Current Experience on Existing Small Scale Irrigations

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Abstract

Ethiopia, with an income level and standard of living of the lowest in sub-Saharan Africa, is characterized by wide spread poverty. Agriculture which employs 85% of population is based on rain fed. The agricultural sector is facing severe failures among others due to inadequate rainfall management and drought. Drought is a recurrent phenomenon in the country and recent estimation indicates that on average five up to seven million people are in need of food assistance every year.

On the contrary, the country has a considerable potential of 110-120 billion cubic meter of surface water and 2.6 billion cubic meter of ground water as well as 3.5-4.25 million hectare of irrigable land. Irrespective of this potential and challenging problem very small amount of this is tapped for irrigation.

Recognizing the huge untapped surface resources there has always been attempts to develop these resources since 19605. After the 1984 drought enormous pressure has been exerted to expand irrigation projects for the sake of coping up with drought and hunger problems.

Currently, in response to the recurrent drought situation the government focused on water centered development with special attention to water harvesting and small scale irrigation schemes.

In spite of previous and ongoing efforts to increase the irrigated area, only about 477 schemes with estimated command areas of about 52,000 hectares have been completed and commissioned to the beneficiaries and successes with these new schemes have been counteracted by poor performance and decline on existing schemes due to among others poor participatory planning and implementation processes, poor design and construction quality, and insufficient attention to O&M.

According to the data obtained from regions, only 361(75%) schemes are fully operational, the rest of the schemes are either non-functional/abandoned or partially functional. Hence, the productivity and sustainability of the schemes is very low.

This paper, therefore, introduces the existing experiences on planning, construction, operation, maintenance and management of small-scale irrigation schemes. Furthermore, it highlights the functional or utilization status of existing SS schemes. Finally, the paper also tries to deal with challenges and constraints in small scale irrigation development and discusses key issues and recommendations for the development of the sub-sector.

1. Introduction

Agriculture is the dominant sector of the Ethiopian economy and its performance has the major share of the over all GDP growth rate. On average, the sector contributed to 48% of the Ethiopia's GDP between 1995 and 2001. The agriculture sector accounts 90% of the export earning, 70% of raw material inflow into agro-based industries and as a major employer accounting for 85% of the total employment. From this, the crop sub sector accounts 60%, livestock 30% and forestry 10%. However, recent survey data shows that around half of the country's rural population is chronically food insecure.

On the other hand, the country has 110-122 billion m$^3$ of annual runoff and ground water potential of about 2.6 billion m$^3$. The irrigation potential is also estimated about 3.5-4.25 million hectares. Irrespectively of these potentials and the above-mentioned food insecurity gap only a small percent of the potential is currently tapped for irrigation.

Furthermore, drought is a recurrent phenomenon in the country. Recent estimation
indicates that five up to seven million people are in need of food assistance every year.

To overcome the effects of drought and land degradation and thereby improve food insecurity, there is a growing interest in the promotion of water-centered development among which Small-Scale Irrigation and Rainwater Harvesting are the main interventions.

2. Existing Experience on Traditional Irrigation Schemes

Schemes initiated, planned, and implemented by beneficiaries themselves with minimum or no technical and financial support from external bodies are known as traditional irrigation schemes. These schemes do not have study and design reports. Most of them are river diversions and surface irrigations (Furrow or free flooding).

The initiation of traditional irrigation schemes development takes centuries back, which is difficult to trace exactly. What is clear is beneficiaries of many traditional schemes trace that they got inherited them from their forefathers. Of course, recently the recurrence of drought in the country has increased and intensified the development of these traditional irrigation schemes. Now a days traditional irrigation schemes are common all over Ethiopia.

Traditional irrigation schemes have the advantages of:

- Beneficiaries ownership of the physical infrastructure and the social organizations
- Well known and accepted managing organizations and leaders
- Independence of external support for sustainability
- Labor intensive, but not capital intensive.

However, traditional irrigation schemes suffer from the following limitations:

- Frequent rebuilding of head works, gully crossings and canals requires large amount of labor & risk of injury or even death every year.
- Very low conveyance efficiency because head works and canals leak significantly;
- Inability to cross wide gullies
- No irrigation water regulatory and distribution structures;
- Erosion of canals on command areas;
- Don't have study & design reports and difficult to trace back their history
- Limited command area due to inefficient diversion and very low irrigation efficiencies

To develop these schemes farmers organize themselves into associations. With the recognition of Kebele Officials, beneficiary farmers start to construct traditional irrigations schemes, and there was no technical as well as financial input from outside. Materials used for construction of headwork are fully local. Namely-stone, soil and wood.

The schemes range in size from less than 20ha to 100 ha. The farm size of these schemes per family head varies from 0.25 to 0.5 ha. The beneficiaries of these schemes are well organized and effectively operate their schemes. The organizations of beneficiaries (water users) are long existed to manage these traditional schemes. It is those farmers, who know and respect each other very well, form these associations and are committed to cooperate and achieve their common goal. Such typical associations comprise up to 200 user members.

Some of these traditional irrigation schemes are hundreds of years old. This indicates that such long-lasting has given them good experience to manage their schemes. Irrespective of this, each group is scheme as well as water users' conflicts, and it is very difficult for them to achieve their common goal. Such typical associations comprise up to 200 user members.

The members of traditional irrigation schemes don't have clear boundaries, usually occurs are the stream users' conflict of interest, which is called traditional irrigation schemes. There are also some traditional irrigation schemes, which are temporary, such as they are working in some other areas.

Head work and canal maintenance of traditional irrigation schemes is usually done by the government or traditional irrigation associations. On their farms, in which flow is collected and distributed. Because of this, the flow is not eroded usually. This is the reason for traditional irrigation schemes to last.

In almost all traditional irrigation schemes, farmers carry out all operations from research to practice as well as organization area and management, and get little support from external organizations.

According to the data of the government, the average area of the traditional irrigation schemes is about 200 ha, and the area under crop irrigated is about 280,000 hectares annually, which is about 20% of the total irrigated area.

3. Existing Experience on Small-Scale Irrigation

These are generally constructed in the areas of about 200 ha, and schemes are planned, designed, and built by the government or with the benefit of the farmers.
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One of these traditional irrigation schemes are adrets of years old. This indicates that such long lasting has given them good experience to manage their schemes. Irrespective of this experience, during rainy season since their traction is made up of weak soil, stone and mud, it can't tolerate the maximum flood during. Therefore, the flood always takes their erosion weir away during rainy season. Cause of this they construct new earthen weir every year.

Since most of these schemes are long lasting, almost of the areas of these schemes are covered by permanent crops like coffee, sugar cane, banana, chat etc.

On traditional irrigation schemes, supervision of water distribution is carried out by the leaders of their association (usually called father of water). In fact, each association is categorized into groups for maintenance of the scheme as well as water distribution. Based on this, each group is scheduled as to when to irrigate. Irrespective of the area and type of crop irrigated, time allocated is similar.

The members of traditional irrigation schemes' associations don't have conflict on water, what usually occurs are the upstream and downstream users' conflict between different associations. On their farms there is no structure in which flow is controlled as well as distributed. Because of this their canals get eroded usually. This is the case where traditional irrigations are well established. There are also some traditional irrigation schemes, which are temporary. That is to say, they are working in some years and not in others.

Head work and canal maintenance of traditional irrigation schemes is usually carried out once at the beginning of the year. Additional maintenance with in the year is not commonly practiced.

In almost all traditional irrigation schemes, farmers carry out all operation and maintenance as well as organization and management. They get little support from development agents.

According to the data obtained from regions, farmers on average develop more than 1200 traditional irrigation schemes with a command area of about 280,000 hectares national wide on annual basis on their exclusive efforts.

3. Existing Experience on Modern Small-Scale Irrigation Schemes

These are generally considered to be command areas of about 200 ha or less. Modern SSI schemes are planned, designed and constructed by the government or other external body for the benefit of the farmers with minimum contribution (about 10% of the investment cost) in terms of labor and/or local materials or no contribution by the beneficiaries. Gravity surface irrigation predominates with low irrigation efficiency, probably less than 30-40%. Few micro-earth dam and pump schemes exist due to relatively high cost.

These schemes have been expanded after the 1984 drought, which affected the country. The objective is to achieve food security & improve livelihood of farmers.

Since then, even though the pace is slow due to different factors, the schemes expansion has been on progress as water centered development is on the prime agenda of the government.

In terms of water source and abstraction methods the major models of modern SSI schemes currently used are:

- River + diversion weir
- River + micro-earth dam
- Spring + diversion weir
- River + pump
- Lake + pump
- Well + pump

River plus diversion weir is the most commonly used modern SSI model in almost all regions. This model has the following advantages:

- Relatively simple to study, design, construct and operate
- Cost per hectare is relatively low
- Sedimentation and seepage problems are minimal

Therefore the river plus diversion weir schemes are more successful as compared to others. As a result, currently regions are turning to and giving high emphasis to this model. However, this model has the following limitations:

- Can be applied only in rivers which are permanent and have a considerable discharge
- Water harvesting in rainy seasons is not possible so that irrigation water shortages during long dry seasons

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- commands very limited area due to limited discharge

The other commonly used model is river plus micro-earth dam. This model has the following advantages:

- Water harvesting during the rainy season to use in the dry season
- appropriate in areas where there are no perennial rivers
- Increased command area due to harvested water

The limitations of this model are:

- Investment cost per hectare is relatively high
- Needs relatively highly qualified professionals & heavy machineries
- Increased risk of seepage and sedimentation problems
- environmental impacts such as submergence of productive lands & infrastructure
- Health hazards such as malaria & other water born diseases

Having all these advantages and disadvantages regions are planning & implementing this model.

The pump models are also being implemented even though the operation and maintenance works are difficult to farmers. They require skilled manpower and relatively high cost for proper operation and maintenance. Availability and access to spare parts is also an other problem. Well plus pump model is being piloted at Kobo Gerana valley (Amhara region) & some private farms and found promising.

Planning of modern small scale irrigation schemes is carried out in the following three steps:

1. Project Formulation & identification.
2. Reconnaissance
3. Feasibility study & design

Modern small scale irrigation schemes are being conceived either in the office from the topo maps/ aerial photos or by demands from the farmers. Following the steps required the scheme would be prepared for implementation. Depending on the availability of budget, with some contribution of labour by the beneficiary farmers, schemes can be constructed and made ready for use. The constructed and completed schemes are usually handed over to WUAs for managements, and maintenance. In almost the majority of existing schemes water users association have been supposed to be established before the construction of schemes have been started.

In a lot of schemes constructed by NGOs, schemes are not well studied and designed. Because of this, after construction there is a shortage of water. There are also several schemes where NGOs constructed only headworks and leave the development of irrigated land. In some cases where proper study has not been carried out, conflict between traditional and modern schemes users arises.

In most of irrigation schemes watershed developments have not been considered. This has resulted in reduction of rivers discharges, silting of head works as well as canals, which highly affect the water management capacity of schemes.

Concerning management of SSI schemes, there is no clear responsibility between the implementing agencies as well as beneficiary communities on completed irrigation schemes. Redistribution of land is one of the impediments on the efficiency of some schemes. There is limited supply of agricultural inputs and credit service on SSI. There is no production plan on SSI, which severely affects the production market of SSI schemes. There is poor marketing service. In general it is possible to say that there is no extension service wherever small-scale irrigations are implemented.

There is also no adequate research undertaking at federal and regional centers on the sub sector and hence improved technologies on irrigated agriculture are not available.

In some cases due to budget constraint some SSI schemes were under designed. In others, schemes are not completed in accordance with their design and those implemented lack quality, which in turn affect the management of the scheme.

In areas where food aid and become part of life, it is hard to strategically anticipate to it livelihood options. Therefore, it is not hard to accept any development initiatives due to dependency syndrome.

There is also lack of expertise in irrigation water management, the efficiency of irrigation water use has been improved and diversifed agronomic practices. Poor land leads to high levels of erosion, reduction of rainfall and inadequate fertility.

Finally limited management capacity for maintenance practices for sustenance of the schemes by farmers and the NGOs has resulted in reduction of land, number of experts involved in irrigation water management practices, terms of study, design, construction, development and maintenance of irrigation schemes highly suppressed the development of small scale irrigation.

4. Institutional Arrangements

Prior to the establishment of governments, small scale irrigation schemes have been organized and coordinated by the federal and regional governments. In 1992 the whole of small-scale irrigation has become part of the regions where by several institutional set up have been developed so far.

The institutional set up of regions where small-scale irrigation schemes varies from regions, the design and construction of small scale irrigation schemes are under taken by the Federal Irrigation Bureaus, and operation and maintenance are carried out by the Regional Irrigation Bureaus of Agriculture and Rural Development. In Oromia, all the irrigation schemes are under the control of Oromia Irrigation Development Authority (OIDA). Currently, the implementation of small scale irrigation schemes are being handled by governmental and nongovernmental enterprises.
their design and those implemented some times lack quality, which in turn affect the water management of the scheme.

In areas where food aid and donation has become part of life, it is handicapping farmers to strategically anticipate to it as one of their livelihood options. Therefore, they hesitate to accept any development including irrigation due to dependency syndrome. There is also lack of experience in basic irrigation water management, how to improve efficiency of irrigation water use as well as skill on improved and diversified irrigation agronomic practices. Poor land management leads to high levels of erosion, poor infiltration of rainfall and inadequate fertility management.

Finally limited management capacity to initiate maintenance practices for sustainable running of the schemes by farmers and limited capacity of experts involved in irrigation development in terms of study, design, construction, operation and maintenance of irrigation infrastructure highly suppressed the development of small-scale irrigation.

4. Institutional Arrangements

Prior to the establishment of regional governments, small scale irrigation schemes has been organized and coordinated at the central level. Then in 1992 the whole responsibilities of small-scale irrigation has been transferred to the regions where by several schemes have been developed so far.

The institutional set up of regions to implement these schemes varies from region to region. In Tigray, Amhara and Southern region study, design and construction of small-scale irrigation schemes are under taken by Water Resource Bureaus, and operation and maintenance (Agricultural Extension) being implemented by Bureaus of Agriculture and Rural Development. In Oromia, all the irrigation activities (study, design, construction as well as its extension) are carried out by Oromia Irrigation Development Authority (OIDA). Currently; regions are undertaking a structural reform that traditional water management organizations, and maintenance. In almost all the schemes with a history of traditional irrigation, have tended to be ignored. WUAs are usually set up initially to mobilize the community to participate in the construction work. Once construction has been completed, the focus is to the irrigation cooperatives. Lack of policy support to WUAs and traditional water fathers threatens to undermine sustainability as the irrigation cooperatives are not expected to operate and maintain the scheme and manage water distribution.

5. Utilization and Operational Status of Existing Modern SSI Schemes

Development of small scale irrigation has been continuing by the regional Bureaus & NGOs. In the previous decades, a number of SSI schemes have been constructed, completed and commissioned to the beneficiaries. However, getting updated and actual data is being difficult. As a result the number and command area of completed & commissioned SSI schemes is not accurately known. This is due to lack of exhaustive investigations and lack of institutional memory due to frequent restructuring and changing of mandates. Further more, operational and utilization status of existing SSI schemes is even more difficult to trace.
There are various data and information regarding these issues. However, according to the data obtained from regions in 2004 and 2005, the total number of completed and commissioned modern SSI schemes to date are more than 477, with an estimated command area of 52,247 ha. Of the above figure, a minimum of 59(13%) schemes with command area of 5,136 ha. have been completely abandoned and out of production. Further more about 57(12%) schemes with a command area of 7,092 ha are reported partially functional or under utilized and seeking for major and minor maintenance.

Structural failures (Seepage, sedimentation of head works and canals, demolition of head works, breaching of canals, etc), shortage of water, lack of proper operation and maintenance, lack of awareness and skill of the beneficiaries are some of the problems observed in most of the schemes.

Productivity and sustainability of SSI schemes is also affected by lack of participatory planning process (beneficiaries, all stakeholders), lack of proper attention to social organizations, lack of post-construction support to beneficiaries, absence of access to market and poor watershed management.

The complexity of modern irrigation development makes the task more challenging. The attempt to move subsistence agriculture to intensive, diversified, and commercialized agriculture involves many changes of mindset that need to be improved for better performance. The attempt to move subsistence agriculture to intensive, diversified, and commercialized agriculture involves many changes of mindset that need to be improved for better performance.

6. Key Issues and Recommendations

Lessons learned from previous experiences indicate that the following issues are corner stones to successful planning, implementation and sustainability of irrigation projects:

- **Adopting of Participatory Approach**
  - Full participation of beneficiaries and involvement of all stakeholders in the planning, study & design and construction of the schemes needs to be improved for better performance.
  - **Combatting Dependency Syndrome**
    - Dependency is one of the major factors that affect productivity of irrigation schemes. In some areas farmers believe that they can't live without food aid. Hence, they are reluctant to accept any development interventions including irrigation because of the fear that they will lose the aid. Hence, continuous awareness creation and attitudinal change forums are relevant to avert dependency syndrome.
  - **Integrated/ Multidisciplinary Approach**
    - It is a common practice for more emphasis to be placed on physical construction than operation and management. It is also true that an irrigation scheme is not appreciated in the context of the entire catchment in which it exists. A shift from a single discipline approach to multi-disciplinary approach is crucial for sustainability & balanced emphasis is required among the different disciplines & components in irrigated agriculture. An irrigation schemes should not be treated as an isolated entity.
  - **Watershed Based Water Resources Planning & Development**
    - This is important from the view point of water resources planning, assessment of soil and water conservation requirements, and the prevention of conflicts among users. Catchments water balance studies should be undertaken to determine the potentials we have. Scheme based approach should be replaced by watershed approach.
  - **Watershed Management**
    - It is worth considering watershed management as a prerequisite to scheme development. Wherever, irrigation is proposed it should encompass upstream catchments management/treatment as the major component as it protects sedimentation and flood hazards and improves the hydrology of the watershed.

Adequate support to establishment and strengthening of relevant institutions

Frequent restructuring and changing of mandates highly affect the development of irrigated agriculture in the country. Therefore, rectification of mandates, accountability of governance involved in the development of agriculture based on curricularly highly important for sustainability.

**Establishing Basic Data Base**

Designing and constructing a scheme based on inadequate data is a failure. Hence, institutes of basic data needs and database centers should be established in areas that can be easily reached by stakeholders.

**Availability and Access**

Access to market and marketing opportunities to be improved in all areas. Sufficient emphasis to be given to enable beneficiaries to adopt high value and high potential crops. Expansion of preserve production systems and marketing technologies as well as marketing would reduce poverty in industries in rural areas and lead to agricultural sustainability.

**Sufficient Emphasis on Organization and Extent of Extension**

SSI operation and management is important because it requires shifting to more intensive, diversified group farming systems. Extension training in operation & maintenance structures, water management and the like is critical to successful management. Besides, establishment and implementation of trial plots, timely availability of extension services, assignment of qualified personnel at the scheme level are important issues to be addressed.

**Adequate Emphasis on Organizations for Water Management**

In most of the modern SSI schemes, water management organizations are only on institutional level, while irrigation cooperatives responsible for planning and implementation of irrigation cooperative schemes.

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Adequate support to establishment and strengthening of relevant institutions

Frequent restructuring and changing of mandates highly affect the development of irrigated agriculture in the country. Therefore, rectification of mandates, responsibilities, and accountability of governmental institutions involved in the development of irrigated agriculture based on current experiences is highly important for sustainability.

Establishing Basic Database Centers

Designing and constructing an irrigation scheme based on inadequate basic data leads to a failure. Hence, institutions working on the survey of basic data need to be strengthened and database centers should be established in all areas that can be easily accessed by all stakeholders.

Availability and Access to Market

Access to market and market information needs to be improved in all irrigation schemes to enable beneficiaries to sell their products. Expansion of preservation and storage technologies as well as agro-processing industries in rural areas is crucial for sustainability.

Sufficient Emphasis to Agricultural Extension

SSI operation and management is complex because it requires shifting from subsistence to more intensive, diversified, higher input & group farming systems. Therefore, intensive training in operation & maintenance of structures, water management, input application and the like is critical for sustainability. Besides, establishment of demonstration and trial plots, timely availability of inputs and assignment of qualified personnel at woreda & scheme level are important measures to be addressed.

Adequate Emphasis to Social Organizations for Irrigation Water Management

In most of the modern SSI Schemes traditional Water management organizations tend to be ignored in the establishment of WUAs and irrigation cooperatives. This threatens the viability of the modern organizations is disempowering. The cooperatives promotion bureaus are only interested in the promotion of irrigation cooperatives WUAs do not have a legal status and policy support to enable them to operate a bank account and access credit. Neither WUAs nor ICS fully represents the water users farming with in the command areas.

Adequate Emphasis to Post Construction Maintenance & Repair Works

Government should take responsibility for post construction, maintenance and repair when this lies beyond the capacity of the farmers. There should be a clear and transparent planning procedures and allocation of adequate budget for major (head work, main canal) and emergency maintenance works. Long term support is a necessity not an option for sustainability.

Establishment of Cost Recovery Mechanisms

A cost recovery mechanism should be established to strengthen investment capacities. This can be a long term strategy as irrigation development is in its infant stage in the country. Funding and implementation of O&M through Collection and management of water charges is an essential component and guidelines need to be developed to ensure that irrigation water is affordable and meets the demands of O&M and also discourages over use of water.

Hence, as a short term strategy beneficiaries should contribute and collect money which can be used for operation and maintenance of irrigation schemes.

Adequate Training

There is a knowledge and skill gap in the study, design, construction, operation and management of irrigation schemes. A number of schemes have been failed due to poor study, design and construction qualities as well as low capacity of agricultural extension services.

There is also lack of experience in basic irrigation water management, how to improve efficiency of irrigation as well as knowledge on improved and diversified irrigation technologies. Hence, long-term and short term training of experts is mandatory for the development of the sub-sector. Further more, periodic training in the field of irrigation water
Current experiences on existing small scale irrigation management, operation and maintenance, improved agronomic practices and marketing to irrigators & experts are highly recommended for sustainability and improve productivity.

Further more establishment and strengthening of relevant research institutions is necessary for the provision of improved irrigation technologies.