ABSTRACT

In Uganda the agriculture practices is a rain-fed system using waters that are available during the rainy seasons, but the country faces two dry seasons where crops suffer sever shortages of water that affect their yields. Water use for irrigation is among the technical options for enhancement of Water for Production in Uganda as set out in the Water Sector Strategic Investment Plan (WSSIP) 2009-2035. However, there has been limited utilization of this option. The supplementary irrigation activities is a resentintervention practices in Uganda, so many constraints could be expected when running such activities in the country. This new strategy will efficiently and effectively supply water to meet the competing demands all year round.

Effective community mobilization is important to ensure adequate and effective participation of the beneficiaries in the development of schemes, and proper legally constituted organization is essential for beneficiary operation and management of irrigation schemes. When there is already a form of irrigation in place still it is important that the farmer knows how much he/she has to irrigate and how often. In most cases the water sources are scares and the users should make use of the water in an optimum way. Therefore establishment of the water distribution schedule and basis for determining the allocation rights for the scheme is a must.

The Researcher (the Technical Advisor TA-MWE) insisted to provide on-job training of key staff in all aspects of the scheme especially the post construction management set-up and illustrates the prepared operational model (institutional and technical) for the scheme. This strategy achieved the purpose of sustainable water use to improve production.

Due to water shortages in the dry period and related storage facilities in the scheme; the researcher designed a complete water distribution scheduling for the two project’s phases including the amount and related frequencies for Rice crop. The operation of this irrigation scheduling was tested to ensure water equity between farms during the running of the training assessment program for the scheme as an activity of the TA-MWE for the target capacity development strategy in the MWE Irrigation Schemes.

One of the main findings from this applied research study is designing the required institutional management system in form of cooperative society for the scheme, this mechanism will guarantee scheme level’ accountability and regulation for institutional governance purposes with the business of irrigation scheme for both related management and technical aspects. The needed scheme’s management structure was developed based on the value chain approach to ensure its sustainability.

It is strongly recommended that this application case study for a successful best practice of a supplementary irrigation project with its management strategy can be reviewed for disseminating in some Arab or Middle East Countries that have similar operation condition using the water harvesting techniques.

Keywords: Irrigation Scheme, Management, Scheduling, Operation and Maintenance, Capacity Building, Sustainability.
1 INTRODUCTION

Uganda is considered fairly well gifted with water resources, estimated at approximately $65 \times 10^9$ m$^3$ of water giving a 2,171 m$^3$ per capita per year (2008) with open water covering close to 12% of total land area; however these water resources exhibit both seasonal and spatial variability. There is a mismatch between the location of the water and the location of demand, together with highly fluctuating seasons make Uganda vulnerable and has implications on the water security of the country. The Government of Uganda, through Ministry of Water and Environment (MWE) is seeking to establish small irrigation schemes in the Country. The estimate of Uganda’s irrigation potential in terms of land (around 550,000 ha, made up of some 295,000 ha of easily irrigated “Type A” land situated close to reliable water resources and 275,00 ha of “Type B” land requiring storage and/or significant conveyance systems).

The configuration of a supplementary irrigation system mainly for the innovation irrigation practices and needs for such programs in Uganda is obviously determined by the relation of water and land resources, beneficiaries and the economic considerations. The design should incorporate as much as possible features that facilitate operation and provide flexible irrigation services. Sustainability of the introduced supplementary irrigation system is a must. It is well known that over irrigation is a waste of water, time and energy, but under irrigation will reduce yield.

Stakeholder's participation is mandatory, and formation of, and capacity building of beneficiaries organizations is an essential element to prepare the beneficiaries for self-operation and management of the schemes. It is important to support formation of the required institutional and capacity building to ensure good performance of water management and the operation of water infrastructures. The existing institutional, organizational and management arrangements for the current irrigation schemes in Uganda are faced with numerous challenges such as:

- Unclear ownership arrangements – land, hydraulic works and irrigation infrastructure;
- Absence of clear and appropriate management approach;
- Unclear linkages, accountability and reporting between different stakeholders;
- Lack of functional analysis of the management structure for the irrigation schemes;
- Inadequate skills/capacity and poor facilitation of scheme staff – low motivation;
- Inefficient operation and maintenance of the irrigation systems.

The above challenges have delayed the scheme management to demonstrate the ability to effectively supervise, operate and maintain and deliver efficient irrigation water services; and hampered proper regulation of water resource use and distribution. It is envisaged that the new structures will be anchored in the existing frameworks from centre government for policy matters to the local authorities for management, operation and maintenance and communities/users/farmers for effective and productive use – water service delivery. Regulatory activities, monitoring and reporting will be a shared responsibility among the different institutions and agencies, including catchment management structures, depending on area and level of competence. Finally, in order to achieve sustainability of different operational levels for a certain irrigation project; they will have to be well coordinated and linkages defined. It is especially at the scheme level that substantial effort will be needed towards institutional development.

2 THE NEED FOR IRRIGATION IN UGANDA

Domestic agriculture remains the mainstay of Uganda’s food security at both the household and national levels, and has been a significant contributor to Gross Domestic Product (24%), to export revenues (estimated at 48%) as well as providing a livelihood for over 70% of the population. The sector however, is dominated by rain-fed farming systems:

- The viability of which is becoming increasingly compromised by climate change;
The productivity of which is reducing in the case of some crops, due to a variety of constraints both technical and institutional; and

The ability of which to contribute to national food security is decreasing due to one of the highest population growth rates in the world.

The following terms should be introduced for such intervention practices:

- **“Irrigation”** is the practice of maintaining root zone moisture at levels necessary to ensure optimal growth conditions for a given crop at a particular stage of growth when soil moisture would otherwise be inadequate.

- **“Irrigation Infrastructure”** comprises the physical works necessary to abstract water from its natural location to the farm level.

- **“Supplementary Irrigation”** is a somewhat loosely applied term that refers to irrigation practised in areas with reasonable but inadequate or unreliable rainfall, and can be thought of as a means by which to add value to whatever rainfall is received.

- **“Water harvesting”** describes simple physical and operational measures to divert and/or store water for the purpose of irrigation (and other uses) and is usually characterised by its highly localised nature, low costs and suitability for community based implementation.

In the light of the previous intervention practices for irrigation; the objective of rehabilitation works for such irrigation projects are to re-establish the original irrigation capacity of the existing schemes and support community/farmer based institutional capacity to sustain maintenance and management of the rehabilitated schemes.

### 3 RATIONAL FOR THE PAPER

This technical paper introduces the findings of operating pilot irrigation scheme as an application case study for the use of harvested water in dry seasons for the irrigation purposes. The researcher presents the main tasks and procedures to achieve such main goal. The outputs of this study will enable scheme’s farmers to increase and sustain production and marketing of the agricultural produce from those areas (mainly Rice crop). The main task of the TA-MWE is to physically rehabilitate the irrigation scheme and put in place a management system for operation and maintenance that would reduce the burden on the government and make the scheme farmers take ownership of the scheme for sustainability.

The introduced model within this paper (irrigation scheduling, operation and maintenance mechanism, practical training and institutional management system) will ensure delivery of benefits/rewards to the most efficient members/beneficiaries and allocate services depending on quantified inputs used, while maintenance of common infrastructure for access to water for production will be guaranteed.

The used concepts and related interventions for this technical study are approved legal, institutional and policy frameworks; according to the National Development Plan NDP in Uganda, in which the governing “off-farm” mandates and functions with regard to MWE and “on-farm” mandates and functions with regard to the Ministry of Agriculture, Animal Industry and Fisheries MAAIF.

One of the main methodologies to be considered is that, the designed delivery service and the allocation of water distribution scheduling system should be as much as possible user leaning. Reliability and equity of water delivery are the basic features of irrigation service; in the meantime, providing some form of flexibility in duration, flow and interval of irrigation should be considered during the planning/operation stages.
4 MUBUKU PILOT IRRIGATION SCHEME

The Mubuku scheme is located in Kasese District in the Western part of Uganda. It is about 430km from Kampala and about 5km east of Kasesewa which is the nearest big town. It lies in the Western rift valley at an altitude of 900-1050ma.s.l and latitude of less than 30 minutes north of the equator. It is bordered by River Sebwe from the east and River Rukook from the west. River Sebwe is the main source of irrigation water. There are other areas implemented or planned around the scheme in different phases which could share the same water source.

These are shown in the table below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Phases</th>
<th>Area (ha)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase I</td>
<td>412</td>
<td>The main scheme area using a pipe system</td>
</tr>
<tr>
<td>2</td>
<td>Phase II A</td>
<td>176</td>
<td>Diversion of water US of phase I using open canal systems</td>
</tr>
<tr>
<td>3</td>
<td>Phase II B</td>
<td>78</td>
<td>Not implemented for shortage of water for the DS of Phase I</td>
</tr>
<tr>
<td>4</td>
<td>Phase III</td>
<td>375</td>
<td>It needs other storage facility to be implemented</td>
</tr>
</tbody>
</table>

The Mubuku Irrigation Scheme is located few kilometers north of Lake George. The scheme falls within Western Uganda climatic zone (mainly related to rainfall pattern). However, rainfall tends to rapidly rise with height, reaching as high as 2,500 mm per annum at the peaks of Rwenzori area. The bi-annual rainy season pattern comprises of two wet seasons, the first peaking in September-October while the second peaking in April-May.

Low Flows and Risk Assessment
To evaluate the water resource potential of Sebwe River for irrigation use it is worthwhile to investigate low flows to quantify drought risk. The exceedance frequency relationship has been developed using annual minimum mean daily flows. Most of the low flows occur during February. The following table provides various exceedance levels of low flows, (DWD, 2009).
Layout of Mubuku Irrigation Scheme

**Low Flows Exceedance Level of River Sebwe (at Kasese – Fort Portal Road Station)**

<table>
<thead>
<tr>
<th>Exceedance Level (%)</th>
<th>Flow, m$^3$/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>0.41</td>
</tr>
<tr>
<td>75</td>
<td>0.43</td>
</tr>
<tr>
<td>70</td>
<td>0.46</td>
</tr>
<tr>
<td>50</td>
<td>0.56</td>
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<tr>
<td>20</td>
<td>0.77</td>
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<tr>
<td>10</td>
<td>0.90</td>
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<tr>
<td>5</td>
<td>0.01</td>
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<tr>
<td>2</td>
<td>1.13</td>
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</tbody>
</table>

The low flow that was used for designing the required water distribution scheduling for the scheme is about 0.30 m$^3$/sec from River Sebwe; as maximum flow that could be used daily for such irrigation activities; and taking into considerations the flow required in the river for the downstream use and the ecosystem requirements. According to the Ugandan Environmental Act, a minimum of 20% of the river flow in dry season should be reserved for the need of environment and ecosystem in the downstream portion.
5 METHODOLOGY FOR NEEDED ASSESSMENTS

General Consideration

The main key issues for enhancing the target capacity building for the existing water management and irrigation programs to ensure its successful operation and sustainability could be summarized as follows:
- Review the feasibility studies for the rehabilitation of existing government schemes;
- Scoping studies for new smallholder and bulk service schemes;
- Demonstrations and awareness raising;
- Drafting the institutional capacity building for scheme’s responsibilities and management then present the results for beneficiaries and different stakeholders in the introduced training assessments in the scheme for final adoption and approval.

The previous poor performance and inefficient operation of the irrigation schemes is largely attributed to the current ineffective institutional & legal environment and management systems in addition to the decaying infrastructure. Establishing effective institutional arrangements and improved management structures and systems are intended to offer efficient irrigation services delivery for the rehabilitated schemes.

Scheme’s Water Distribution Schedule

The effective operation of the irrigation system will be to a large degree determined by the appropriate distribution of water, timely and in sufficient quantities, to each block and farm. The needed water supply depends on two basic factors; first, it is required to put the irrigation map up prepared with the field staff and farmers; then, ask them to allocate the different hydraulic structures in the scheme to describe their functions and to categorize the structures according their functions. It is important to identify how the operation and control of water distribution can be improved; therefore, preparation of irrigation schedule for the scheme is mandatory.

Operational Institutional/Management Structure

The researcher will design the required water distribution scheduling to face water shortages in the dry season and the limitation of water storage in the scheme, for such new challenge in the scheme establishment of proper and strong management structure for these responsibilities is a must. This study includes the procedures for establishment of the needed management structure in the scheme. The scheme’s management body will face many challenges to achieving an effective and functional organization structure/system for the irrigation scheme, financial control and cost recovery for operation and maintenance and lack of clarity on institutional functions/roles/relationships/linkages with respect to regulation of the water resource, contractual obligations for irrigation service delivery.

The established management system for this scheme should ensure these clusters of institutional issues which therefore identified and analyzed in terms of the challenges and opportunities that they represent. Five of these clusters are distinct:

1. Awareness raising between different beneficiaries;
2. Establishment mechanism and institutional arrangements;
3. Operation and maintenance strategy of the scheme;
4. Monitoring and evaluation of different activities;
5. Training levels of service providers.
6 DESIGN OF SCHEME’ WATER DISTRIBUTION SCHEDULING

Irrigation Scheduling

The amount of water that should be applied for any given irrigation depends on the stage of crop growth, the depth of the rooting zone, and the field capacity of the soil. Irrigation time can be round the clock, day time only and a combination of day time and part of the night time. Day time irrigation is convenient and more efficient. However, lack of regulation on the water resources makes this option good for development of limited area. Thus depending on the water requirement, night storage is required to develop more area. However, large space it takes and problems in aggravating the potential water logging and cost are the constraints with night storages.

Good irrigation water management practice requires that the water be supplied in timely, equitable and efficient manner. To achieve this, water must be distributed equitably proportional to the land area. The water stream size should be optimum for easy handling by farmers and to minimize losses. Water delivery to the field should be in fixed time, and distribution should be easy without much control by gates. It is proposed that the design of canal system will be based on a rotational water supply. It is known that the scheme’s irrigation system will be mainly used during the two dry seasons in the area, this supplementary irrigation should be used wisely as the available and storage water is limited; therefore, establishing an irrigation schedule for the scheme is a must.

Assumptions for Preparation of Irrigation Scheduling:

The Scheme is cultivated with Rice

The maximum supplementary irrigation water demand for Rice is about 1.5 L/s/acre

The daily operational hours for irrigation is 12 hours (starting 7 am and end 7 pm)

Maximum duration for water applications/rotations is 3 to 4 days for the same block

The water demands from the main Sebwe River will be available according to the operational rules of the two weirs.

The amount of flow from the headwork will be transferred into level stage of water for easy operation by users using designed roles for the main water source. These draft irrigation scheduling tables should be reviewed with the society group Leaders and also to be tested and demonstrated to the users. Other irrigation scheduling could be needed at on-farm level inside block to distribute water between farmers/valves.

Calculation of Maximum Area to be irrigated each day:

Allowable minimum flow from Sebwe River: 0.35 m3/sec i.e. about 30000 m3/day

This available water will be used to fill the reservoir at night time to be used at day time to compensate the required flow for supplementary irrigation

Designed water demand for the scheme 1.5 L/S/acre i.e. about 65 m3/acre/day

Irrigable area per day is about 465 acres i.e. about 1/3 of scheme area (587 ha, i.e.1400 Acres).
As an outcome for this technical assistance of the scheme, the researcher prepared a complete irrigation scheduling according to the area of each block and its conveyance system (the scheme has 12 blocks in the two scheme’s phases). The following table presents the data of the scheme with the length of each branch canal with the designed water distribution scheduling. Also the next diagram presents the layout sketch of the scheme with the designed irrigation scheduling for its operation in one week.

### MUBUKU IRRIGATION SCHEME BLOCKS
(Proposed Irrigation Scheduling)

<table>
<thead>
<tr>
<th>SUPPLY CANAL</th>
<th>BLOCK</th>
<th>AREA (HA)</th>
<th>LATERAL CANAL</th>
<th>CANAL LENGTH (M)</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONVEYANCE PIPE (Phase I)</td>
<td>1A</td>
<td>54.4</td>
<td>LC - 1A</td>
<td>562.0</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>1B</td>
<td>34.0</td>
<td>LC - 1B</td>
<td>1,133.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2</td>
<td>53.0</td>
<td>LC - 2</td>
<td>969</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>53.5</td>
<td>LC - 3</td>
<td>1,190</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>4</td>
<td>46.0</td>
<td>LC - 4</td>
<td>1,303</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>5</td>
<td>58.5</td>
<td>LC - 5</td>
<td>1,383</td>
<td></td>
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<tr>
<td></td>
<td>6</td>
<td>54.4</td>
<td>LC - 6</td>
<td>1,470</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>7</td>
<td>57.6</td>
<td>LC - 7</td>
<td>1,590.7</td>
<td></td>
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<tr>
<td>Total</td>
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<tr>
<td>OPEN CANAL (Phase II)</td>
<td>8</td>
<td>41.6</td>
<td>LC - 8</td>
<td>955</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>9</td>
<td>44.8</td>
<td>LC - 9</td>
<td>1,209</td>
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<td></td>
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<tr>
<td></td>
<td>10</td>
<td>35.2</td>
<td>LC - 10</td>
<td>764.5</td>
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<td></td>
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<tr>
<td></td>
<td>11</td>
<td>28.8</td>
<td>LC - 11</td>
<td>785.7</td>
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<td></td>
<td>12</td>
<td>25.6</td>
<td>LC - 12</td>
<td>678</td>
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<tr>
<td>Total</td>
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<td>176.0</td>
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<td>Grand Total</td>
<td></td>
<td>587.4</td>
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</table>

The findings/outcomes of this irrigation scheduling were also presented and tested/demonstrated during the prepared training assessment of the scheme’s management staff.
5 FINDING OF ESTABLISHMENT OF SCHEME MANAGEMENT SYSTEM

Irrigation schemes offer a mixture of opportunities and interests, both socio-political i.e. public interest and commercial-profit interests which are largely private to individuals or groups of individuals. From this context therefore, whatever management model to be adopted, a combination of public and private interests must be the key focal point.

Considering the need for sustainable management of structures and systems, the model adopted will of necessity be a business model. The business model will ensure delivery benefits/rewards to the most efficient members and allocate costs depending on quantified inputs used those members, while maintenance of common infrastructure for access to water for production must be guaranteed.

The following Figure presents the cyclical overall Capacity Development CD Process Model, which will be a technically useful benchmark/point of reference in guiding the entire cyclical planning, implementation and Monitoring & Evaluation process, as recommended for this irrigation scheme.

The 5 Steps: CD Process Model for the Scheme

The success of the planned Capacity Development for the scheme require a strong sense of ownership, collective responsibility, partnership and commitment (including readiness to commit, or contribute resources), among all participating stakeholder institutions/entities; as well as a strong sense of readiness and determination to succeed amongst all stakeholders.

In this context, operation and management of the irrigation schemes (as Water for Production WfP facilities) requires that the lowest level possible be organized in such a manner that supervision, oversight and regulation are made possible. It is through these functions that an institutional structure is designed and for which roles consistent with the functions are allocated.
The diagram below presents the scheme level structural organization and governance flow of authority.

**SCHEME GOVERNANCE STRUCTURE**

The proposed Cooperative Society will draw its authority from the membership – General Assembly, which will elect offices – Executive Committee. The Executive Committee will then be mandated to hire technical staff headed by and answerable to the General Secretary. The technical officers so appointed will also act as secretaries to the relevant committees.

**Scheme’s Technical Committees TCs**
There may be three mandatory technical committees although the individual cooperative societies can be allowed influence to form any number of committees deemed necessary for proper functioning of the operations of the schemes. Staff and technical committee members shall be rewarded in accordance with terms and conditions agreed by the General Assembly and approved by the Chief of Cooperatives. The functions of the three Technical Committees TC cold be illustrated as follows:

a) **TC – Water Use & Irrigation**
This committee will primarily be responsible for water use planning, management and regulation within the scheme. It will also be charged with ensuring compliance with the abstraction permit conditions and will be the advisory committee to the Executive Committee and cooperative society on matters of water use and irrigation.

Other functions may include:
- Execution of different activities with cooperative society-assigned funds, as required,
- Supervise maintenance of scheme’s channels at the end of each rainy seasons,
- Regulation of the use of water among the various blocks; under its scheme of influence,
- Ensuring equity of water distribution.
The above functions are only indicative and may be adjusted from time to time according to the interests of the respective cooperative societies.

b) TC – Finance & Business Development Services
This TC will be responsible for compiling operation and management expenses, computing and recommending membership rates and fees, developing draft budgets and monitoring budget performance. Additionally, the committee will develop mechanisms and procedures for collection of membership contributions for O&M and ensure value for money on expenditure outlays.

Business development services will, among others, include processes such as:
- Analytical preparation of potential growth opportunities for the cooperative society
- Support implementation and monitoring of business development plans
- Tracking of price trends and advisory on response actions
- Provision of backstopping support for implementation of collective marketing schemes.

c) TC – Research & Production
This TC will be responsible for all tangible and intangible inputs and support processes for improved production, productivity and quality. The committee will liaise with research agencies as mandated, but may not enter into any contractual relationships with external parties except where expressly authorized in accordance with the Act. Also this TC would collaboration with and integration of knowledge and feedback from the market.

Findings of Applied Field Training Practices

The main objective of this training activity is to impart knowledge and necessary skills to the community own resource persons who shall on a voluntary basis operate and maintain the irrigation structures at Mubuku Irrigation scheme. The user community/farmers are the primary beneficiaries of all these development activities. Their roles are; active participation in the planning process, formation of management structures, monitor implementation, operate and maintain the scheme and effective usage of the provided water; therefore, a training program was introduced to cover these topics:

Training Objectives:
- To establish/approve the prepared management mechanism for the scheme.
- To assist farmers in defining a proper irrigation frequency and water application amounts according to the designed schedule.

Expected Outputs:
- A well established cooperative society management team for the scheme
- Farmers know how they can determine the irrigate amounts.
- The frequency of a piece of land that has to be irrigated.
- Proper O&M strategy for the scheme to ensure its sustainability.

Challenges covered with the users:
- Proper scheme management and related responsibilities.
- Ways to ensure improving irrigation by participation.
- Existing irrigation problems and system maintenances.
- Ensure equity and water availability at the lowest outlets.
- Operation and maintenance of the system.
- Test measuring devices according to the designed irrigation schedule
- Introduce drainage problems.

This tailor-made course in management of scheme structures imparted the volunteer trainees with hands on skills to enable them oversee smooth delivery of water right from the intake chamber, through the storage reservoir to the distributions canals within the scheme.
Target groups:
The training program was important at the level of both extension agent (District Authority DA) and the beneficiaries. The training of the extension worker is necessary for acquiring and updating his knowledge on irrigated crop production techniques and methods on irrigation development plus teaching principles to the farmers.

The selected target group for this applied training includes the three management levels for the scheme under the new arrangement, the scheme Operation and Maintenance (O&M) strategy shall operate at a three level management tier namely: the farmers, the technical team and the district/Government):

First level (Farmers)
- The household farmers
- The block leaders

Second level (Technical team)
- The management/technical team at the scheme head offices
- The scheme association executive

Third level (District/Government)
- Government technical staff (MWE and MAAIF)
- The district and extension staff

The training content covered the following topics:
- Input utilization.
- Introduction to irrigation development
- Irrigation and its uses
- Mubuku scheme care and management by beneficiary (participation and responsibilities).

The specific achievements include:
I. Conduct an open community meeting with the residents around the intake structure and discuss the irrigation practices and the introduced water distribution schedule.
II. Conduct a meeting with the farmer’s cooperative society and discuss community roles in operation and maintenance of the scheme.
III. Draw an action plan for management of Mubuku scheme.

Roles and responsibilities:
It is recognized that, different parties in the community are suited for different stages of the Management, O&M of the scheme facilities and should do this accordingly.

Scheme Key Players:
1) Farmers (Users)
2) Block leaders
3) Scheme Management Committee

1) The Farmers
- Observing safety of the scheme facilities
- Attend all meetings related to the scheme
- Payment of fees (user contribution) for the overall management of the scheme

2) The Block Leaders
- Mobilize farmers to participate in the rehabilitation of the scheme
• Guide farmers on proper farming procedures
• Organize regular meetings of the farmers
• Encourage use of bylaws
• Mobilize farmers to pay annual contributions

3) The Scheme Management Committee
• Organizing farmers meeting and discuss matters related to the scheme
• Effective use and looking after money and other resources the scheme
• Monitoring the activities of the technical team
• Responsible for O&M and the entire management of the scheme
• Responsible for enforcing the bylaws to govern the scheme
• Keep records of both maintenance and repairs done
• Responsible for rationing of water during low flows of the river
• Advise about the required measures to be taken to improve on yields
• Make monthly reports to the district
• Responsible for planning and budgeting for the scheme activities

6 CONCLUSIONS AND RECOMMENDATIONS

If there is no irrigation in such scheme in the dry seasons, the area can be productive with limited yields. Thus irrigation in this area is indispensable. In view of the limitation in the water resources during the dry periods; it is recommended to establish a joint management of the flow in Sebwe River such that it is fairly and equitably shared and conflicts that may arise are agreeably solved between the various phases; therefore, establishment of the required water distribution scheduling (quantities and frequencies) is a mandatory to ensure scheme’s sustainability. The researcher applied some assumptions for designing this irrigation scheduling that technical match the situation of the scheme and experiences of the operators in the prepared institutional management mechanism. This water scheduling were tested and verified during the running of the training program for this purposes

The basic belief of sustainable institutional and management structures elaborated are that the institutional arrangements must be acceptable, offer potential opportunity to all members to participate, and deliver benefits to the members that subscribe to the arrangement. The TA-MWE designed this management mechanism to encourage farmers to form participate in the required associations as a pillar for day-to-day management of this irrigation scheme in Mubuku area.

The prepared Capacity Development strategy for this irrigation scheme was designed and operated in such a way that they will have to be in harmony and consistent with the overall goals and objectives of the MWE’s irrigation programs in general. The activities of such organization will be technically monitored with the local government District i.e. Kasese District’s responsible officers for over side and regulation purposes. Contract/MOU for the purpose should be drawn to include these roles and the conditions under which cooperative society will be allowed to manage the facilities.

One of the main outputs of this technical assistance is to deliver to the users during the running of the training program, the importance of Operation and Maintenance of the scheme to ensure its sustainability. It is a fundamentalrequirement for the successful operation of the irrigation system.

It is recommended that this case study for a successful best practice supplementary irrigation project can be benefited for disseminating in some Arab or Middle East Countries that have similar climatic and hydrological condition using the proposed water harvesting techniques for storing the required water
needs during the expected dry seasons. The presented management strategy and concept of introduced techniques could be applicable for implementation of a sustainable irrigation practices.

REFERENCES


Annex: Field Activities for Testing Research Findings

A) Water Distribution Scheduling

B) Training Practices