Across System Comparative Assessment of irrigation performance of community managed scheme in Southern Ethiopia

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Abstract

The water users located at the upstream of the irrigation system have more access to water than those located at the downstream of the system. Moreover, the irrigation activity of tail-enders is seriously affected in both water scarce and water abundant periods due to under and over irrigation respectively. Not only water but also the situation of landholding affects the productivity and income of the farming community. The goal of this study was to assess the spatial variation of irrigation performance and to evaluate its effects in terms of performance of agricultural production (intensification and productivity), income and resources base as well as the environment. Across-system performance assessment study sponsored by International Water Management Institute (IWMI) was done on the basis of simple illustration of the approach followed for the assessment and different levels of water accessibility along the canal reaches. The level of availability of irrigation water or accessibility to the farm is affected by the proximity of the farm to the water source or to the water carrying canals. The study confirmed that as one gets away from both the water source and the canal the accessibility of water becomes less and less, unless proper system for water allocation is in place and practiced. In view of that, six zones can be differentiated based on the condition of water accessibility. These are highly accessible, moderately accessible, less accessible, very less accessible, poorly accessible and water scarce zones. Sometimes the tail-end, which is characterized by water scarce zone, is also found to be affected by water logging. Since, available water and demand for water are not continuously monitored and managed, the situation outlined paves the path for potential conflicts among water users in response to visible livelihood differences. Despite disruption of downstream users from irrigating their field, significant loss of scarce resource by the upstream users have resulted in detectable environmental threat such as water logging, sodicity (10.44meq/l, k (H.C.) 0.00279cm/hr) and salinity problems in the area.

1. Introduction

There is a common perception that water users located at the upstream of the irrigation system have more access to water than those located at the downstream of the system. Moreover, the irrigation activity of tail-enders is seriously affected in both water scarce and water abundant periods due to under and over irrigation respectively. In Hare irrigation scheme there are three diversion sites very close to each other which are planned to serve a wide range of users. Before the establishment of the scheme, only limited numbers of farmers which are close to the water source were using traditional methods to irrigate their lands. It is common that after the establishment of irrigation scheme the number of population in the command area increases through migration of peoples from elsewhere. Intended is to get the benefit of irrigation that the early settlers are enjoying. Land acquisition of new comers is most likely possible at downstream of the canal reaches in the system. Not only these late settlers will become the victims of water shortage but also the whole irrigation system will get under pressure because initially designed capacity may not met the increased demand through time. Unless the available water and demand for water are continuously monitored and managed, the situation outlined above could be one of the potential causes of conflict among water users.

There are complaints among four involved Kebeles regarding unequal distribution of water among the users in the scheme. Especially, during dry seasons Kolla Shara Kebele which is served by the upstream diversion structure is diverting water without considering the share of three other Kebeles (Chano Dorga, Chano Chalba and Chano Mile) that are feed by the rest two downstream diversions. There are visible livelihood differences among the beneficiaries of the scheme. On the other hand there are poor and food self-insufficient households living in the system.

Not only water but also the situation of landholding affects the productivity and income of the farming community. Provided that water is sufficiently available, the direct benefits of irrigation, in terms of increased farm output, will tend to accrue in proportion to the size of landholdings, with large holders benefiting more than smallholders, and smallholders benefiting more than the landless.

The objective of this study was to assess the spatial variation of irrigation performance in Hare community managed irrigation scheme in southern region of Ethiopia. The specific objectives are:

- to assess the water distribution performance of the scheme
- to evaluate the effect of being at the upstream, midstream or downstream regions of irrigation canal system in terms of performance of agricultural production (intensification and productivity), income and resources base

2. Description of the irrigation scheme

2.1. Hydrometeorology of the area

The climate of the area is characterized by mean maximum and minimum temperature of 30.3 and 17.4^{0}C respectively, annual rainfall of 843mm and potential evapotranspiration of about 1644mm. Mean monthly distribution of these parameters are shown in Table 1. The rainfall distribution pattern is bimodal with first and maximum peak in April to March and second peak in October. The area is characterized by high potential evapotranspiration rate that ranges from 112mm in July to 180mm in March. Consequently, except in April and May, the evaporative demand of the area is greater than the amount of natural rain. This means that there is a negative climatic water balance in the area. This calls for supplementary water application to the crop fields through irrigation to sustain crop production. The warmest months of the year are February and March while the coldest are November and December.

The maximum flow hydrograph of Hare River which is the source of water for the scheme shows also two distinct peaks that occur in May (5.60m^3/ s) and October (4.53m^3/s). The low flow hydrograph between the two peak rainfall periods, i.e. from May to October, is almost consistent ranging from 1.26 to 1.62m$^{3/}$s. The low flow declines during the months from December to April.

Table 1: Mean monthly values of hydro-meteorological parameters

	Rainfall (mm)	PET (mm)	Temperature (^{0}C)		Hare River Flow (m^3/s)	
			Maximum	Minimum	Maximum	Low flow
January	28.1	139.5	31.7	16.3	1.31	0.69
February	27.9	140.0	32.9	17.1	1.49	0.64
March	64.0	179.8	33.0	18.3	1.95	0.63
April	144.1	141.0	30.8	18.2	4.06	0.85
May	140.5	136.4	28.9	17.9	5.59	1.33
June	63.1	120.0	28.1	17.9	3.79	1.25
July	43.4	111.6	27.7	17.9	3.81	1.26
August	53.2	124.0	28.5	18.0	3.54	1.31
September	78.1	135.0	30.1	17.8	4.26	1.33
October	110.6	136.4	29.8	17.7	4.53	1.62
November	59.3	138.0	30.6	16.0	2.65	1.16
December	31.1	142.6	31.1	15.7	2.13	0.93
Total/Mean	843.2	1644.3	30.3	17.4	3.26	1.09

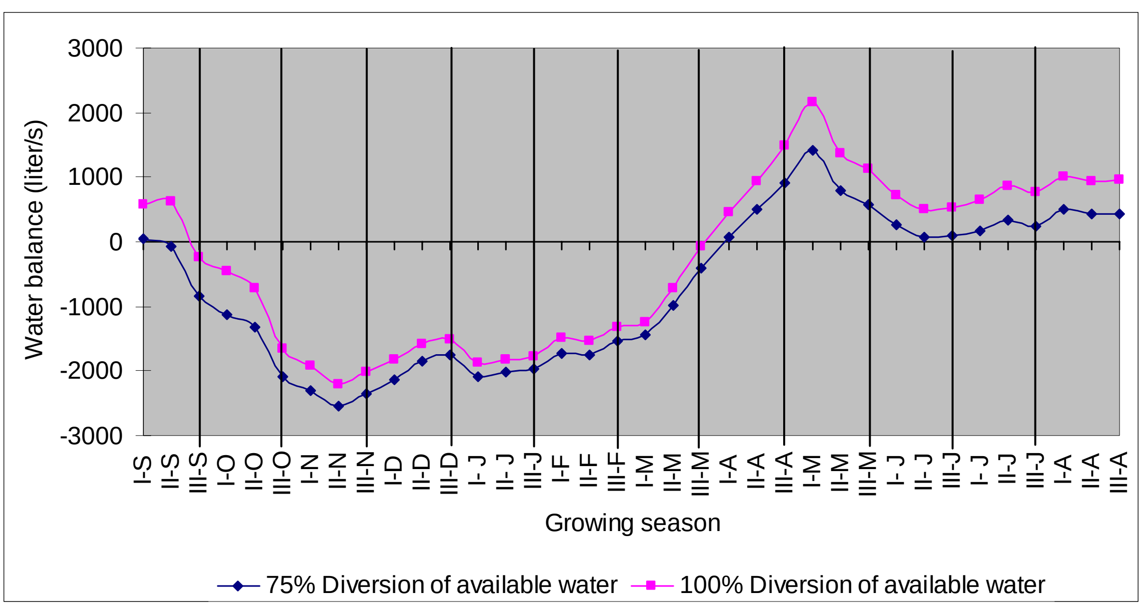
To see the relationship between demand and available water two scenarios have been considered; (i) with 75% dependable diversion and (ii) with 100% diversion of the available water. The results are presented in Fig.1. In both scenarios the available water cannot meet the water demand for irrigation during seven consecutive months of the year viz. from late September to March. Feedback from the users also revealed that these identified periods to be water scarce times. Total diversions of water from the river course to the canals have been observed in the months of December and January. The available water in these months can only irrigate an area which is 24% of actually irrigable land (2224 ha). As the river pass through diversified bushes to end in Abaya Lake which is located downstream of the scheme (Fig. 2), its total diversion will likely have negative effects on these ecosystems. The water balance (water supply minus demand) is positive from April to August.

Fig. 1: Mean decade water balance (water demand minus available water from the source) from September to August.

2.2. Background of Hare irrigation scheme

2.2.1 Irrigation Scheme

Hare irrigation scheme encompasses three diversion systems the upstream diversion with control gate, the midstream traditional diversion and downstream diversion weir. These diversion points are respectively designated as D1, D2 and D3 (Fig. 1).
The upstream and midstream diversions and



their delivery systems were established in the year 1993 while the downstream diversion weir was implemented in 1996. It was meant to serve four villages which are locally called "Kebele", viz. Kola Shara, Chano Dorga, Chano Chelba and Chano Mille. Fig. 2 shows the diversion points and the canal systems delivering water to the respective Kebeles.

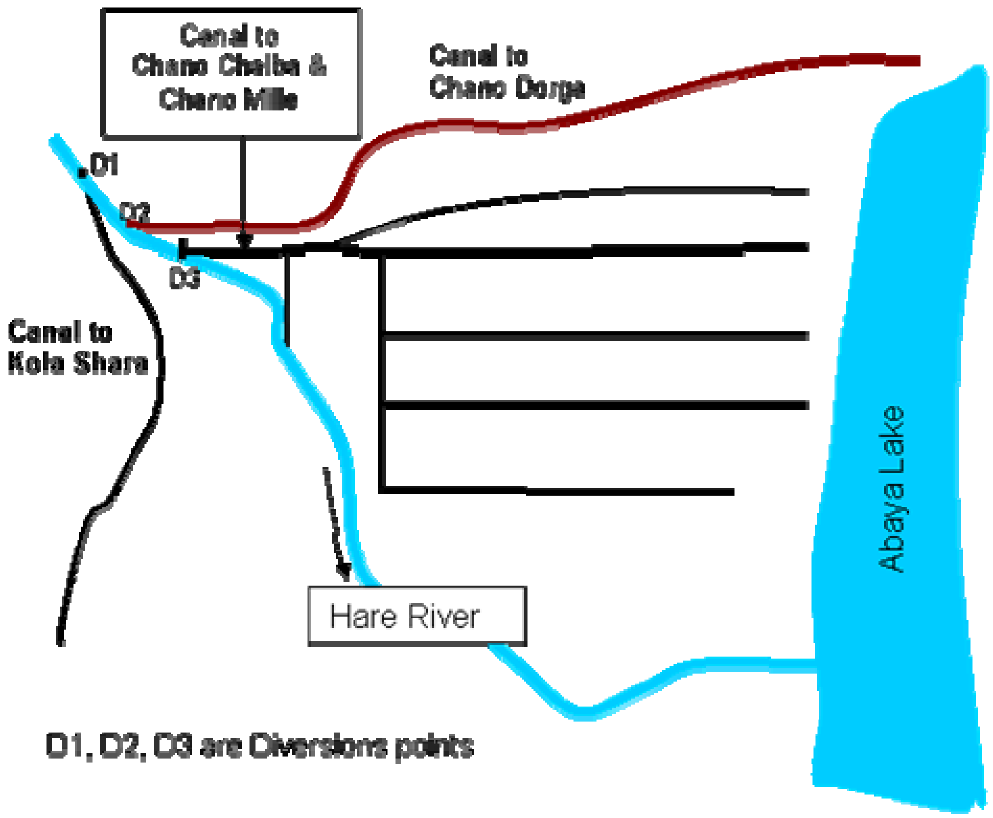


Fig. 2: Layout of Hare Irrigation Scheme

The upstream diversion (D1) of water is accomplished by simple concrete intake structure. The earthen unlined canal is receiving water from the intake structure to irrigate Kolla Shara command area. The 6km long main canal was initially trapezoidal in shape and now it is irregular. The canals pass through villages and are subjected to damages by human and animals which resulted in bank breaks, overtopping, weed growth, accumulation of silt and wastes in the canals.

Downstream of D1 is D2 the point at which traditional diversion of water is practiced. That means there is no headwork and water diversion is accomplished by a simple open cut in to the river bank which is supported by diagonally arranged temporary barrier (stones, plant rests) and act as divide wall. Unlined earthen canal which is running on the left bank of the river takes water from this diversion point to irrigate Chano Dorga area. The main canal runs over 7.1 km distance and has got irregular shapes. In some areas the canal bed has developed to gorges while in other locations shallow depth and wide surface areas are the characteristics of the canal. There is not as such well designed secondary canal. Hence field channels arranged by the community take of water which is directly used to irrigate the corresponding fields. There are about more than 60 major outlet points along the main canal. Since there is not control structure at the head some farm fields are affected by flood during rainy seasons.

Downstream of the above mentioned intake points (D2) there is a diversion weir (at D3) to convey water it to a partially masonry type lined main canal. The structure was provided with a flow control mechanism though its performance has deteriorated from time to time. The weir and its delivery infrastructure were constructed by technical and financial support of Chinese government. It was planned to serve large portion of Chano Mille and some part of Chano Chalba irrigable areas. The construction of the weir was started without feasibility study and awareness of the users. Hence it was accompanied by complaints from the users and even from local and regional authorities. The reasons were luck of awareness, imbalanced weir location, and demand for small dam that could ensure the balance between water supply and demand over the growing season. During construction phase the communities have realized that the implementation of the system will bring about the dissections of their farming field for delivery systems and for the access roads etc. and became more reluctant. In spite of these resistances the Chinese contractors have implemented the diversion weir.

While the construction work was under final phase, some parts had started to give partial services but the discontented farmers partly started destroying the irrigation channels, particularly plowing over the secondary and tertiary canal systems and dismantling of the structures. But gradually the community realized that they have made a lot of mistakes during construction while they have observed a lot of positive impacts in their life due to the intervention. Particularly, the primary user of this weir, Chano Chalba, is the leading Kebele with respect to their production competence as well as the significant change in their standard of living.

Those who complained and protected the irrigation canal from reaching their field at that time are now the one who are straggling to bring the water to their field are still relatively poorer.

The main canal taking of water from the weir is of two types. A certain length is masonry rectangular canal and the major portion of the main canal is trapezoidal pitching. The other irrigation infrastructures such as the turn outs, the division boxes, the road crossings, the drops, the head and cross regulators are all constructed with masonry and reinforced concrete, all are lined and plastered except in some area pointing work. The main canal has got a length of 5.33 km. There are 7 secondary canals which when totally summed have got a length of 12.95 km. The longitudinal slope of the canal alignment is 0.1 % which was ensured through 13 drops.

Group of farmers take water from secondary canals to their field plots through the outlet structures prepared for same purpose. The excess water from the canals and from the runoff joins the main drainage system. Part of the drainage water joins the Hare River and the remaining flows in to Lake Abaya. It is only the main drainage canal which is functional at present and serves to remove immense amount of excess water at the down stream section of the irrigation scheme.

As far as water allocation is concerned there is a water users committee (WUC) which is responsible for fair distribution of water among the users. WUC also organizes maintenance activities. Whenever irrigation is required, each water users group submit request for water to the WUC. Once the request is made to the WUC, then this committee prepares a tentative time schedule up on which irrigation can be made.

2.2.2 Socioeconomics

Prior to construction of irrigation scheme in the area local farmers used to irrigate their lands on their own traditional ways. This accounts to only some 300 hectares. After the implementation of first and second phase construction in 1993 1996 respectively more than 1031 ha and 1336 ha of land have been developed. The number of beneficiaries has also increased from time to time.

The principal crops grown in the command area are banana, maize, mango, avocado, sweet potato and also cotton. Those farmers who have better access to water have preference of growing banana mainly due to its marketability on central market. As it is suitable for fruits trees the area is known for the provision of fruits such as mango, avocado, papaya to the central market. Farmers grow crops such maize and sweet potato for own consumption. Cotton is an alternative crop for tail-enders as it withstands water stress conditions.

Table 2: Demographic feature of Hare irrigation scheme

Name of Villages	Number of Households			Number of Population		
	Male	Female	Total	Male	Female	Total
Kola Shara	800	164	964	2358	2474	4832
Chano Dorga	413	20	433	1403	1363	2766
Chano Chalba	751	175	926	2339	2713	5052
Chano Mile	821	102	923	3950	3074	7024
Total	2785	461	3246	10050	9624	19,674

As per the information in 2006 the total number of beneficiary households is about 3246 out of which 14% are female headed. The relative proportion of female and male of the total population in the command area is almost equal. More female households are found in the command areas of upstream and modern diversion canals viz. in Kola Shara and Chano Chalba commands. The number of households is almost equally distributed in the three of the Kebeles except in Chano Dorga which has the least number of households (Tab. 2).

Table 3 shows the land use patterns of the command area. From the total irrigable area of 2224ha in the scheme the highest proportion is in Chano Mille (32.2%) followed by Chano Chalba (29.2%), Kola Shara (27.7%) and Chano Dorga (10.9%).

Table 3: Land use patterns in the command area

Type of land use	Kola Shara	Chano Dorga	Chano Chalba	Chao Mille	*Total*
Total area, ha	800	745	799	900	*3244*
Cropped area (annual), ha	251	282	199	496	*1228*
Cropped area (perennial), ha	391	120	450	400	*1361*
Total cropped area, ha	642	402	649	716	*2409*
Irrigable area at the moment, ha	617	242	649	716	*2224*
Irrigated area at the moment, ha	617	242	649	454	*1962*
Area occupied by infrastructures, ha	100	43	90	164	*489*
Forest area, ha	20	200	40	10	*270*
Grassland, ha	38	100	20	10	*188*
Average landholding, ha	*0.97*	*1.50*	*1.50*	*1.25*	*1.42*

Except in Chano Dorga Kebele, the largest proportion of cropped area is covered by Perennial crops such as Banana and other fruit trees. Irrigable areas in the first three Kebeles have already been developed under irrigation. However in Chano Mille which is relatively far from the headwork, the irrigated area is only 63% of irrigable land.

2. Methodology

Like other schemes in the country, there is no any kind of record available in Hare community managed irrigation scheme. Hence, useful information for the execution of this study was generated through measurements, observations and interviews. Discussions have been held with water development committee, community elder groups Kebele administration member, development agent/extension agent, farmers, female headed households etc. The scheme has been frequently visited to examine the operations, the conditions and functions of irrigation systems, agronomic practices of farmers, cropping patterns etc. These visits were conducted with the accompany of different water users and operators group, viz. water development committee members, administrators, local elders, model farmers, male and female farmers. An attempt was made to understand the system and collect data necessary to measure the performance indicators.

The main canal and the secondary canal, tertiary canals and field canals including the drainage lines of all the three schemes have been inspected. The capacities of the canal systems have been measured at different reaches.

More than 800 GPS points has been taken for evaluating the scheme performance with respect to its proximity to the watercourse and main canal reach.

Measurements of flows in the canals have been conducted after the canals are maintained, i.e. after the removal of sediments, weeds and other barriers in the canals. Since this study was conducted during the out set of the rainy season right after they maintained the canal section to start irrigation, while they were not yet opened their many illegal outlets particularly the canal of traditional diversion to Chano Dorg. Accordingly, the measurements for this diversion have been only taken along the canal at 5 points (300, 1804, 3802, 5390 & 6730 m). Then again, for the other two diversions, measurements have been taken safely in both directions along the canal and laterally at several points. For instance, for the u/s diversion, Kola Shara along the canal at 370, 1600, 3290, 4190 & 4889 m positions, while for modern diversion 334, 1100, 2230, 2810, 3860, 4030, 5560 & 5890m. For the lateral flow performance investigation, the traditional diversion was not considered as it has no as such properly managed or working secondary canals. Thus, the other two diversions lateral canal performance was evaluated in two categories that is comparison between the secondary lined canal and the secondary earthen canal of the Modern versus the secondary earthen canal of the Modern Cum Traditional.

It is common to measure the discharge at the intake and the application point to estimate the losses. Even though such method is capable of giving the general nature of the water conveying structures performance, by this study we assumed such methods are really less important as it hardly locate the apparent position of the significant loss. In contrast the method we applied here, measuring within short interval and projecting the loss per unit length found to be a relevant technique to get the desired result. Accordingly by linking the actual efficiency and the distance from the intake point the linear correlation coefficients have been obtained.

Across-system performance assessment was done on the basis of illustration given in figures 3 and 4. The level of irrigation water availability or accessibility to the farm is affected by the proximity of the farm to the water source or to the water carrying canals. As one gets away from both the water source and the canal the accessibility of water becomes less and less unless proper system for water allocation is in place and practiced. According to figure 4, seven zones can be differentiated based on the condition of water accessibility. These are highly accessible zone, moderately accessible, less accessible, very less accessible, poorly accessible and water scarce area. Some times the tail-end which is characterized by water scarce zone can also be affected by water logging.

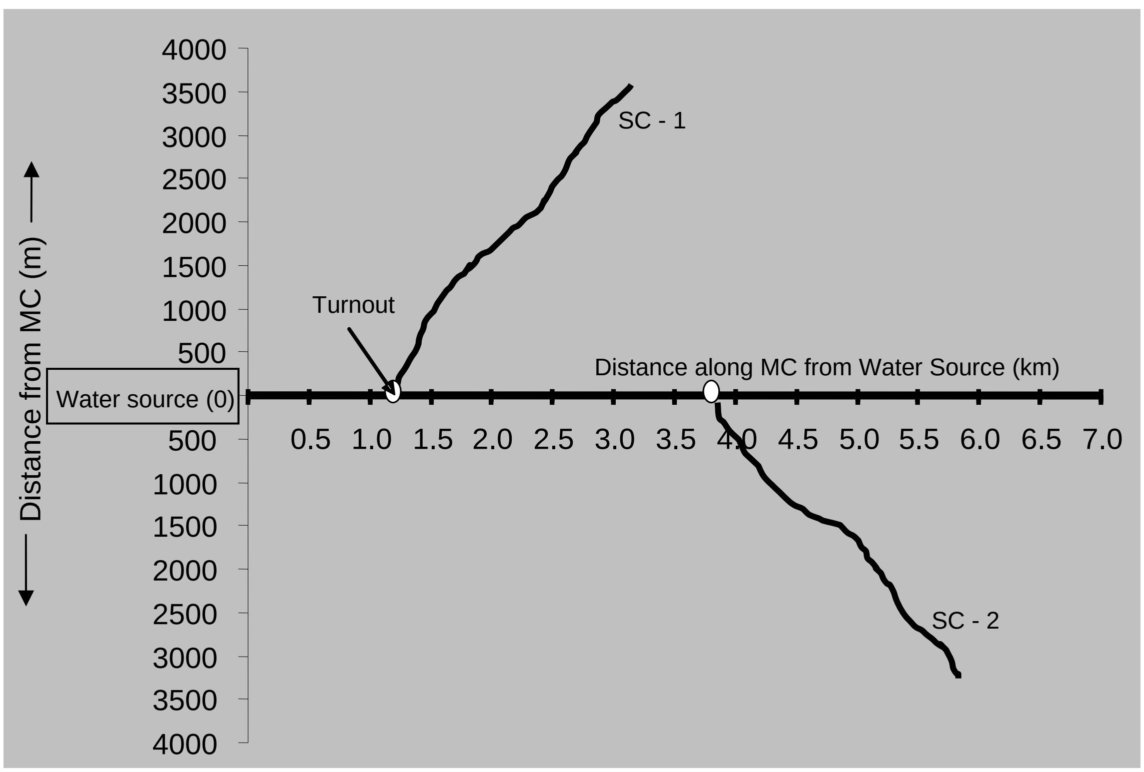


Fig. 3: Simple illustration of the approach followed for the assessment

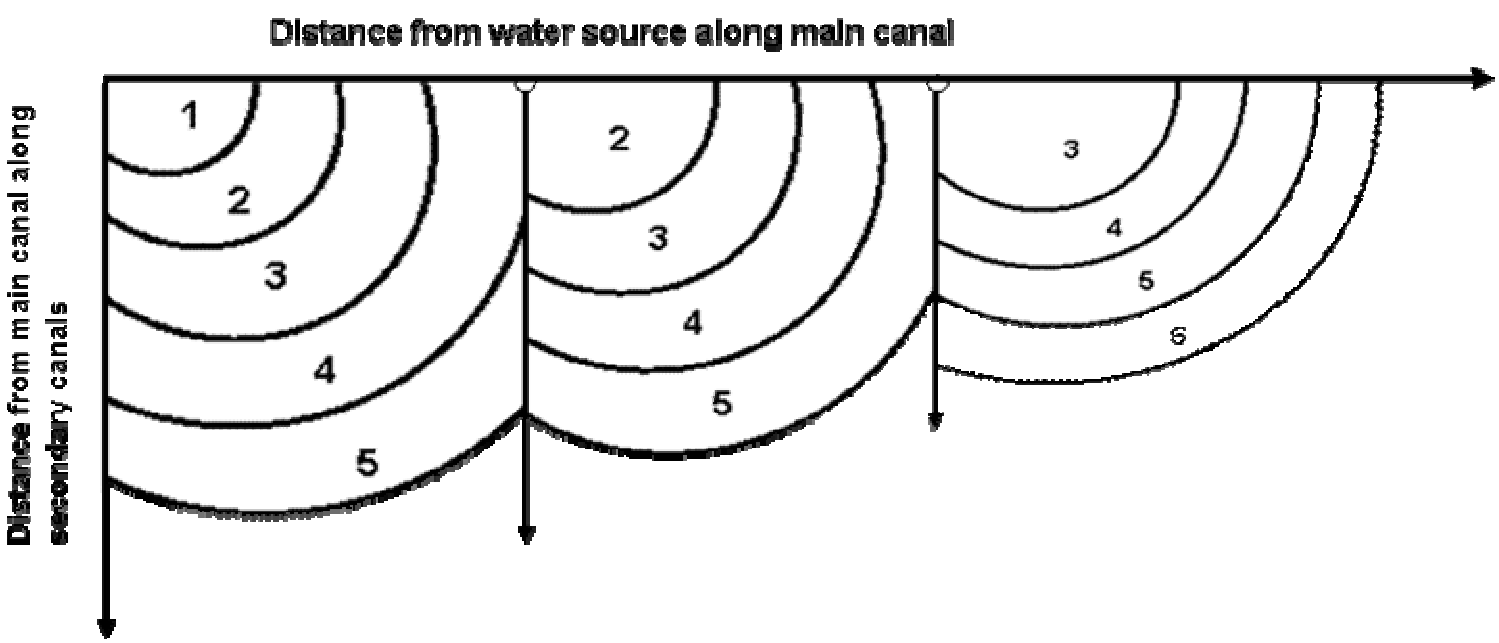
All relevant data were collected along main canal (MS) and secondary canals (SC) that are functional during the season. Accessibility of water to a farm unit which is measured in amount and timely delivery is defined in this case with respect to proximity to water source that decreases from the head to tail end of the canal systems. The assessment was carried out following two directions (Fig. 3), i.e., (i) along the main canal that receives water from the main source and (ii) along secondary canals that takeoff from the main canal. The hypothesis here is that the secondary canal 1 (SC-1) have more access to water than secondary canal 2 (SC-2) due to its relative closeness to the water source along the main canal. Likewise there are differences along the secondary canal itself as one goes from head to tail.

Table 3: Summary of information in Fig. 4

Zones	Distance ranges (m) along		Water accessibility
	Main canal	Secondary canal	
1	0 - 500	0 - 250	high
2	500-1000	500-750	moderate
3	1000-1500	570-1000	less
4	1500-2000	1000-1250	Very less
5	2000-2500	1250-1500	Poorly accessible
6	2500-3000	1500-1750	Water scarce

Areas that fall in the regions of poorly available and water scarce zone are characterized by critically limited water availability and hence depend more on rainfall. Water logged areas are located at end of the systems. The owners of such lands are suffering from shortage of water during irrigation and flooding during off-irrigation periods. These areas are covered by cotton which is relatively water stress resistant compared to common crops grown in the area.

Fig. 4: Simple illustration for different levels of water accessibility along the canal reaches



4. Results and Discussions

4.1. General Practices

One of the most important problems that exist in and around the small- and medium-scale irrigation schemes in the country is discrepancies between design specifications of the systems and expectations from the same. No reference is usually made, if at all available, to the design documents while operating and managing the schemes.

With increasing number of population the size of the landholdings in an area becomes smaller and smaller. This is exactly what is observed around successful irrigation schemes. The main advantages of irrigation practice lay on provision of opportunity for intensification of cropping. Under decreasing size of landholdings in irrigated agriculture, intensification of cropping coupled with productivity improvement is the way to enhance food production. No doubt that better access to inputs and technologies contribute to improvement of productivity. Intensification of cropping is mainly determined by the type of crops selected and availability of water.

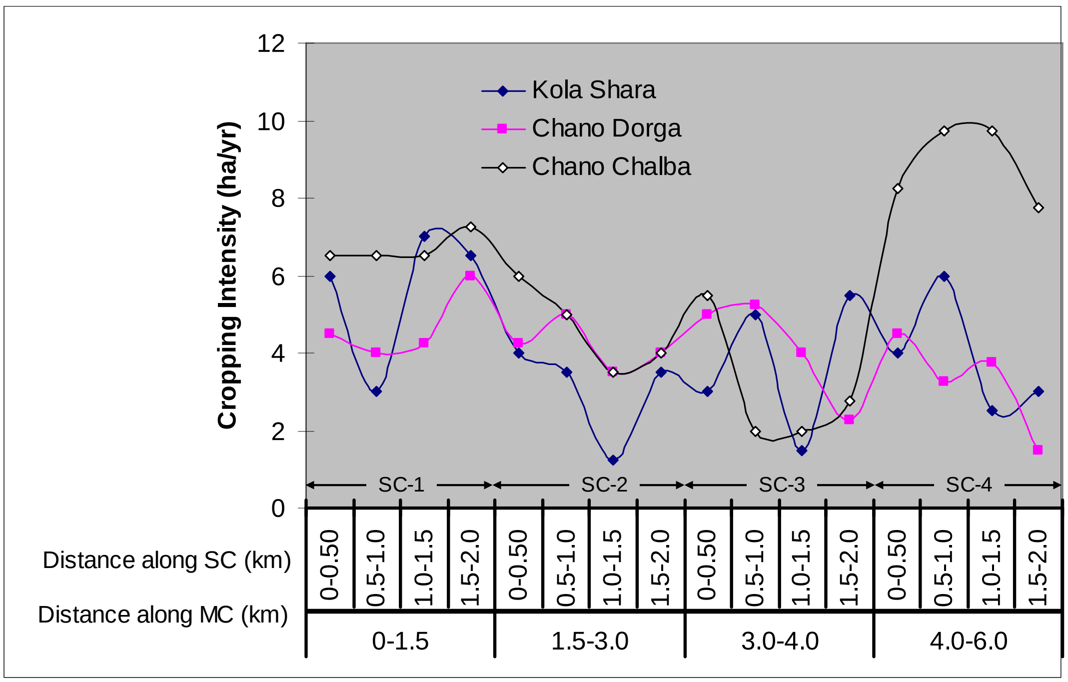


Fig. 4.1: Cropping intensity along the canal reaches (the product of average area cultivated per season and frequency of harvest per season)

Figure 4.1 shows the spatial variation of mean cropping intensity that was practiced by one household. It is evident that the intensity of cropping decreases along the main canals from upstream to downstream incase of communities in Kola Shara and Chano Dorga which are served by the upstream and midstream diversions respectively. On the contrary, there is slight decreasing trend of intensity as one goes down along the secondary canals. Under Chano Chalba condition, the trend of the curve coincides with the previous two up to a certain distance beyond which rapid raise is taking place. Farmers located here, i.e., 4 – 6 km away from the diversion point along this canal, are practicing higher crop intensification compared to those located in the middle and head regions of the canal. These framers are trying to convert the challenges of flooding and shallow groundwater depths in the tail regions of the canals to opportunities in that they are adopting multi-cropping system or intercropping.

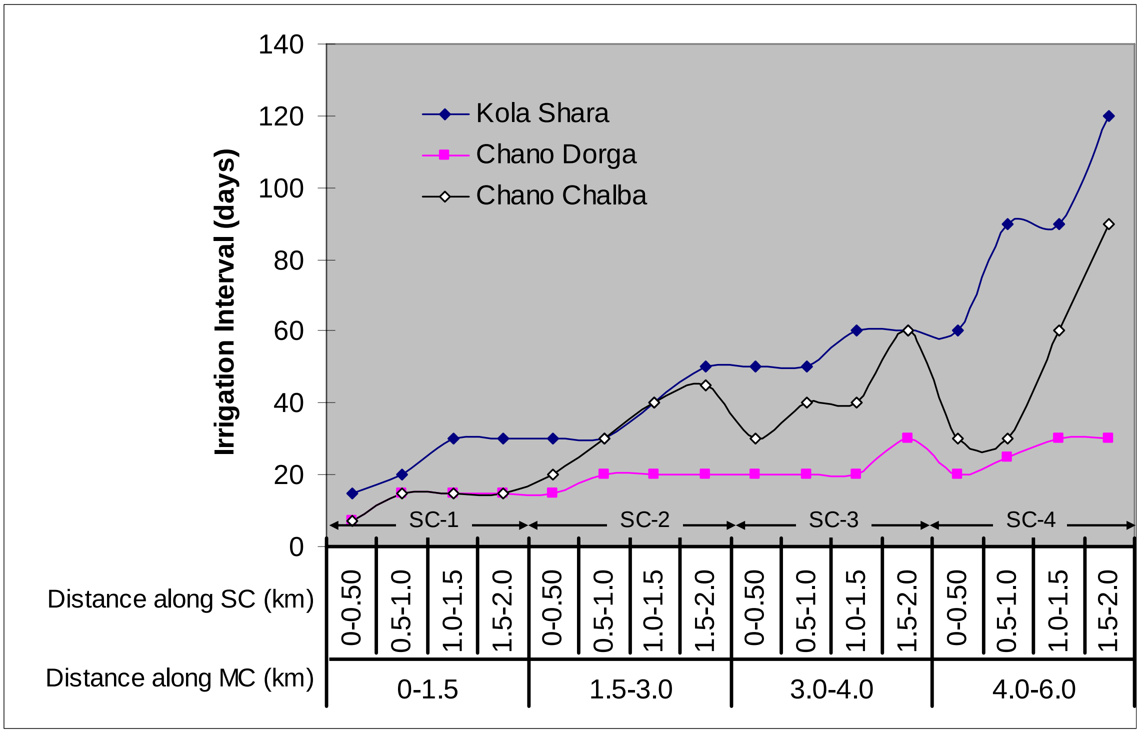


Fig. 4.2: Irrigation Interval (days the users have to wait until the arrival of the next irrigation water)

As can be viewed from Fig. 4.2 the frequency of getting water by the users decreases from head to tail-ends of all canal systems. It varies from 7 – 30 days, from 7 – 90 days and from 15 – 120 days in Chao Dorga, Chano Chalba and Kola Chara respectively. Irrespective of the location of diversion point with respect to each other, those users close to water source get frequent access to water. The communities using traditional diversion get frequently water compared to Kola Shara and Chano Chalba that use respectively simple diversion structure and diversion weir.

4.2. Water delivery performance

The values of some performance indicators are given in the table 4.1. As far as most of these indicators are concerned, Chano Dorga which is served by traditional diversion (D2) is found to perform better than others. The productivity of land and water is higher in Kola Shara followed by Chano Dorga. The later is characterized by greater values of water supply performance indicators, i.e. RIS, RWS and WDR.

Table 4.1: Values performance indicators

Performance Indicators	Kola Shara	Chano Dorga	Chano Chelba
Output per water consumed (birr/m^3)	0.56	0.44	0.35
Output per cropped area (birr/ha)	4400	3464	2736
Water delivery ratio (WDR)	0.56	1.09	0.71
Relative irrigation supply (RIS)	1.40	2.70	1.78
Relative water supply (RWS)	1.18	1.79	1.36

Community in Kola Shara, Chano Dorga and Chano Chalba are served by the upstream, midstream and downstream diversions respectively.

4.3. Output performance

According to figure 4.3 the productivity of banana decreases from upstream to midstream rapidly in Kola Shara and Chano Dorga command areas. From midstream to downstream no decreasing trend both along main canal and secondary canals rather variation among the canals in terms of productivity is visible. The lower areas of tail ends are usually characterized by shallow groundwater tables (o.6 – 2m below the surface) which are likely to contribute to the water requirements of perennial crops.

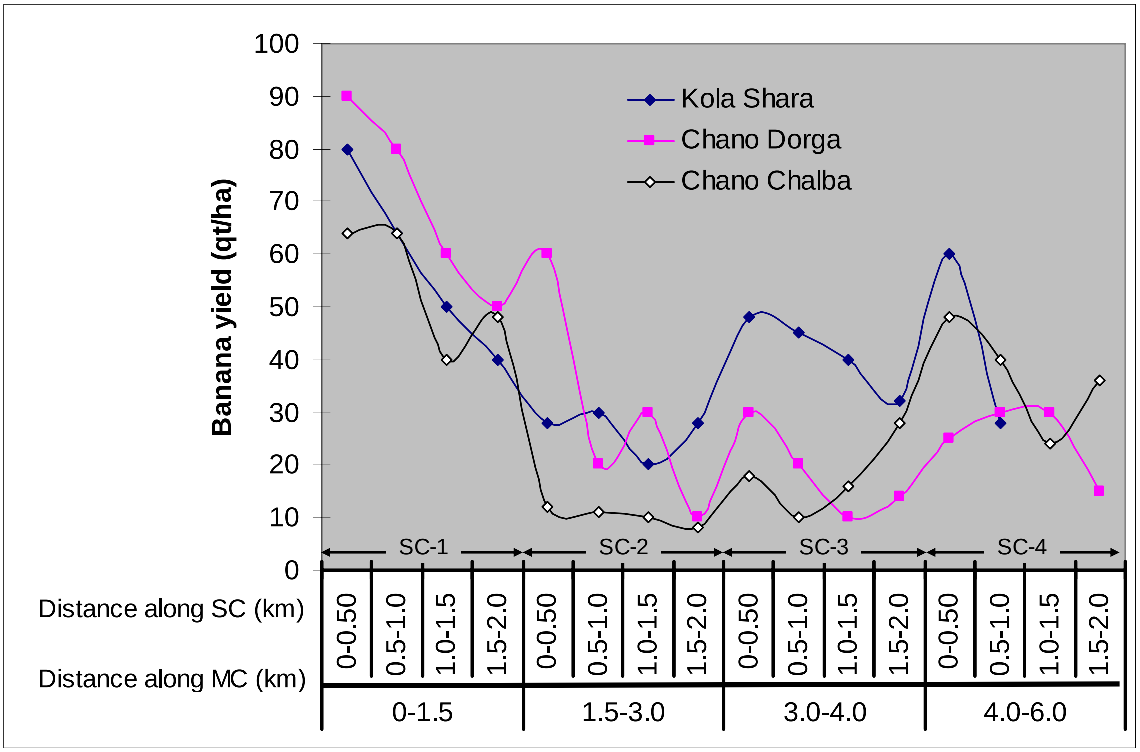


Fig. 4.3: Productivity variation of banana along the canal reaches

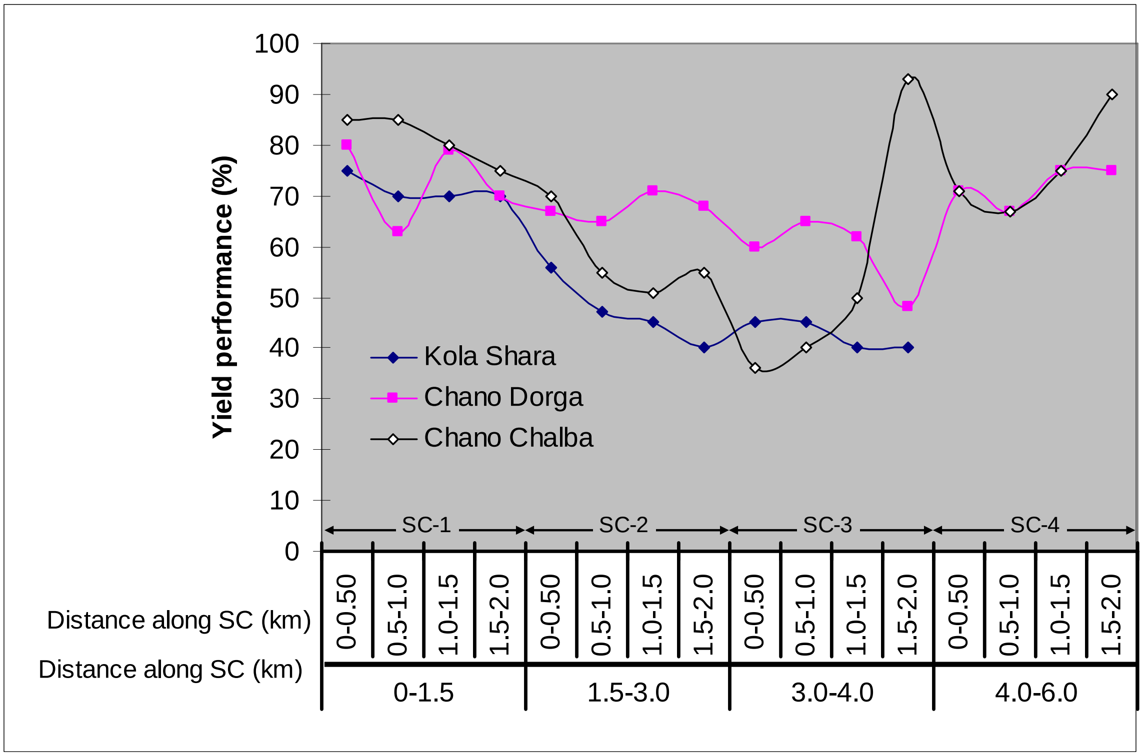


Fig. 4.4: Yield performance (actual yield/potential yield) irrigation along the canal reaches

Yield performance which is the ratio of actually harvested yield to potentially harvestable yield of crop varieties can be an indication for how agronomic practices and other inputs (water and agrochemicals) were effective to exploit the yielding potentials of the crops selected. The indicator shows also a decreasing tendency towards midstream. Almost equal yield performance is observed in Chao Dorga which is located in the command area of traditional diversion. It shows more variation between upstream, midstream and downstream in Chano Chalba that is found in command area of modern weir diversion. Except Chano Chelba the yield performance of the other villages is the reflection of irrigation intervals (Fig. 4.2). Those villages that have got water in shorter intervals have registered better yield performed than villages with longer irrigation intervals.

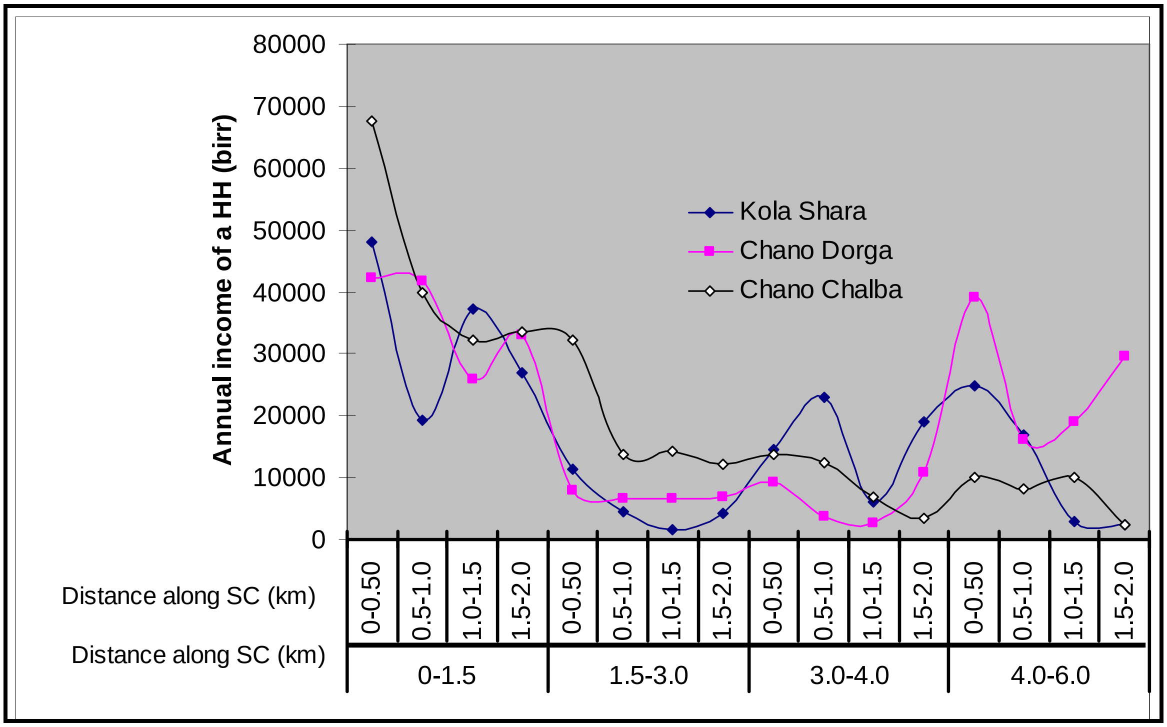


Fig. 4.5: Average annual income of Household along the canal reaches

The ultimate goal of irrigation development is to improve the livelihood of the farming community. Its achievement is largely depends on integration and coordinated operation of nested systems of irrigation which was indicated by Small and Svendsen (1992). As the production increases the income of the farmers is likely to increase. Other factors such marketability of the produce and market access influences the total income of the households. The annual income of households which have year round access to water be it from canal or groundwater is greater than farmers with limited access to water (Fig. 4.5). Annual income of households in Kola Shara and Chano Dorga command areas is variable irrespective of proximity to the canal. Most often, resources are efficiently and effectively utilized when they become scarce. Similarly households that have less access to water tend to use it more efficiently than those having access to abundant water resources.

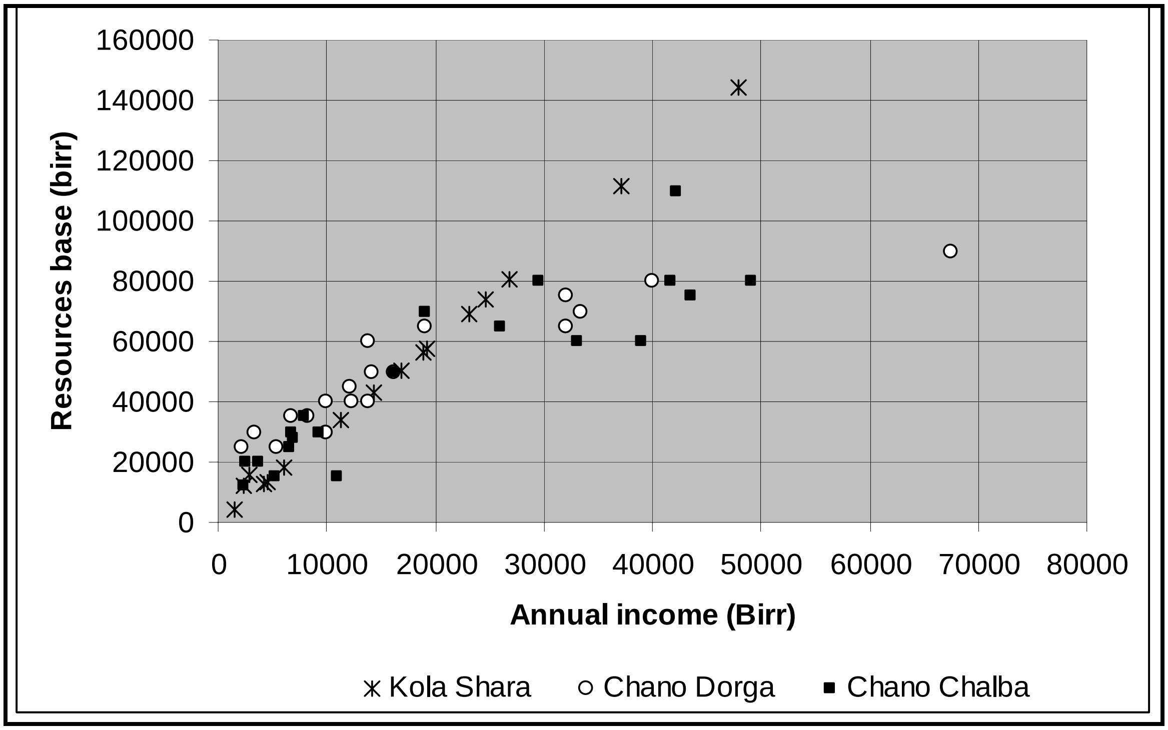


Fig. 4.6: Relationship between annual income from agricultural production and resources base (monetary values of important possessions; example house, chattels etc.)

Improved agricultural production coupled with remunerative selling of the production will result in improved income of the farming community. This together with better social facilities enhances the betterment of farmers' welfare. Fig. 4.6 shows how the resources base of a household improves with the level of income. There are farmers who have managed to construct house in the nearby towns, buy taxis and small transporters etc.

Table: Chemical properties of the soil of different Kebeles

	EC (µmohs/cm)	PH (meq/l)	SAR (meq/l)	ESR (meq/l)	ESP (%)	Texture	K cm/hr
Kola Shara	2060.8	8.35	10.44	5.87	85.44	Clay	0.00279
Chano Dorga	166.4	7.82	6.94	6.94	71.61	Sandy Clay Loam	0.015
Chano Chalba	147.2	7.69	5.3	1.63	61.94	Loam	0.0882
Chano Mile(D)	170.24	7.47	0.5	0.49	32.7	Clay	0.00576

4.5. Environmental Indicators

From suitability aspect based on FAO frame work, the soil of Kola Shara with its SAR, 10.44meq/l value and the soil of traditional irrigation users, SAR value of 8.84 both appear within 8 to 18meq/l hence characterized in moderately suitable range (i.e. class 2 level). However, along with its clayey nature and very small hydraulic conductivity value calculated, that is 0.00279cm/hr, which is quite less than threshold level of 5cm/hr, hence the soil category as per critical limit for sodium tolerance could be n2 (that is permanently not suitable range). Nevertheless, salinity level (EC, 2060.8 μmohs/cm) that is sufficiently less than10, 000 μmohs/cm) preserved the area soil in the moderate suitability range. Still, the soil is categorized under good to injurious, suitable only permeable soils and moderate leaching coupled. The extent with in this range is harmful to more sensitive crops. This has been also confirmed from the actual survey done in the area; they grow mostly cotton which is salt tolerant crop. From acidity and alkalinity point of view also, the soil of Kola Shara is categorized under alkaline category as its pH value, 8.35 is greater than 8, which has a potential to cause depletion of the important micro nutrients such as iron, manganese, and zinc

4.6. Social Problems

Although there are official rules and agreements that regulate water distribution among the users, there exist unofficial diversions, unauthorized use of water, vandalism and stealing of water by the upstream user kebeles particularly by Kola Shara as the controlling mechanisms are the local river materials that can easily be subjected for deviation. Non-permanent control materials instead they use stones and plant rests, as they are easily shifted from their initial position (see figure 4.14) along with the absence of observers assigned to oversee the proper functioning of the delivery system aggravated the disruption of the downstream users from irrigating their field. Such problem of unlawful diversion also exists by Chano Chalba KA, the one using the modern diversion, because of such gateway mentioned above the downstream users Chano Mile KA are highly disrupted to irrigate their field.

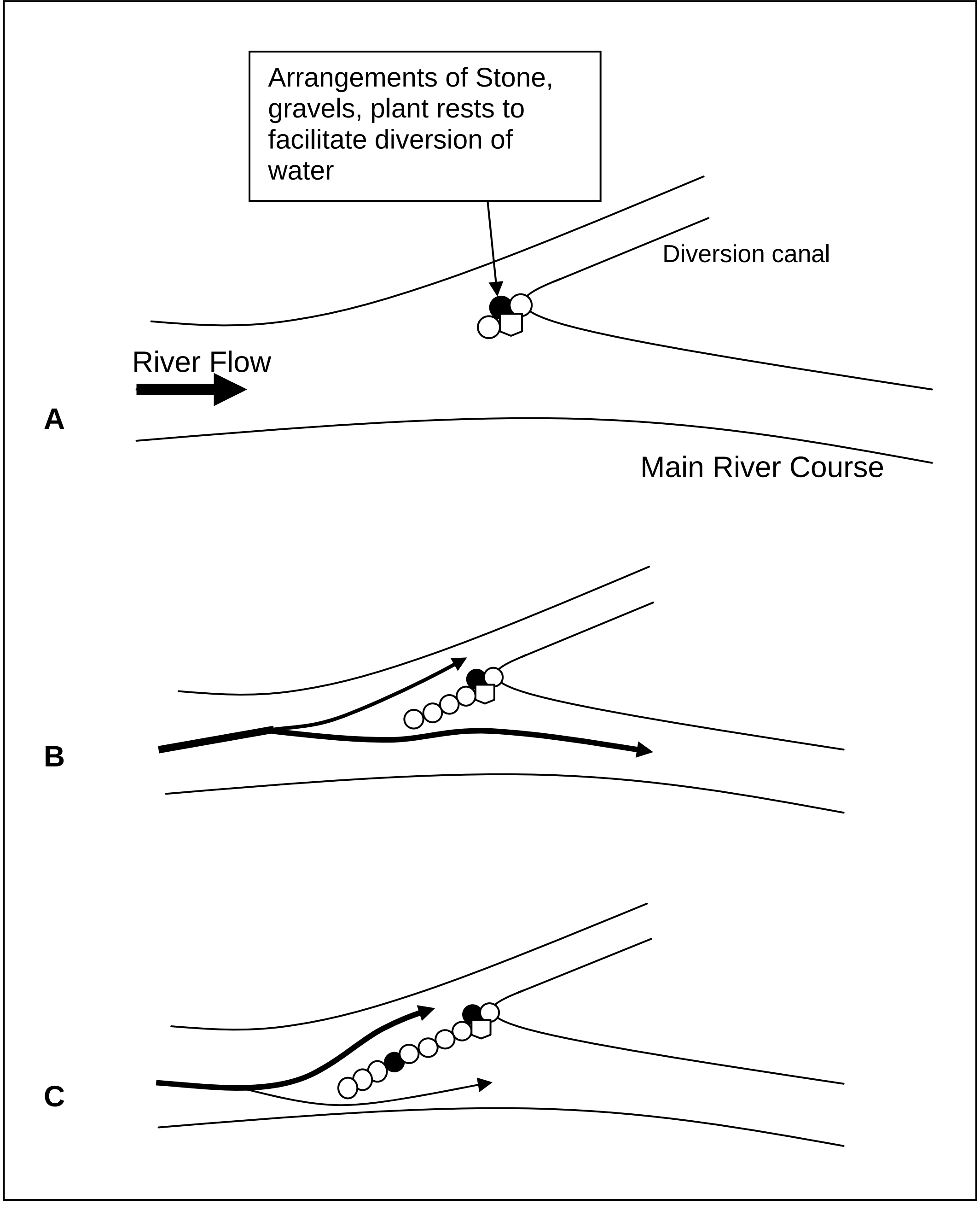


Fig. Simple illustration showing how farmers manipulate the arrangements of traditional water diversions based on the conditions of water availability (with decreasing availability of water in the rivers and increasing demand for water the adopted diversion arrangement by farmers shift from A to B and to C

5. Conclusion

At Hare irrigation scheme, it has been identified that the availability of water, the poor water management and high demand are the main actors. From the water availability versus demand analysis undertaken within ten days interval for the whole year, out of P=38, f (D>Q, 0.00)= 20 times, s (D<Q yield, 1.00)=18, thus, it is possible to articulate, with the current system of use, Hare river cannot supply the required demand, i.e. failure, f=54.05%.

The water availability analysis revealed that, the diverted water is noticeably lesser than the demand during the dry season, in contrast, the available water is very much surplus during the wet period. Owing to this, those located far away from the diversion site and main canal, plant their crops anticipating rainfall. Irrigation is hardly possible in these periods to the farthest area yet the potential irrigable area has not yet achieved by the users. Some of the key findings for less performance are the skew ness in distributions, simultaneous extraction of the available water, and very poor performance of delivery structures particularly the traditional ones.

The results in conveyance efficiency determination at different delivery point has disclosed supplying equal amount of water, the traditional one finish the water after 7750 meter; the modern diversion with traditional delivery finish its water after 8019 meter. But the modern irrigation with its earthen secondary canal goes up to 13, 074 meters; nearly double distance compared to the traditional one. The results depicted that the two schemes total instantaneous loss of the allocated water compared to the modern scheme is 37%.

Another critical social problem is continued inconsiderate use of irrigation water at upstream i.e. ample loss of water which is disrupting downstream users from irrigating their field, as well as visible environmental threat to the up stream irrigators themselves such as water logging coupled with continual malaria out break and other waterborne diseases, sodicity (SAR, 10.44meq/l, clayey soil, hydraulic conductivity calculated, 0.00279cm/hr) of their soil (in permanently not suitable range (n2)) and salinity problem, mainly at Kola Shara KA looking into FAO frame work and the facts in the area.

Thus, in order to maximize the resourceful use of the present water supply at Hare irrigation scheme, a matched and designed better water management of the irrigation scheme is not only capable of reducing the effect of naturally occurring low flow and subsequent yield reduction, but also the increased efficiency augments the production substantially.