Status of Small-Scale Irrigation Projects in Amhara Region, Ethiopia

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Abstract

The Amhara Region debate on irrigation was concentrated on expansion of hectares under irrigation, whilst skirting around the socio-economic effects of such investments. Attention paid to the socio-economic impact of small-scale irrigation development although growing is still limited. This study aims to know the status of small-scale irrigation in Amhara region and identify its economic, social and environmental impacts.The assessment was carried out on 12 small-scale irrigation schemes in the region through informal survey covering the farmers, DAs and woreda experts. It came out from the study that some schemes like Tebi, Gulina, Alewha and Geray to some extent performing well and others like MahibereGenet and Mylomy have no water totally, and Kility, Dana and Fetam actually performing badly. From this study, the main findings were: 1) Projects that are planned with full farmer participation perform better than those that are planned by experts on their own, 2) Projects planned by consultants without Participatory Rural Appraisal (PRA) experience have operational problems, and 3) Projects which draw participants from different backgrounds may have internal problems and usually suffer from lack of group cohesion.Major constraints of the projects are: design, construction and operation and maintenance like technical constraints, handing over, theft and vandalism of control structures and lack of monitoring and evaluation. Sedimentation of reservoirs has direct and indirect effects on irrigation practices. Study from sedimentation of 9 reservoirs in the region shows reduction of 7 ha annually from 2004 – 2025. This implies that about 1.887 MCM sediment will be accumulated in all reservoirs displacing equal volumes of irrigation water. This will be equivalent to abandoning of about 151 ha of irrigable land before achieving their economic life.

***Key words**:* participatory, reservoirs, schemes, sedimentation; Small-scale irrigation.

1. INTRODUCTION

The irrigated agriculture sector is facing increasing challenges in the face of rapid population growth, decreasing availability of land, and competition for scarce water resources. Due to decreasing investments and declining performance of many large-scale irrigation schemes, interest has been developing in recent years for seeking ways to improve the productivity and livelihoods of the world's small-scale schemes. At the same time, smallholders are capable of managing irrigation systems efficiently provided they have access to affordable technologies that are easy to operate, maintain and repair. Small-scale systems and technologies are attractive since they put the operation, maintenance and management of systems directly in the hands of the individual farmers, thus eliminating any need for centralized control or management.

The previous focus on large-scale conventional schemes in Ethiopia with few baseline studies has led to disappointing results: Among others are low physical productivity resulting from poor management, soil salinization and other environmental problems, and in some cases abandonment of schemes (Penning de Vries et al., 2002; McCornick et al., 2003; Tilahun and Paulos, 2004). These disappointing experiences have been the primary reasons for the recent focus on exploiting opportunities associated with investments in Small-Scale Irrigation (SSI), Micro-Irrigation (MI) and Rain Water Harvesting (RWH). However, given the complex set of constraints that often face smallholder production, experience has shown that providing irrigation water alone is not enough; smallholder farmers also require a broad range of institutional support services (access to inputs, credits, output markets), capacity to manage and maintain the acquired technologies, etc. Achieving reasonable poverty reduction and food security impacts requires access to support services and opportunities for diversifying production to include high value crops, institutional linkages, access to markets and credit, etc. This is beyond the narrow scope of just proving irrigation water. There is accruing evidence that these conditions remained largely unmet by most irrigation interventions in Ethiopia (IWMI, 2004a).

The Awash and Tekeze river basins are the two important basins for irrigation in Ethiopia. The Awash is the most developed with large-scale and small-scale irrigation schemes located along its banks. In the Tekeze, recently built small micro-earth dams and ponds provide supplementary irrigation and supply of water for both livestock and people. In the Tekeze and Awash areas, hundreds of micro-dams have been constructed to provide domestic water; water for livestock and water for food crop and animal feed production. However, many problems are associated with irrigation in these basins. They include soil salinisation, sedimentation of dams, up-slope erosion, water contamination and increased water-borne disease, and poor design leading to water loss through leakage and evaporation (ILRI, 2003). Increased malaria and schistosomiasis are all too common. There are many cases where micro-dams were completely filled with sediments during the first rainy season after construction so they cannot be used for one subsequent dry season (ILRI, 2003). As such abandonment of micro-dams is on the rise.

Small-scale irrigation system in Amhara region comprises about 75% of the region's total improved irrigated area. Enhancing their efficiency therefore is a key element of regional agricultural development. Accordingly, government policy has recognized farmer participation as an important strategy towards more efficient irrigation. As a result, for their eventual management, all implemented schemes are formally handed over to beneficiary farmers upon the end of construction phase. In line with this, the partial or full construction of no less than 30 irrigation projects has been accomplished since the official set up of the regional government in 1995. For around twenty of these projects, all the headwork and farm structure works have been fully completed and hence they have been formally handed over to the beneficiary farmers (COSAERAR, 1999). However, the follow-up of these schemes, especially with regard to operation and maintenance, cropping systems, water utilization, economic and financial success etc. have not been well studied and documented. Successive field visits have shown that a common problem in most of government constructed irrigation schemes in the region is the continuous cycle of irrigation system construction, followed by deterioration of the system because of inadequate maintenance. Due to this all the economic, physical, environmental and other benefits that irrigation could contribute towards the positive improvements of agriculture in the region have not yet been fully realized. Based on the above constraints of the irrigated agriculture in the region, this study was focused on conducting preliminary assessment on status of selected small-scale irrigation projects in the region.

2. METHODOLOGY

2.1. The Amhara Region and Its Small-Scale Irrigation

The Amhara region is located in the northern part of Ethiopia with a total area of 170,752 square kilometers (km^2). The region has a common boundary with Tigray in the north, Oromiya in the south, the Afar region in the east and the country Sudan in the west (Figure 1). It extends from $8^0 45'$N to $13^0 30'$N latitude and from 36^0 E to $40^0 45'$ E longitude. The majority of the people living in the highlands are traditionally subsistence grain farmers with surplus production farmers constituting quite some portion of the high land.

The fluvial patterns created by the high mountains and the mountains plateau with spectacular configuration ranging from 2000 up to 4620 meters above sea level feature the dominant topographic glamour of the country. The north and central massive of the Semen Mountains and high land plateau of Gojjam, Gondar and North Shewa, together with Eastern Highlands of Wollo are the main feature of the North western high lands of the country which is also part of the region.The region is characterized by its huge plateau and mountain ranges dissected by numerous stream and rivers, which are the tributaries of Blue Nile, Tekeze and Awash. The north and northwestern low lands and the valley plains of the eastern portion of the region are vast land mass extremely suitable for modern agricultural production.

The Amhara region despite its enormous land and water resources, being also the home of the largest surface water resource potential in the country, has remained to be drought prone. This is mainly attributed to climatic factors (the prominent element being erratic occurrence and distribution of rainfall) in addition to backwardness of the agrarian system, migratory and local pests that added up to poor performance in agriculture. In spite of the short rains and irregularity of rainfall, most creeks convey a large amount of water for a considerable period of time during the rainy season. Eventhough the availability of data on the rainfall-runoff relationship is limited; a large amount of surface runoff exists in the Amhara region, which is attributed to the rugged topography and bare slopes. A recent estimate shows about 35 billion cubic meter of runoff water is available in the region per year (Melkamu, 1996). Almost all of the estimated volume of water is lost without any meaningful economical or environmental use. The ever-increasing loss of fertile topsoil through different forms of erosion and expanding destruction of forests to fuel wood and tillage have exposed a good portion of the region to serious environmental imbalance.

Although the water resource of the region being one of the most abundantly available and that could be easily turned into the most valuable commodity has been left untouched for the last many years. This resource has never been consciously developed and utilized and as yet it remained the only crucial element in transforming the primitive agrarian system as well as the major element for environmental rehabilitation and a decisive element in enhancing agricultural production towards food self sufficiency and economic growth. The region has an estimated 500,000 ha total potential of irrigable area in four basins (Abay, Awash and Tekeze-Angereb river basins and Afar drainage basin**)** (Melkamu, 1996).

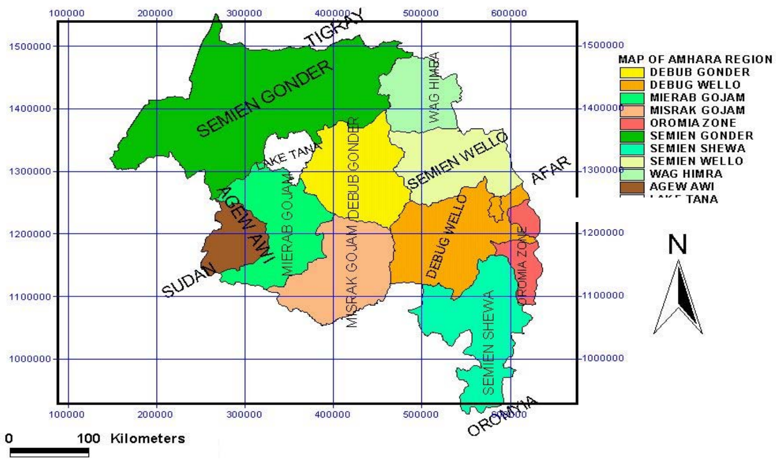

Figure 1: The Amhara Region

2.2. Methodology of the Study

A total of twelve schemes (dams and weirs), for which all the construction activities have been completed were selected for the study. Criteria for selecting the irrigation schemes were: variation in physical environment, available resources, level of deterioration, and operational capability. Informal survey systems were used for the assessment and key informants, woreda office of agriculture experts that are available in that time and the local development agents (DA) were interviewed. Moreover, a diagnostic ‘walk through’ survey was conducted in each scheme on the headwork, farm structures as well as on irrigated fields and pictures are also taken.

Table 1: Description of the surveyed projects in Amhara region

No	Project name	Location		Type of structure	Structure height (m)	Structure length (m)	Irrigable area (ha)	No. of Beneficiaries
		Zone	Woreda					
1.	Adrako	S/Gondar	Ebnate	Dam	20	176	75	300
2.	Alewha	N/Wollo	Gubalafto	Diversion	1.2	111	360	610
3.	Dana	N/Wollo	Habru	Dam	20	252	70	280
4.	Fetam	Awi	Banja	Diversion	6	65	400	434
5.	Geray	W/Gojjam	Jabbitenan	Diversion	4	100	618	480
6.	Gimbora	N/Wollo	Gubalafto	Diversion	1.2	22.5	310	1024
7.	Gulina	N/Wollo	Kobo	Diversion	3	-	400	1600
8.	Kility	W/Gojjam	Achefer	Diversion	3	119	290	760
9.	M/Genet[b]	W/Himera[a]	Sekota	Dam	19.5	425	70	280
10.	Mylomy	W/Himera	Sekota	Dam	22	285	60	236
11.	Sawer	N/Shewa	Kewet	Diversion	-	-	191	764
12.	Tebi	S/Wollo	Mekedella	Dam	-	477	200	720

Source: Commission for Sustainable Agriculture and Environmental Rehabilitation of Amhara Region (COSAERAR) a = Wag Himera, b = MahibereGenet, - = information not available

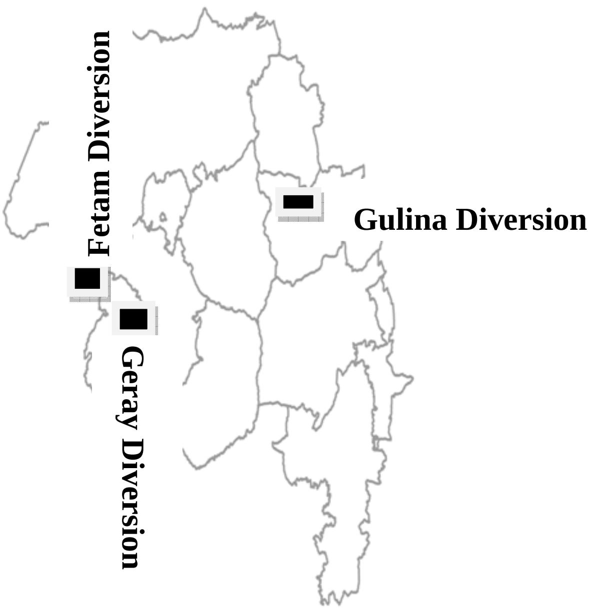

Figure 2: Location of Diversion Structures

3. RESULTS AND DISCUSSION

3.1. Major Problems in Irrigated Agricultural Development

Based on the discussion made with irrigation experts, development agents and farmers, the problems that brought about inefficiency on the existing schemes and the low rate of overall irrigation development are:

- Shortage of water - the occurrence of shortage of water is either due to the reduction of the base flow water during dry period or improper utilization of water or the wish of irrigation beneficiaries to irrigate more land without the capacity of the source of water. This was observed in MahibereGenet and Mylomy due to the reduction of water source and in Geray due to poor utilization of water.
- Capital and shortage of labour - One of the problems that were identified during the study was lack of capital to develop or maintain the schemes. Since irrigation requires labour intensive works, shortage of labour even unskilled ones at the time of irrigation was also reported in most of observed schemes.(As an example Gulina diversion has shortage of labour during irrigation.)
- Agricultural input - Agricultural input supply problem occurred due to inaccessibility of the rural areas and/or lack of credit facilities for the beneficiaries. For example in Mylomy irrigation project shortage of insecticides and pesticides were reported by farmers to protect their crops form insects and pests.
- Market - Market problem could occur due to inaccessibility of market service and/or due to non-market oriented crops production. This is a problem to all observed irrigation schemes but Tebi is well organized.
- Other problems - The other problems that affected the efficiency of the existing schemes and/or the overall development of irrigation agriculture were lack of irrigation extension agents or experts, lack of coordination among the users to manage the existing schemes properly, pest problems, less construction quality of irrigation projects, lack of simple irrigation technologies, very deep river beds, significant reduction of the base flow of most rivers during dry seasons and inconvenient features of the farm land for development of irrigation agriculture.

Institutional and policy issues

Water resource development, especially irrigation development is a task that requires multilateral cooperative work between concerned parties to attain result. However, what has been witnessed during the field visit was institutional myopia that affected operation and maintenance of many irrigation schemes.

During the survey the following major reasons for lack of coordination was observed:

- Lack of clear statement on institutional responsibilities and accountability of SSI management
- Low level of environmental impact awareness and consideration at all levels specific to small-scale irrigation management
- Low-level participation and consultation at all levels.

Policy issues in the visited schemes operation concentrates on land tenure, hydraulic tenure, water rights and community participation where all the issues, in one way or another, afflicted operation and maintenance of irrigation schemes.

3.2. Limitation of the Existing Irrigation Schemes

3.2.1 Design and construction related limitations

Up until 1995 (the establishment of COSAERAR), the study and designs for all headworks and irrigation networks were formulated and produced at the ministry of Agriculture, Irrigation Development Department (IDD) in Addis Ababa with a minor support from the then Regional Office at Debre Markos. This clearly precipitated the following:

- No capacity is available or developed at site level,
- All original data, including surveying works are at the center in Addis Ababa, prohibiting the use of such data for further use,
- During the construction stage the support on construction supervision aspect were

extremely poor,

- No attempts are made in the need assessment including the encouragement of participatory approach of the beneficiaries,

Shortage of construction materials like cement, reinforcement bar, etc, and consumable like fuel/lubricants have contributed to the protracted delay.

Almost all the visited schemes (Gimbora, Alewha, Geray, Kility, etc.) are frequently vexed with diverse technical problems usually resulting in inefficient water management systems. The following are mentioned as examples of the problem as lack of proper layout and distribution network, long spaced turnouts, or in other cases, absence of turnouts in essential locations seepage lines especially on main and secondary canals, absence of scheme access, such as roads, footpaths, bridges, catch drains, cattle watering trough, etc. Foundations on black cotton soils lack the required depth and are not treated with compaction of selected material in their bottom, absence of discharge measuring devices on main canals and lack of proper and timely provision of siphons in areas where they are needed.

3.2.2 Operation and maintenance related constraints

Handing over of irrigation systems to farmers, upon completion of construction, has been a standing procedure in small-scale irrigation development. It is based on a desire to decrease the resource burdens of the government for irrigation operation and maintenance and to enhance the long-term sustainability of irrigation systems through local management and control.

Based on COSAERAR (1999) in handing over what is usually done is that after completion of scheme construction, a limited number of farmers are selected for training. These are trained for 10-15 days, and upon culmination, they are assigned as WUA leaders. The handing over process is then undertaken with these 'farmer representatives'. Nevertheless, by the nature of the issue, a lot of problems are embedded within the existing hand over mechanisms. The following policy issues, for instance, need immediate response.

- What should be handed over? Which roles and tasks should be turned over to water users? Only maintenance obligations? Or both maintenance and operation below the offtake?
- When should handover be carried out? Immediately upon completion of construction? Or should there be a transition period of limited months?
- What should be the criteria? For deciding whether a scheme is ready for handing over or not?

The most frustrating experience in the majority of visited schemes was the very common occurrence of theft and vandalism of irrigation structures frequently by the beneficiaries themselves. Interference with structures that the farmer feels is imposing some constraint on his irrigation plot is understandable, even if it affects the supply of water to others downstream. Theft of items which are either saleable or off use on the farm or in the home (such as extracting steel rods from reinforced concrete structures) is also very common. More difficult to understand, however, is simple vandalism, in which there is no illicit benefit other than dubious pleasure of simple destruction.

One of the weakest links in irrigation project cycles has been the complete absence of monitoring and evaluation activities after project hand over or when the project is in full operation. In all twelve projects visited monitoring of technical performance especially of factors related to irrigation efficiency is notably missing.

3.2.3 Water users associations related limitations

Lack of water laws and policies, absence of formal WUA, absence of irrigation association bylaws, conflicts among the same and different users of water, sense of ownership and lack of accountability are the critical limitations observed in almost all of the surveyed irrigation schemes.

3.3. Impact of Existing Irrigation Schemes on the Beneficiaries

The direct positive impact of the irrigation project on the beneficiaries is: reliable harvest, improved yield/ha and diversification to vegetable production.

3.4. Common Problems in Irrigation Infrastructures

The functioning of an irrigation canal network depends not only on how the network is operated, but also on the condition of the canals and on the condition of the hydraulic structures. The most common problems seen in structures of the surveyed projects were leakage, erosion, siltation, rot and rust.

3.4.1. Leakage

The water level upstream of a structure is higher than the downstream water level. Therefore water may search for another way underneath or along the structure, or even through a crack in the bottom or sides of the structure to this lower level. The Figure 3 below shows part of the diversion weir collapsed due to scouring and Figure 4 shows the leakage on headwork of Geray irrigation project and result in water loss and forced the weir to damage.

Figure 3: Part of Gray River Diversion

Figure 4: Leakage on Geray River Diversion

3.4.2. Erosion and Siltation

Sections of an unlined canal immediately downstream of a structure or downstream of a lined canal section often suffer from erosion. Downstream of a structure, the canal bed suffers from a water jet that flows through a gate or pipe, or it will be caved in by water that spills over a weir.

The deposition of soil and debris can affect the functioning of a structure. If for instance, a stilling basin collects soil deposits the available water mass diminishes and energy dissipation will be less effective. Similarly, in the case of soil deposits in a flow division box, the division of the flow will be less accurate due to imbalance in flow velocities and water levels. The same applies for intake structures and night storages, such as the pumping stations. Large volumes of sand in the intake chamber of the pumps causes damage to the pumps and will lead to sand deposits in the canal system too. Figure 5 shows night storage of Gulina irrigation scheme, which is silted up by sediments and misused as trough for drinking animals.

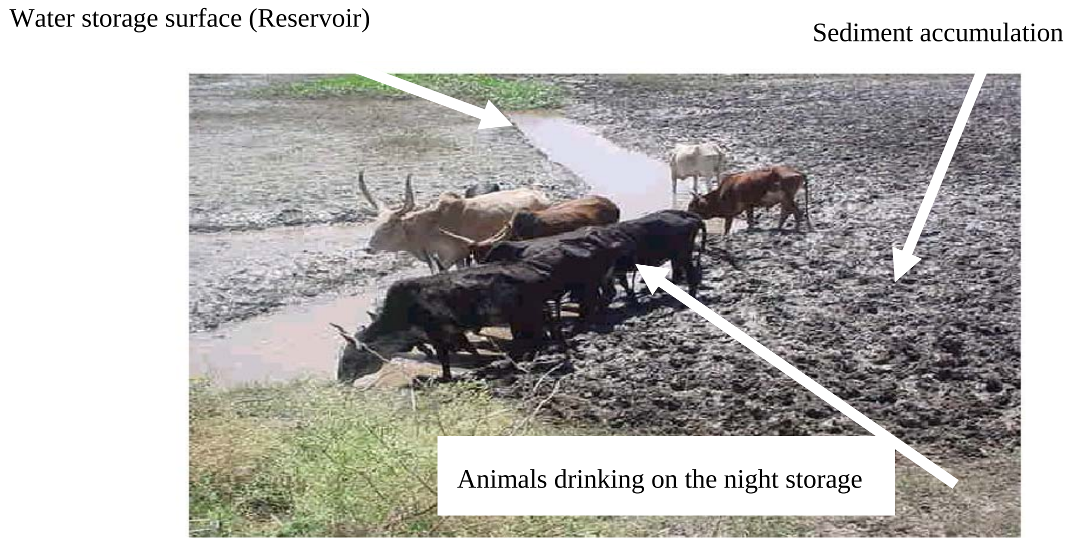

Figure 5: Night Storage of Gulina Irrigation Scheme

3.4.3. Rot and Rust

Wooden and steel parts in structures suffer from being alternately wet and dry. The wooden parts will rot and disintegrate, while steel parts will rust, expand and get jammed in the slides. All such corrosion affects in a negative way the operation of the structures. Routine maintenance is necessary to avoid these problems, or to reduce their effect to a minimum. Figure 6 shows an intake gate of Fetam diversion, which is deteriorated due to rust and is not manageable to operate.

Figure 6: An intake gate of Fetam Diversion

3.5. Problems in On-Farm Water Management

Water remains the determining factor in intensifying agricultural production. Considerable investments in irrigation infrastructure have importantly improved the availability of water for irrigation. However, the availability of water does not automatically increase agricultural production and there is reason for concern as only part of the irrigation infrastructure is effectively used. There are ranges of technical, agricultural, social and institutional factors that play a role in the disappointing performance of many irrigation systems.

The key to intensifying and sustaining irrigated agriculture is the introduction of improved on-farm water management conditions combined with better agricultural practices for irrigated crops. On-farm water management integrates the various technical, agricultural, socio-economic and institutional aspects of irrigated agriculture into one improving package.

3.5.1. Poor canal conditions

The conveyance and distribution systems consist of canals transporting the water through the whole irrigation system. Canal structures are required for the control and measurement of the water flow.
During the survey the following poor conditions of canals were observed:

I. Collapsed canal banks in Kility, Geray, Gulina and Fetam irrigation schemes caused by fast flowing water, unstable embankments due to unsuitable soil or water saturated soil, leaking lining in elevated embankments, crabs and other animals dig holes in the embankment and cattle climbing in and out the canal and these led to canal deterioration, reduced flow and frequent disruption of irrigation supply, frequent maintenance and losses.
II. Steep canal slopes were observed in Dana main and secondary canals considering steep slope canal design due to technical constraints, introducing illegal diversions by the local farmers and progressive erosion of steep channels led to erosion of canal bottom and progressively digging–in of canal, erosion and landslide of side slopes and collapse of the embankment, continuous maintenance, frequent failure and disruption of water supply and loss of land.
III. Canal obstruction in Gimbora, Dana, Kility and Fetam irrigation schemes caused due to canal vegetation and canal obstruction upstream of water diversions to increase water inflow to their fields by increasing the water level (head). These brought reduced water flow through canals, overtopping and unequal water distribution for farmers downstream.
IV. Water losses and leakages in Geray and Adrako headworks and canals of Tebi and Kility caused by holes in embankments of canals often due to improper compactions or organic material buried in bunds, crabs and other digging animals, small embankment of canals and leaking lining. Figure 4 shows this problem.

3.5.2. Poor water distribution

The management of the collection, storage and conveyance system in a project is a critical factor in the performance and production of the irrigation system at the farm level. To ignore these linkages is to invite low production, waterlogging and salinity, pollution of both surface and subsurface water resources, poverty of the agricultural sector, and numerous other well known irrigation problems. The conveyance and distribution of water from the main intake to the different farmers and fields is referred to as the farm irrigation system. Much of these losses and inadequacies of irrigation systems occur at this level.

I. Illegal offtakes which were produced by breaking the embankment of the canal observed in Kility and Dana irrigation schemes resulted in uncontrolled water offtake and water loss, unequal water distribution, collapse of the embankment by progressive erosion, undermining of the foundation by water erosion and collapse of the structure and frequent maintenance and rapid deterioration of the irrigation structure.
II. Uncontrolled and Inadequate offtakes (diversions) caused by temporary construction from simple and easily available materials (stones, straw, and brush wood) in Fetam, Dana and Kility irrigation projects led to uncontrolled and mostly excessive water distribution, collapse of the embankment by progressive erosion of the embankment and frequent maintenance.
III. Damaged and Inadequate structures-caused by inadequate design like locations of structures not relevant, elevation of the structure in relation to canal height inadequate, inadequate protection of

embankment causes erosion of the foundations and collapse of the structure. This resulted in disruption of water supply, frequent repair and maintenance and high expenses for frequent repair and replacement of structures.

IV. Inefficient Water Management in Geray, Kility, Dana and Fetam irrigation schemes caused by inadequate (distantly located) or non-functional structures like the division boxes and siphons and non-functional water users association. These resulted in abolishment and collapse of structures, arbitrary and unequal water distribution, and uncertainty in water supply, excessive and arbitrarily offtake of water by the individual farmer and shortage of water in middle and tail end.

4. CONCLUSIONS AND RECOMMENDATION

4.1. Conclusion

In the analysis of the studied schemes in the region it has come out clearly that at times government just stops its management obligations on irrigation schemes without properly handing over the operation and maintenance to the farmers. This creates problems at such schemes as farmers remain with the understanding that the government is still responsible. It is important that the government works out clear, transparent and systematic system of handing over of the schemes to the farmers. This will avoid some of the problems mentioned in the body of this paper. It is also important to be transparent and not to threaten people as a way of making them accept the project.

A major constraint in irrigation development in the past was the top-down approach by the government, which viewed the “target population” primarily as beneficiaries rather than as customers or stakeholders. In turn, “beneficiaries” perceived the government as a “free delivery channel” and consequently no one would be willing to pay for operation and maintenance. There was also a tendency for technical experts and politicians to make decisions on behalf of the farmer. The experts pretended to know what was best for the poor, uneducated farmer. The government is moving away from this approach and participatory planning is now being highly emphasized.

Sedimentation of reservoirs is the common problem in Ethiopia in general and Amhara region in particular. Adrako irrigation project is a failed project due to violation of the technical procedures that should be followed. Adrako is a bowl shaped watershed with a highly rugged and dissected topographic terrain and most part of it is a farmland, because of this high sediment yield from the watershed reservoir sedimentation resulted and led to outlet clogging.

The project failed as a result of sedimentation, which should have been protected by watershed management. Based on report by experts and design document review the dam should have not been constructed at that period. But political intervention has taken the great responsibility of the failure of the project. This is because experts were forced to construct the project without the consideration of the study document. Therefore, for future irrigation project development watershed management should be given due attention before the construction of diversions and dams.

4.2. Recommendations

Recommendations regarding SSI schemes in Amhara region:

- A bottom-up approach is ideal for irrigation development, treating farmers as “owners” and not as “beneficiaries” of the projects. So farmers should participate throughout the project planning, implementation and evaluation phases.
- The government, given the budgetary constraints facing it, should come up with a clear, transparent and systematic policy and method of handing over schemes to farmers and only projects which are technically sound should be handed over.
- Study tour, training in water management, and marketing and general crop production for farmers and extension workers should be organized.
- Institutional support and continuous monitoring and evaluation of irrigation schemes is necessary to provide feedback and information important for the future planning of management of new schemes and maintenance of old schemes.
- Designers should consider secondary outlet when they expect high sediment laden in the respective watersheds.

- Measures for sediment flushing should be considered to prolong the life of the reservoirs and preserve a long-term useful storage capacity.
- Installing bottom outlets for sediment discharge by considering the amount of sediment entering the reservoir.
- To accommodate more silt deposition increasing dam height is also an alternative.

5. ACKNOWLEDGEMENTS

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7. BIOGRAPHY

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