Research System [14] sample size calculator, five percent of users were sampled for the study in the entire system at 95 percent degree of freedom. In order to determine the probability of user's satisfaction in irrigation service, an interview based cross-sectional survey data of 90 farmers out of 1798 water users were undertaken in 2014.

Table 1: Sample size in the irrigation main canal system reaches

Reach	Main canal length (km)	Branch canal	Actual irrigated land in each branch canal (ha)	Number of samples in each reach
Head	1.297	BR_1	25.66	30
		BR_2	205.36	
Middle	1.297	BR_3	183.46	30
		BR_4	173.00	
Tail	1.297	BR_5	132.90	30
		BR_6	138.11	
		BR_7	273.34	
Total	3.89		1131.84	90

2.2.2 DATA SOURCES AND METHODS OF DATA COLLECTION

In this study, the data were collected from primary sources. The primary data were collected through prepared closed and open-ended questionnaires. Such activity includes: discussion, interviews and filed observations.

2.2.3 DATA ANALYSIS

The statues of user's satisfaction provided by the scheme was investigated based on the data that were collected during September to December, 2014 in one irrigation season. The users' satisfaction with respect to water delivery, operation and maintenance requirement and users contribution to operation and maintenance activity needles was estimated based on the beneficiaries' reaction regarding with irrigation services. In the study, the survey data as per the farmers' viewpoint was investigated with Binary logit model.

LOGIT MODEL PARAMETER ESTIMATION: MEASUREMENTS OF USER'S SATISFACTION

Different models are used for evaluating probability of farmer's satisfaction; because of their ability to handle discrete, subjective and qualitative data which is usually associated with irrigation performance assessment studies [15]. The three methods to developing a probability model for a binary response variables viz. Linear probability model, Logit and Probity model are mostly utilized [16 and 17]. However, logit model is the most appropriate model which has been used for the purpose of analyzing the farmers` satisfaction status in the study. Because, the application of logit model in the analysis has varies advantages over the other analytical models, such as; it is easier to compute and interpret, produces statistically sound result and the computation guaranties the rate of probabilities estimated value always lays between 0 and 1 [17]. Binary logit model can therefore be employed to estimate the satisfaction status of randomly selected farmers in the villages. It allows for estimating the probability that an event occurs or not by predicting the binary dependent outcome from a set of independent variables [18 and19]. The output of a model was run on STATA software version 11 with six factors that were expected to have an effect on the satisfaction status of farmers. The basic idea underlying the model is given as [16 and 18]:

$$Pi = E\{Y = 1|Xi\} = \beta o + \sum_{i=1}^{k} \beta_i X_i \quad (3.1)$$

where P_i represents the probability of the farmer being satisfied with irrigation services, X_i denotes the set of explanatory factors and Y is dependent variables. βo and β_i are the intercept and slope of the regression function respectively. If Z is denoted as $\sum_{i=1}^{k} \beta_i X_i$, then the probability of a farmer being dissatisfied is given by $(1-P_i)$ and it can be written as:

$$\frac{Pi}{(1-Pi)} = \frac{1+e^{Zi}}{1+e^{-Zi}} \quad (3.2)$$

Taking natural logarithm both sides of equation 3.2 will yield as equation 3.3 [16 and 18]:

$$\frac{Pi}{(1-Pi)}$$

$$(¿) = \beta o + \sum_{i=1}^{k} \beta_i X_i \quad (3.3)$$

$$Li = \ln ¿$$

L_i is the Logit model. For determining user's satisfaction provided in the irrigation service, the following variables were assumed to have an effect for farmers satisfaction (Table 2).

Table 2: Description of variables affecting user's satisfaction provided in irrigation services.

Dependent variable	
Y	Satisfaction (1) and dissatisfaction (0) with using irrigation service
Independent variable (satisfied response, X_i =1 , otherwise=0)	
X1	Dependability of water supplied
X2	Adequacy of water delivery
X3	Equity of water distribution in the irrigation system
X4	Timelines (water received at requested time)
X5	Operation and maintenance requirement
X6	Users contribution to operation and maintenance activity

The farmer's satisfaction was represented by one (1), while zero (0) represents dissatisfaction in the irrigation service provided. The analyses of determinant factors on the irrigation satisfaction of users were decided based on the model outputs at 1%, 5% and 10% significance level. According to Davies [20] and Thomas [21] the perceived variables has significant effect on dependent variables (i.e. very strong significant, strong significant and weak significant effect), if the estimated p-value is ≤ 0.01, $0.01 \leq p \leq 0.05$ and between 0.05 and 0.1 respectively.

RESULT AND DISCUSIONS

3.1 EVALUATION OF USERS SATISFACTION PROVIDED IN IRRIGATION SERVICE

Based on the survey data collected in the study, the estimated regression results with its regression coefficients (β) and significant test results at the reaches and the entire level are given in Table 3 and 4 respectively.

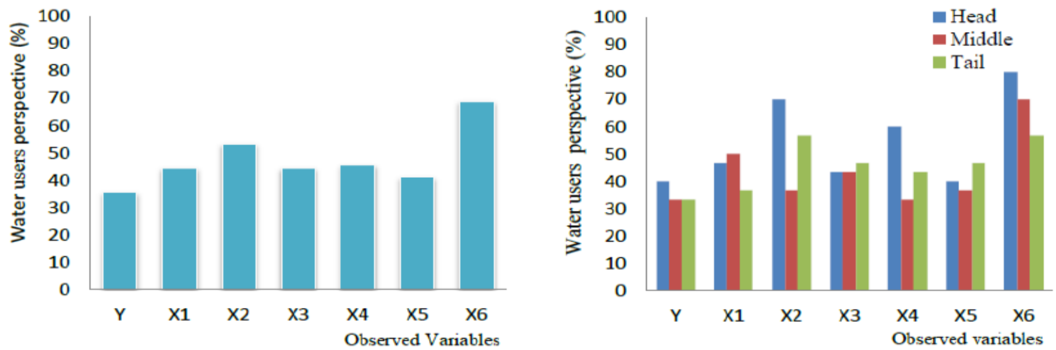
Table 3: Parameter estimates of a Binary logit model in the head, middle and tail reaches

Location	Head				Middle				Tail			
Independent variables	β	Std. Err.	Z	P-value	β	Std. Err.	Z	P-value	β	Std. Err.	Z	P-value
X_1	0.842	1.00	0.84	0.399	2.31	1.35	1.71	0.087^{*}	2.44	1.89	1.29	0.195
X_2	2.102	1.38	1.53	0.126	2.64	1.37	1.92	0.055^{*}	4.31	2.53	1.70	0.088^{*}
X_3	1.319	1.01	1.31	0.190	2.41	1.18	2.05	0.04^{**}	3.20	1.73	1.85	0.065^{*}
X_4	1.447	1.11	1.31	0.191	0.44	1.36	0.33	0.744	3.20	2.57	1.92	0.055^{*}
X_5	2.303	1.17	1.97	0.049^{**}	0.42	1.15	0.36	0.716	4.94	1.78	1.60	0.109
X_6	-0.331	1.25	-0.27	0.791	-0.27	1.32	-0.21	0.837	2.85	1.54	-1.15	0.251
Constant	-4.707	2.15	-2.19	0.029	-4.46	1.94	-2.30	0.021	-9.71	4.45	-2.18	0.029

Table 4: Parameter valuation of a Binary logit model in the entire system

Dependent variable (Y)				
Independent variables	Coefficient (β)	Std. Err.	Z	P-value
X_1	1.29	0.63	2.03	0.042^{**}
X_2	1.96	0.67	2.93	0.003^{***}
X_3	2.00	0.62	3.24	0.001^{***}
X_4	1.46	0.64	2.29	0.022^{**}
X_5	1.52	0.64	2.38	0.017^{**}
X_6	-0.37	0.63	-0.59	0.554
Constant	-4.62	1.13	-4.09	0.000

Note: Based on the review data, number of observation = 90, Log likelihood = -35.90976, observed 32=1(satisfied engaging with irrigation service), 58=0(dissatisfied engaging with irrigation services). ***, ** and * significant on 1%, 5% and 10% level of significant respectively.
Graphical representation of users' perspective in the entire system and in head, middle and tail reaches are shown in Figure 1.



(a) Percived statisfaction view in the entier system

(b) Percived satisfaction view in the reach

Figure 2: Observed satisfaction views of users taken with irrigation services

According to farmers point of view the statistical results given in Table 2, the probability of satisfaction in operation and maintenance requirements of the system is significant at 0.05 significance level on head beneficiaries. As well, satisfactions in middle reach of the system in dependability and adequacy of water supplied to the farm have significant effect in 0.1 level of significance. Satisfaction in equity of water distribution is found to be significant at 0.05 significance level (Table 3). Farmers' opinion in the tail reach perceived that, satisfaction in the equity of water distribution; adequacy and timeliness of water supply are found to be significant in 0.1significance level. Satisfaction in the reliability of water delivery has not significant effect. Yet, in the actual circumstance the dependability of water delivery to the tail reach beneficiaries is unsatisfactory. According to the observed results, the satisfaction of users with irrigation service at head, middle and tail reaches are nearly 40.00, 33.33 and 33.33 percent respectively (Figure 1 b).

As per farmers cross-examined through the entire system in the study, satisfaction taking with irrigation service in equity of water distribution and adequacy of water supplied to the farm are found to be significant at 0.01significance level. Dependability of water supply at full irrigation season, timelines of water delivery (water received at a requested time), operation and maintenance requirements are significant at 0.05 significance level (Table 4). With regarding to the observed result in the entire system shown in Figure 4.1 a, about 35.6 percent of the beneficiaries have been satisfied with irrigation service. As per user's point of view, nearly 44.44, 53.33, 44.44, 45.56, 41.11 and 68.89 percent of users in dependability of water delivered to the smallholding, adequacy of irrigation water provided to the farm, equity of water distribution in the system, timelines of water distribution at a requested time to the farm, operation and maintenance requirements as they have expected and the burden of farmers involved in operation and maintenance activities had been satisfied with irrigation provision respectively (Figure1 a). The results shown in Figure 1a indicate that, the water distribution is inequitable, about 55.56 percent of respondents are dissatisfied. The reason for this inequity of water distribution could be damaged control and distribution structures, poor irrigation scheduling, inconsiderable water losses in distributing water over long distance, insufficient diversion and irrigation network maintenance, lack of clear water rights and supportive training for irrigation water management. Belete [22] and Mekonen [23] also found similar results in the study and suggested that almost upper end outlets were received more water than the tail end.

From the analysis result given in Table 4, the dependability of water distributed at full irrigation season in the scheme and adequacy of water supplied to the farm were unsatisfied due to a number of shortcomings which include: over-abstraction of water by upstream water users of the scheme, inadequate supply of water at water source specially in the driest season, weir and canal sedimentation, damaged control structures, unfortunate scheduling of the available water, inadequate maintenance of the irrigation system and improper water distribution by operation and maintenance administrators. Also the inadequacy of water supply to the farm happened in the irrigation season is due to lack of irrigation planning for restricting farmer's freedom of selecting the cropping patterns.

With regard to timelines of water delivery, farmers and development agents' interview indicated that, the delivery of water at a requested time is found to be unsatisfactory in the entire system (Table 4). The tail reach users are more disadvantaged than the head and middle reaches. The beneficiaries are received water at different times, based on the size of command area and grown crops, which are frequently outside as they have expected and the times agreed with the scheme executive committees. The right times of water delivery at a requested time to the user are disregarded. About 58 percent of the beneficiaries are dissatisfied in operation and maintenance provisions (Figure 1 a). Through the investigation, it was discovered that farmers are neither contributing money for operation and maintenance nor charging for the irrigation water they have used. However, the involvement of tail reach beneficiaries in maintenance of canals are more burden than the middle and tail reach users' (Table 3 and Figure 1 b).

CONCLUSIONS AND RECOMMEDATIONS

Farmer's perspectives and assessments of irrigation scheme performance are thus critically important for seeking how the farmers are reached the decision of being satisfied or not. The level of users' satisfaction has been investigated illustrating on extensive primary survey data. The farmer's satisfaction provided with irrigation service has been observed using Binary logit regression analyses model. Irrigation service provided as measured in terms of dependability, adequacy, equity, timelines of water delivery and operation and maintenance requirements had found to be unsatisfactory. According to the result of the study, adequacy and equity of water distribution are the most determinate factors to user's satisfaction. In general, according to the result perceived, the performance of irrigation system is low with respect to users satisfaction. The main causes of insignificant farmers' satisfaction have been due to unfortunate flow conveyance, distribution; control and measurement structures, technical, institutional and financial issues. A critical problem facing in the scheme is frequent water related conflicts resulting from unregulated and incorrect allocation of irrigation water. The organization (WUAs) of the scheme is too weak to manage the system. Particularly, as it can be observed, there is a possible rise in a potential risk of low irrigation efficiency due to unfortunate approaches including; the physical structure of irrigation system lacks the capacity to deliver irrigation water, problems of operating gates and maintenance of canals, management gaps, flooding, sedimentation and erosion problems. Therefore, a system to be performing well and beneficiary are to be satisfied; thoughtful system management is required so as to achieve the required objectives of the scheme. Moreover, improving water management, adequate maintenance of irrigation infrastructures, capacity building of users in different aspects which can be support for improving irrigation water utilization, soil and water conservation practice becomes required to provide manifold benefits. Also, providing water control and measurement structures are essential. In a system with volumetric water control and measurements, the users request water and are charged for the exact volume of water consumed at field level. The farmers thus have an incentive to apply not more than just enough water.

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