# CHAPTER 7

# IMPLEMENTATION ARRANGEMENT

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Experience from this Study suggests that smallholder irrigation development be promoted nationwide wherever there is potential in order to raise farmers' food security and thereby improving their livelihood. This chapter therefore suggests an organizational arrangement, the dissemination mechanism, and a milestone time frame with necessary inputs to cover the country, followed by implementation disciplines that have to be taken into account on the course of the dissemination.

## 7.1 Organizational Arrangement

Aside from the Department of Irrigation, there are 8 ADDs, 30 RDPs (restructuring is underway), and as many as 186 EPAs nationwide in the Country. This extensive government structure already in place nationwide is really a good "opportunity" in extending smallholder irrigation development over the country. This Study therefore maintains following organizational arrangement in pursuing nationwide smallholder irrigation development, which centers on the existing organizational structure with EPAs being the frontline facilitating the farmers. Local development committee such as District Development Committee at RDP level and Area Development Committee at EPA level should also be involved since they can be a good catalyst. As DOI is not equipped with enough professional staff, there should be a unit which is in charge of managing the smallholder irrigation program. The unit and relevant government offices should coordinate, move hand in hand and discharge their roles and responsibilities well defined at their jurisdictions:

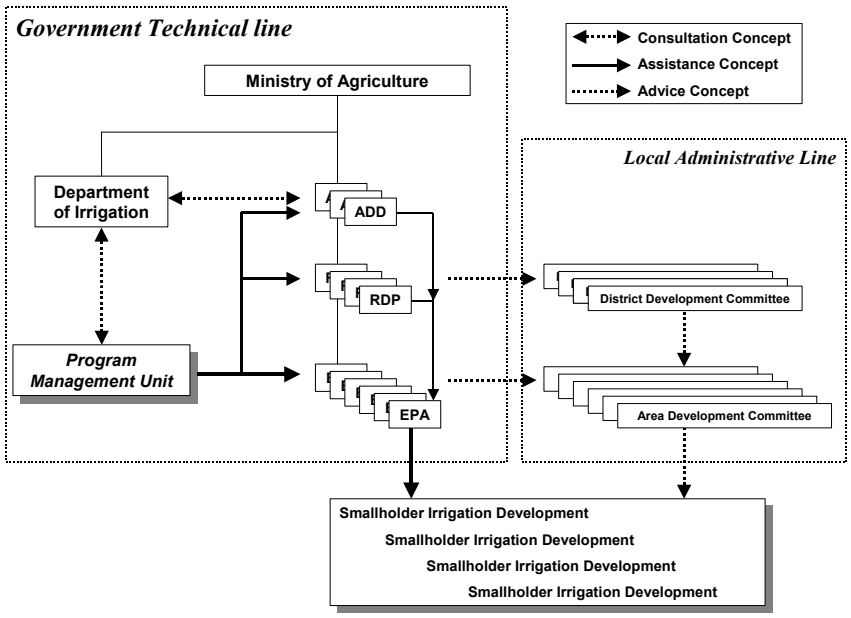



**Figure 7.1.1 Organizational Arrangement**

Program Management Unit: Conducting of smallholder irrigation dissemination activities such as trainings for AEDOs/ AEDCc, irrigation officers in RDPs and ADDs, monitoring and evaluation of smallholder irrigation development, developing of appropriate technologies and forwarding to DOI, and coordinating relevant offices,

DOI (central level): Monitoring and evaluation of smallholder irrigation development at national level, banking of appropriate irrigation technologies/experiences and these dissemination, and

facilitating the exchange of the technologies among ADDs,

ADD level: Technical advices to the RDP irrigation officers, monitoring and evaluation at ADD level, and facilitating the exchange of smallholder irrigation experiences among RDPs,

RDP level: Technical advices to the EPA officers, monitoring and evaluation at RDP level, facilitating the exchange of smallholder irrigation experiences among EPAs, and facilitating farmer-to-farmer-visit over an EPA, and

EPA level: Identification of potential areas for smallholder irrigation schemes, facilitation of the farmers including identification of the potential beneficiaries, arrangement of farmer-to-farmer visit in the EPA, organizing them into group/club, facilitation of the construction work, follow-up of operation and maintenance, etc.

Over the Country, there are 20,721 village headmen (VH), 2,360 group VHs, and 160 Traditional Authorities(TA) [1]. If smallholder irrigation development ends up in village-by-village, concerned local authority is the village headman only. However, this Study proposes cluster-wise development, for which number of potential sites ought to be developed simultaneously. If the concerned group VH is well informed of the development, dissemination from one site to another within the cluster could be well advanced.

**Table 7.1.1 Technical and Administrative Lines**

| Technical Line | | Local Administrative Line | |
|---|---|---|---|
| Coverage | Responsible | Dissemination Catalyst | |
| DOI | Director | (be informed and invited to study tours) | |
| ADD | DIO | | |
| RDP | IO | | District Development Committee |
| EPA | AEDC | Traditional Authority | Area Development Committee |
| Cluster | AEDO | Group Village Headman | |
| Project | AEDO | Village Headman | |

IO: Irrigation Officer, DIO: Divisional IO

Considering there are 186 EPAs nationwide, the jurisdiction of a TA could be more or less same as the coverage of a typical EPA. It implies that if TA is well informed of the development, there should be an opportunity that dissemination at EPA level, which means beyond a cluster, could be facilitated.

Village headman is automatically involved since the beginning of the development. Aside from him/her, it is recommended that group VH, TA, and also as indicated on the right of Table 7.1.1 and Figure 7.1.1, Area Development Committee and District Development Committee should be informed of the development. This arrangement on the local administrative structure could catalyze the extension of the smallholder irrigation development from one site to another in a cluster, beyond the cluster, and then beyond an EPA to an RDP level.

[1] Ministry of Local Government, February, 2003

## 7.2 Desirable Dissemination Mechanism (High Performance Implementation)

In this section, a desirable dissemination mechanism with certain amount of inputs in the activities is presented. The dissemination is programmed to cover the whole country as rapidly as in five years or around 30 EPAs per dry season. The core of the program is a series of trainings for AEDOs in association with tool provision, study tours, etc. It is considered that the dissemination program described below would be to realize the highest performance of diffusing smallholder irrigation all over the country.

### 7.2.1 Implementation centering on EPA

Implementation responsibility, especially on the ground, should be centered on EPA level. There are about 10 AEDOs in each EPA as average. The AEDOs should be equipped with necessary knowledge, skills and attitude to promote smallholder irrigation development through training. The training should preferably be administered to all the AEDOs as far as there is a potential site to develop in his/her jurisdiction. However, budget arranged for the training may not allow undertaking all the AEDOs. Provided the budget is not enough, it is recommended that at least three AEDOs per EPA should be administered the necessary trainings together with their supervisor, AEDC.

Upon completion of necessary training, the AEDOs are supposed to explore smallholder irrigation development together with their fellow AEDOs who have not been given the training. Through working together with the trained AEDOs, the fellow AEDOs will learn what to do in facilitating farmers to develop smallholder irrigation schemes. Since smallholder irrigation schemes this Study promotes are very small scale, in most cases less than 5 ha, more than one scheme per AEDO could be developed in a dry season, at beginning of which the training is administered.

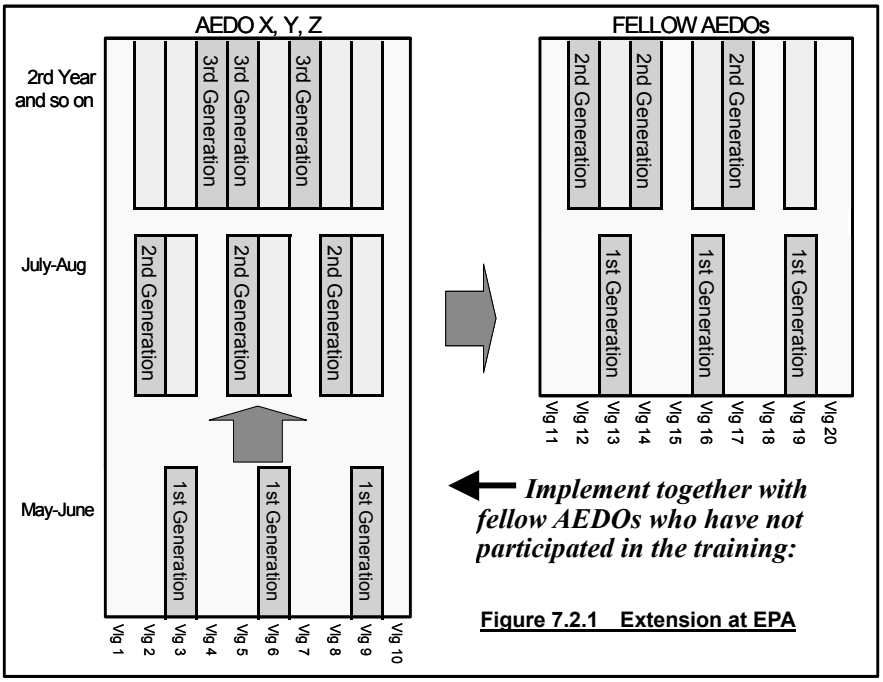



**Figure 7.2.1 Extension at EPA**

Figure 7.2.1 shows conceptually how smallholder irrigation schemes are developed within an EPA; for example, in May/ June the trained three AEDOs develop one scheme each together with fellow AEDOs who have not participated in the training. In July/ August the AEDOs develop 2nd smallholder irrigation schemes and also the fellow AEDOs who have by then learned the skills through working together develop their own 1st generation schemes, then

they proceed in the following year as far as there is potential site and there are willing farmers. It is expected that as they proceed to following years, farmer to farmer extension would be able to work since there will be more sites that can motivate nearby farmers each other.

AEDC will be the coordinator among the AEDOs and also the supervisor on the course of the implementation at his/her EPA level. Technical assistances from relevant irrigation officer(s) at RDP level should be given to the AEDOs. A task force team is arranged at this EPA level being the core of pursuing the implementation; namely, composed of AEDOs, AEDC being the leader and RDP irrigation officer as the technical advisor. The team may ask advices from crops officer at RDP as far as crops are concerned and when approaching planting season. Overall timeframe per project is suggested in the following table:

**Table 7.2.1 Overall Timeframe per Project**

| Item | May | Jun | July | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|
| Kick-off – Planning WS | | | | | | | |
| Construction | | | | | | | |
| Monitoring & Eva. | | | | | | | |
| Planting | | | | | | | |
| Irrigation | | | | | | | |
| Harvesting | | | | | | | |
| Rain-fed Agriculture | | | | | | | |

## 7.2.2 Implementation Schedule

This smallholder irrigation development program is to cover whole country. There are in fact some EPAs which have very little potential for gravity stream diversion as in the cases that they are located in the floor of the Rift Valley. In this case, number of AEDOs who are to be trained in smallholder irrigation development should be reduced and in turn the allocation be given to other EPAs having high potential. Therefore, some of the EPAs might be completely dropped from the training pipeline for smallholder irrigation development, but the smallholder irrigation program itself is basically to cover whole country at least at RDP level.

Available time for administering necessary trainings at the beginning of dry season may be about one month only. Developing smallholder irrigation project in a participatory way needs enough lead-time with the concerned farmers. Enough time should be allocated to develop the projects on the ground. Therefore it is recommended that trainings should be completed within one month which could accommodate three batches of one-week AEDO trainings plus a TOT which should also

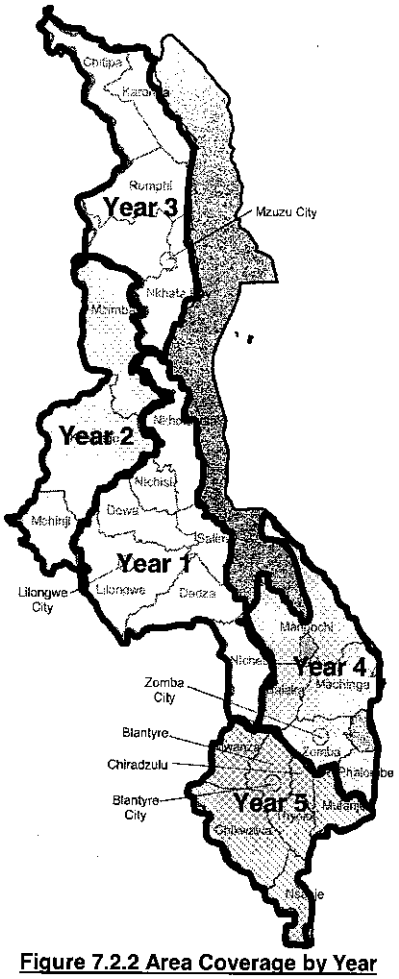



**Figure 7.2.2 Area Coverage by Year**

work as management meeting.

**Table 7.2.2 Program Schedule by Year**

| Region | ADD | RDP | Potential | EPA | Total EPAs | Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North | Karonga | Chitipa | High | 6 | 27 | 3 | | | | | |
| | | Karonga | Middle | 9 | | | | | | | |
| | Mzuzu | Rumphi/N.Mzimba | H | 5 | | | | | | | |
| | | Nkhata Bay | H | 7 | | | | | | | |
| | | Central Mzimba | M | 19 | 31 | 2 | | | | | |
| Central | Kasungu | Kasungu | M | 6 | | | | | | | |
| | | *Ntchisi* | *H* | *4* | | | | done | | | |
| | | *Dowa* | *M* | *9* | | | | | | | |
| | | Mchinji | M | 6 | | | | | | | |
| | Salima | Nkhotakota | Low | 4 | 31 | 1 | | | | | |
| | | Salima | L | 4 | | | | | | | |
| | Lilongwe | Lilongwe West | M | 12 | | | | | | | |
| | | *Lilongwe East* | *M* | *7* | | | done | | | | |
| | | *Dedza East (Dedza Hills)* | *M* | *6* | | | | | | | |
| | | Dedza West (Thiwi-Lifidzi) | M | 4 | | | | | | | |
| | | Ntcheu | H | 7 | | | | | | | |
| South | Machinga | Mangochi | M | 10 | 31 | 4 | | | | | |
| | | Balaka | L | 6 | | | | | | | |
| | | Machinga | L | 8 | | | | | | | |
| | | Zomba | H | 7 | | | | | | | |
| | Blantyre | Neno | M | 2 | 34 | 5 | | | | | |
| | | Mwanza | M | 2 | | | | | | | |
| | | Blantyre | M | 4 | | | | | | | |
| | | Phalombe | H | 2 | | | | | | | |
| | | Chiradzulu | M | 3 | | | | | | | |
| | | Mulanje | M | 4 | | | | | | | |
| | | Thyolo | H | 6 | | | | | | | |
| | Shire Valley | Chikwawa | L | 6 | | | | | | | |
| | | Nsanje | L | 5 | | | | | | | |

Note1: Underlined RDPs (in Italic) have been already undertaken during the Study, therefore excluded.
Note2: Hatched RDPs are located in the Floor of Rift Valley, therefore low potential.

The 2nd year of verification projects undertook 26 EPAs which together consisted of 14% of whole EPAs. To train the AEDOs from the 26 EPAs took about 3 weeks; 1 week x 2 batches of AEDO trainings plus one week TOT. Having one month for the trainings and the experience which covered 14% of whole EPAs during verification, the smallholder irrigation development program should be given 5-year time to cover whole country. Figure 7.2.2 and Table 7.2.2 present the program schedule to cover whole country over the 5-year time, starting at Lilongwe area, proceeding to northward and then southward (though the MOA gave a total number of 186 for EPAs, accumulated EPAs given by ADD was 180, thereby the number in Table 7.2.2 was based on 180 which may increase).

### 7.2.3 Implementation Requirements

Major requirements necessary for the above high performance implementation of the smallholder irrigation program are categorized as: 1) Program Management Unit, 2) Trainings, 3) Tools Provision, 4) Study Tour, 5) Production of Dissemination Materials, and 6) Project Monitoring, which are conceptually shown

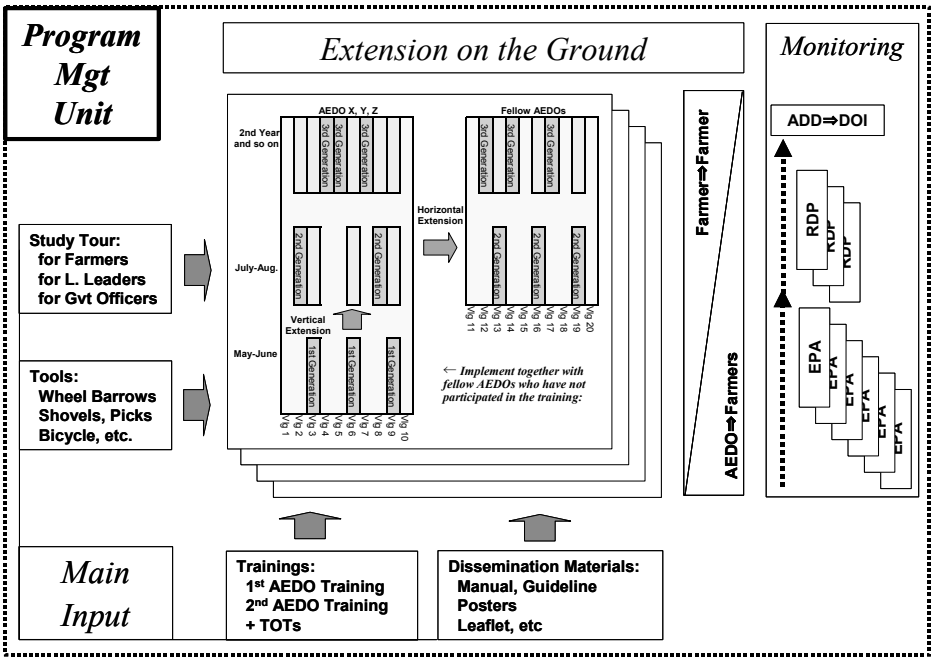



**Figure 7.2.3 Requirement of Smallholder Irrigation Development**

in the Figure 7.2.3.

### 1) Program Management Unit

The Management Unit should be equipped with such experts as; 1) Program Management cum Human Resource Development, 2) Irrigation Development, 3) Agriculture Development, and 4) Project Monitoring cum Logistics, and for office necessaries, 2 x computer, 2 x printer, 1 x photocopier, 1 x secretary, 2 x 4WD, etc. A year round assignment of the four experts is presented below:

**Table 7.2.3 Assignment Schedule for the Expert of Program Management Unit**

| Expertise | MM | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Program Mgt/ HRD | 9.5 | | | | | | | | | | | | |
| Irrigation Development | 6.0 | | | | | | | | | | | | |
| Agriculture Development | 10 | | | | | | | | | | | | |
| Prj Monitoring/ Logistic | 8.5 | | | | | | | | | | | | |

The expert of Program Management cum Human Resource Development leads the unit as well as in charge of administering necessary trainings. Irrigation Development expert should be deployed as the dry season starts and may stay until September. Agriculture Development expert should start his/her assignment when planting activity is to start and stay until almost next dry season's on-set, looking after rainy season agriculture as well. Though irrigation is pursued only during dry season, agriculture components such as compost manure, botanical pesticide, etc. should be promoted and monitored throughout year. In this regard, the Agriculture Development expert should be assigned not only during dry season but also covering rainy season. The Project Monitoring cum Logistics should be assigned from the beginning of dry season to the harvest.

### 2) Trainings

Training necessary for disseminating smallholder irrigation development is basically categorized in two: training of trainers (so called TOT) and AEDO training. The AEDO training course should be carried out two times; namely, one is AEDO training proper and the other is its follow up training. The training of trainers should be administered before each of the AEDO trainings, thus this Study proposes four courses of training altogether in a season:

**Table 7.2.4 Proposed Training Course and Time**

| Training Course | Proper Time |
|---|---|
| 1. Training of Trainers (TOT) for AEDO Training Course | April |
| 2. 1st AEDO Training Course | April – May |
| 3. Refresher Training of Trainers (TOT) for Follow up AEDO Training | September |
| 4. 2nd (Follow up) AEDO Training Course | September – October |

Training of Trainers (TOT) for AEDO training course is to equip trainers with necessary skills of leading the sessions of the AEDO training. There are 12 trainers who have been trained under this Study, who are composed of AEDOs, RDP irrigation officers, and counterparts to this Study assigned by DOI. Provided that they could be once again engaged in the AEDO training, this TOT is regarded as refresher course and also should be a kind of management meeting that is to well define necessary arrangement for the AEDO training.

The 1st AEDO training course is the main one during which all the necessary trainings will be given to the concerned AEDOs. AEDOs are expected to learn what and how they should do to promote smallholder irrigation development in their jurisdictions. This AEDO training should mainly concentrate on irrigation since too many subjects may not be well imparted. Agriculture components are in fact important but at this stage only compost manure should be incorporated because irrigation exploits soil fertility so that always improving soil characteristics should be undertaken together with irrigation.

Training of Trainers (TOT) is once again held before another AEDO training which is the follow up of the 1st AEDO training. This TOT can be defined as a refresher curse since they have been trained before the first AEDO training, and finalizes the follow up AEDO training course contents. During the 1st AEDO training, an action plan is to be made by all the participant AEDOs and also at EPA as well as RDP levels, and the action plan should be reported in this follow up AEDO training, or the first AEDO training would result in little action on the ground. The follow up training should also incorporate agriculture components, catchment area conservation component, etc.

Smallholder irrigations are expected to commence at the beginning of each dry season and come to an end as the dry season comes to the end. A cycle of construction, planting, irrigation, harvesting and dismantling the weirs is repeated every dry season. Therefore, the proper time to administer the trainings is: April for the first TOT, April/May for the AEDO training, September for refresher TOT, and September/October for the follow up AEDO training. Overall schedule with irrigation development is illustrated in the following table:

**Table 7.2.5 Overall Timeframe for Training**

| Item | Apr | May | Jun | July | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|
| TOT for 1st Batch | | | | | | | | |
| **1st Batch Training** | | | | | | | | |
| TOT for 2nd Batch | | | | | | | | |
| **2nd Batch Training** | | | | | | | | |
| Construction | | | | | | | | |
| Planting | | | | | | | | |
| Irrigation | | | | | | | | |
| Harvesting | | | | | | | | |

Three AEDOs plus AEDC per each EPA will be invited to the training courses. As aforementioned, AEDO training will be held two times in a season inviting same participants; first one being the irrigation training proper and second one being the follow up + agriculture components. According to the target EPAs by year, number of participants shown in Table 7.2.6 will be given the training: Including participants from concerned RDP and ADD, there will be 120 to 170 participants a year, and accumulated number including trainers will be about 1,500. In addition, equipment to run the training course such as projector, generator, flip chart, white board, etc. should be procured.

Contents of the trainings refer to the ones administered during the verification on dissemination and necessary materials are comprehensive guideline, technical manual, leaflet, posters, etc., which are already available from this Study. Upon small modifications from the original contents such as incorporation of compost in the 1st training, following tables present the training schedule and major modules for the two AEDO trainings.

**Table 7.2.6 Number of Training Participants**

| Year | 1 | 2 | 3 | 4 | 5 | Total | Remarks |
|---|---|---|---|---|---|---|---|
| No. of ADD | 2 | 2 | 2 | 1 | 2 | 9 | |
| No. of RDP | 5 | 3 | 4 | 4 | 9 | 25 | |
| No. of EPA | 31 | 31 | 27 | 31 | 34 | 154 | |
| 1st Training | | | | | | | |
| AEDC | 31 | 31 | 27 | 31 | 34 | 154 | 1 each |
| AEDO | 93 | 93 | 81 | 93 | 102 | 462 | 3 each |
| RDP | 15 | 9 | 12 | 12 | 27 | 75 | 3 each |
| ADD | 6 | 6 | 6 | 3 | 6 | 27 | 3 each |
| sub-total | 145 | 139 | 126 | 139 | 169 | 718 | Net |
| 2nd Training | | | | | | | follow-up training |
| AEDC | 31 | 31 | 27 | 31 | 34 | 154 | 1 each |
| AEDO | 93 | 93 | 81 | 93 | 102 | 462 | 3 each |
| RDP | 15 | 9 | 12 | 12 | 27 | 75 | 3 each |
| ADD | 6 | 6 | 6 | 3 | 6 | 27 | 3 each |
| sub-total | 145 | 139 | 126 | 139 | 169 | 718 | Net |
| Total | 290 | 278 | 252 | 278 | 338 | 1,436 | Accumulated |
| Trainers | | | | | | | |
| 12 x 3 batches | 36 | 36 | 36 | 36 | 36 | 36 | same personnel |
| 12 x 3 batches | 36 | 36 | 36 | 36 | 36 | 36 | same personnel |
| Total incl. Trainers | 362 | 350 | 324 | 350 | 410 | 1,508 | |

**Table 7.2.7 Course Schedule of 1st AEDO Training**

| Day | Module | Contents | Class/ Field |
|---|---|---|---|
| 1 | 1 | Program Orientation | Classroom |
| | 2 | Overview of Smallholder Irrigation Development<br>・ DOI's Vision, Mission & Objectives<br>・ Irrigation Development in Malawi<br>・ Introduction to Smallholder Irrigation Development Study<br>・ Overview of Smallholder Irrigation Facilities and Structures<br>・ Implementation Mechanism of Smallholder Irrigation Development | Classroom |
| 2 | 3 | *Smallholder Irrigation Development Proper, Observation* | *Field* |
| 3 | 3 | Smallholder Irrigation Development Proper<br>・ Identification of Suitable Gravity Diversion Sites<br>・ Weir Type and Construction Method<br>・ Canal Alignment and Construction<br>・ Ancillary Facilities<br>・ On-farm Irrigation Method<br>・ Soil Improvement, Compost Manure Introduction | Classroom |
| 4 | 3 | *Smallholder Irrigation Development Proper, Practice*<br>・ *Practice of a Weir Construction*<br>・ *Practice of Canal Alignment with Line-level* | *Field* |
| 5 | 4 | Problems to be encountered and Possible Solutions | Classroom |
| | 5 | Entry Planning (Action Plan Formulation)<br>・ Entry Planning Orientation and Presentation<br>・ Dissemination Material (posters, leaflet, picture stories) | Classroom |
| | 6 | Training Evaluation and Closing, in Classroom | Classroom |

***An example of classroom training***

***An example of field training (practice)***

**Table 7.2.8 Course Schedule of 2nd (follow-up) AEDO Training**

| Day | Module | Contents | Class/ Field |
|---|---|---|---|
| 1 | 1 | Program Orientation | Classroom |
| | 2 | Presentation of Smallholder Irrigation Development<br>・ Achievement against the Targets set during 1st AEDO Training<br>・ Problems and Actions Taken (group discussion) | Classroom |
| 2 | 3 | Local Resources Based Agriculture Development<br>・ A quick Maturing Compost (Bocashi)<br>・ Liquid Fertilizer<br>・ Botanical Pesticide<br>・ Bamboo Liquid<br>・ Improved Grain Storage | Classroom |
| | 4 | A Mean of Conserving Catchment Area<br>• Energy Efficient Cooking Stove (conserving fuel wood) | Classroom |
| 3 | 3 | *Local Resources Based Agriculture Development, Practice*<br>・ *A Quick Maturing Compost (Bocashi)*<br>・ *Improved Grain Storage* | *Field* |
| 4 | 4 | *A Mean of Conserving Catchment Area; Cooking Stove, Practice* | *Field* |
| | 5 | *Smallholder Irrigation Development: On-farm Irrigation, Observation* | *Field* |
| 5 | 6 | Gender, and HIV/ AIDS | Classroom |
| | 7 | Entry Planning and Output Presentation; mainly Agriculture C., in Classroo<br>・ Entry Planning Orientation, and its Presentation | Classroom |
| | 8 | Training Evaluation and Closing, in Classroom | Classroom |

### 3) Tools Provision

Though the smallholder irrigation development program does not provide foreign materials such as cement, ballast, iron bars, etc., essential tools that will be required for the construction of irrigation facilities should be arranged. Tools necessary for the construction per EPA are shown in the Table 7.2.9 including stationeries for the EPA and bicycles for the mobility of AEDOs. Total amount of the tools per EPA is about MK 270,000 (U$2,460). The item and quantity have been based on the experiences from the verification project. These tools will be provided to EPA, and upon request from the farmers, the EPA will lend out and upon

**Table 7.2.9 Necessary Tools for the Construction per EPA**

| Item | U. Price, MK | Quantity | Price, MK | Remarks |
|---|---|---|---|---|
| **Tools** | | | | |
| Panga | 225 | 10 | 2,250 | |
| Hoe | 275 | 10 | 2,750 | |
| Shovel | 995 | 10 | 9,950 | |
| Clober | 650 | 5 | 3,250 | |
| Pick | 750 | 10 | 7,500 | |
| File | 255 | 5 | 1,275 | |
| Wheel barrow | 5,950 | 10 | 59,500 | |
| Hammers(14lb.) | 1,995 | 5 | 9,975 | |
| Axe | 650 | 3 | 1,950 | |
| Saw(26") | 995 | 3 | 2,985 | |
| Bow saw | 1,150 | 3 | 3,450 | |
| Gun boot | 1,650 | 40 | 66,000 | |
| Measuring tape | 895 | 5 | 4,475 | |
| Line level | 350 | 5 | 1,750 | |
| String | 625 | 10 | 6,250 | |
| Push bike | 10,800 | 6 | 64,800 | |
| Pump | 450 | 6 | 2,700 | |
| Sub-total | | | 250,810 | |
| **Stationaries** | | | | |
| Paper(A4), rim | 650 | 2 | 1,300 | |
| Hard cover note | 295 | 10 | 2,950 | |
| Level arch file | 295 | 3 | 885 | |
| Calculator | 1,950 | 2 | 3,900 | |
| Plastic bag | 100 | 10 | 1,000 | |
| Ball point pen | 25 | 10 | 250 | |
| Pencil | 8 | 10 | 75 | |
| Shapener | 50 | 5 | 248 | |
| Punch | 950 | 1 | 950 | |
| Ruler | 35 | 5 | 175 | |
| Paper glue | 295 | 2 | 590 | |
| Colour pencils, set | 700 | 2 | 1,400 | |
| Paper Cutter | 400 | 2 | 800 | |
| Thick A-4 Paper | 94 | 20 | 1,880 | for picture story |
| Staple machine | 1,150 | 1 | 1,150 | |
| Flip chart | 495 | 2 | 990 | |
| Marker pen | 450 | 2 | 900 | |
| Sub-total | | | 19,443 | |
| G. Total per EPA in MK | | | 270,253 | |
| G. Total per EPA in US$ | | | 2,457 | 1US$=MK110 (Dec. '04) |

completion of the work the tools should be returned for the use of next sites.

### 4) Study Tours

Study tour provides learning venue for the potential farmers. Seeing is believing, so that the visitors will be very motivated by seeing their peers' development and also the host becomes proud of showing their achievement, thereby they become more active. Most of the farmers, especially women, are very restricted in terms of their mobility. Arranging an opportunity to see somewhat outside world will widen the farmers' view. In this regard, during early stage of the development and also during on-farm irrigation, study tour should be arranged for the farmers especially for women.

Aside from the farmers' study tour, tours for local leaders such as village headman, group VH, TA should also be arranged since they are expected to be catalyst to further disseminate smallholder irrigation development. Government officers such as AEDOs/AEDCs and in case inclusive of RDP officers should be given the opportunity of study tour as well. In fact there are many AEDOs who have seldom been to other sites beyond their RDP, so that the study tour for such officers will widen their views.

There should be 4 mini buses, 18 passengers each. Service in two months of the 4 minibuses can organize about 200 study tours (25days/month x 2 months x 4 minibuses). As about 300 sites or more are expected to be developed per year, about 2/3 of the sites are to be given the opportunity. Sites which has not been given the opportunity during the early stage of the development should be considered study tour during planting season, so that most of the site will be given at least one opportunity.

### 5) Dissemination Materials

Materials required for participants to the AEDO trainings are comprehensive guideline and technical manuals for their training purpose, and leaflet and posters for wider dissemination purpose. These materials should be reproduced according to the requirement of the participants. Modification may have to be required upon the comments from the participant, and if any it should be considered in the following year. As per picture stories, the participants to the AEDO trainings are to produce by themselves during the 1$^{st}$ AEDO training. The program as mentioned in the Table 7.2.9 should provide necessary materials such as thick paper, color pencil, glue, etc.

### 6) Project Monitoring and Evaluation

RDP irrigation officers should closely monitor and also provide technical advices as needs arise. Most RDP irrigation officers have motorcycle. However those motor cycles are very old and very often require rehabilitation and maintenance. Another problem is fuel which reimbursable mileage per month is only 250km. Therefore, the smallholder irrigation development program should provide spare parts for the bike as well as fuel to the RDP irrigation officers.

Base data recording should be done by the AEDOs in charge. They are expected to fill a site profile, simple one or two A-4 sheet(s), consisting of type and dimension of diversion weir,

canal length, developed area and harvested area, numbers of farmer members and landowners, crops planted, production by crop, problems, etc. The site profile should be consolidated at the EPA level. Upon consolidation, the AEDC should forward the summary to RDP, and then from the RDP to ADD. ADD should forward the summary to the headquarters of DOI. The Program Management Unit should make periodical visits to EPAs and RDPs to closely follow up the monitoring.

One thing remarked is that there may be farmer-to-farmer extension taking place as proceeding. Even during verification projects, there were several sites which were started by the farmers by just seeing their neighbuor farmers achievement. This farmer-to-farmer extension could be expected even during 1st year but mostly from 2nd year. In the second year, the Program Management Unit will be in next area, so that the reporting from EPA, RDP and then ADD and DOI should be supervised by the responsible officers such as DADO, PM, etc.

An evaluation meeting should be held by calling all the concerned AEDCs, RDP irrigation and crop officers, and ADD irrigation and crop officers. This evaluation meeting could be held in February because by then all the developed area will have been harvested, so that the Program Management Unit as well as relevant officers can know how much areas have been wetted and actually harvested in the year (by the time of 2nd AEDO training, no harvest has come yet). Also, during this evaluation meeting, AEDCs should report how many compost manures for the rainy season have been prepared by then. Since irrigation in most cases uses same land two times a year, compost application is very important so that the compost application should always be closely monitored.

### 7) Cost Required

Based on the requirements discussed above, necessary costs excluding experts' remuneration are summarized in the Table 7.2.10 and detailed in Table 7.2.11. Procurement such as 4WD, minibus, office equipment, training equipment, etc. should be done at the beginning of 1st year. These equipment will be about MK24,450,000. Necessary cost for running the program per year ranges from MK23,000,000 to MK28,000,000, of which MK4,000,000 to MK4,900,000 is for the trainings and MK7,800,000 to MK9,700,000 is for the tools. Estimated grand total for the 5-year inclusive of the 1st year procurement is about MK147,000,000 or US$1,339,000 (excluding experts' remuneration for the program management unit).

**Table 7.2.10 Summary of the Procurement and Operation Cost**

| Component | Unit | Procurement | yr 1 | yr 2 | yr 3 | yr 4 | yr 5 | Total | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Project Management Unit | MK | 11,730,000 | 3,680,000 | 4,280,000 | 4,280,000 | 4,280,000 | 4,280,000 | 32,530,000 | |
| | US$ | 106,636 | 33,455 | 38,909 | 38,909 | 38,909 | 38,909 | 295,727 | |
| Study Tour | MK | 10,000,000 | 2,500,000 | 2,500,000 | 2,500,000 | 2,500,000 | 2,500,000 | 22,500,000 | |
| | US$ | 90,909 | 22,727 | 22,727 | 22,727 | 22,727 | 22,727 | 204,545 | |
| Training | MK | 500,000 | 4,374,800 | 4,247,600 | 3,972,000 | 4,247,600 | 4,883,600 | 22,225,600 | |
| | US$ | 4,545 | 39,771 | 38,615 | 36,109 | 38,615 | 44,396 | 202,051 | |
| Tools (MK270,000/EPA) | MK | 0 | 8,670,000 | 8,770,000 | 7,790,000 | 8,770,000 | 9,680,000 | 43,680,000 | |
| | US$ | 0 | 78,818 | 79,727 | 70,818 | 79,727 | 88,000 | 397,091 | |
| Dissemination Material | MK | 0 | 800,000 | 800,000 | 800,000 | 800,000 | 800,000 | 4,000,000 | |
| | US$ | 0 | 7,273 | 7,273 | 7,273 | 7,273 | 7,273 | 36,364 | |
| Project Monitoring & Evaluation | MK | 0 | 1,801,600 | 1,166,800 | 1,461,000 | 1,466,800 | 3,088,600 | 8,984,800 | |
| | US$ | 0 | 16,378 | 10,607 | 13,282 | 13,335 | 28,078 | 81,680 | |
| Contingency (10% of above) | MK | 2,223,000 | 2,182,640 | 2,176,440 | 2,080,300 | 2,206,440 | 2,523,220 | 13,392,040 | |
| | US$ | 20,209 | 19,842 | 19,786 | 18,912 | 20,059 | 22,938 | 121,746 | |
| Total | MK | 24,453,000 | 24,009,040 | 23,940,840 | 22,883,300 | 24,270,840 | 27,755,420 | 147,312,440 | |
| | US$ | 222,300 | 218,264 | 217,644 | 208,030 | 220,644 | 252,322 | 1,339,204 | |

**Table 7.2.11 Detail of the Procurement and Operation Cost**

| Component | Unit | Procurement | Year | | | | | Total | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Project Management Unit | | to be done in yr 1 | yr 1 | yr 2 | yr 3 | yr 4 | yr 5 | | |
| 2 x 4WD | MK | 10,000,000 | | | | | | 10,000,000 | |
| 3 x computer | MK | 900,000 | | | | | | 900,000 | 2 Desktop & 1 Laptop |
| 2 x printer | MK | 300,000 | | | | | | 300,000 | |
| 1 x photo copier | MK | 300,000 | | | | | | 300,000 | |
| 1 x LAN | MK | 50,000 | | | | | | 50,000 | |
| 1 x telephone w/ fax | MK | 180,000 | | | | | | 180,000 | |
| 1 x secretary | MK | | 360,000 | 360,000 | 360,000 | 360,000 | 360,000 | 1,800,000 | |
| 2 x driver | MK | | 720,000 | 720,000 | 720,000 | 720,000 | 720,000 | 3,600,000 | |
| 2 x driver lodging | MK | | - | 600,000 | 600,000 | 600,000 | 600,000 | 2,400,000 | 200 nights/year |
| Fuel & car maintenance | MK | | 2,000,000 | 2,000,000 | 2,000,000 | 2,000,000 | 2,000,000 | 10,000,000 | 200km x 20D/Mx12Mx2LC/5km/l |
| Office operation&M | MK | | 600,000 | 600,000 | 600,000 | 600,000 | 600,000 | 3,000,000 | copy, toner, etc. |
| Sub-total | MK | 11,730,000 | 3,680,000 | 4,280,000 | 4,280,000 | 4,280,000 | 4,280,000 | 32,530,000 | |
| Study Tour | | | | | | | | | |
| 4 x mini bus | MK | 10,000,000 | | | | | | 10,000,000 | 4 months per year |
| 4 x driver | MK | | 1,000,000 | 1,000,000 | 1,000,000 | 1,000,000 | 1,000,000 | 5,000,000 | including lodging |
| Fuel | MK | | 1,500,000 | 1,500,000 | 1,500,000 | 1,500,000 | 1,500,000 | 7,500,000 | 150kmx120daysx4bus/5km/l |
| Sub-total | MK | 10,000,000 | 2,500,000 | 2,500,000 | 2,500,000 | 2,500,000 | 2,500,000 | 22,500,000 | |
| Training | | | | | | | | | |
| Participant (lodging&allowance) | MK | | 2,784,000 | 2,668,800 | 2,419,200 | 2,668,800 | 3,244,800 | 13,785,600 | MK1600/night/person |
| Trainer (lodging&allowance) | MK | | 460,800 | 460,800 | 460,800 | 460,800 | 460,800 | 2,304,000 | MK1600/night/person |
| Trainer (remuneration) | MK | | 240,000 | 240,000 | 240,000 | 240,000 | 240,000 | 1,200,000 | MK2000/day/person (2x5daysx12T) |
| Material Production | MK | | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | 1,500,000 | |
| Facilities | MK | | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | 1,500,000 | Training Center |
| Transportation (to the venue) | MK | | 290,000 | 278,000 | 252,000 | 278,000 | 338,000 | 1,436,000 | MK1000 per person |
| Generator | MK | 150,000 | | | | | | 150,000 | |
| Projector | MK | 250,000 | | | | | | 250,000 | |
| Flip chart, white board, etc. | MK | 100,000 | | | | | | 100,000 | |
| Sub-total | MK | 500,000 | 4,374,800 | 4,247,600 | 3,972,000 | 4,247,600 | 4,883,600 | 22,225,600 | |
| Tools (MK270,000/EPA) | MK | | 8,370,000 | 8,370,000 | 7,290,000 | 8,370,000 | 9,180,000 | 41,580,000 | |
| Delivery (LS) | MK | | 300,000 | 400,000 | 500,000 | 400,000 | 500,000 | 2,100,000 | |
| Sub-total | MK | 0 | 8,670,000 | 8,770,000 | 7,790,000 | 8,770,000 | 9,680,000 | 43,680,000 | |
| Dissemination Material | | | | | | | | | |
| Poster | MK | | 600,000 | 600,000 | 600,000 | 600,000 | 600,000 | 3,000,000 | |
| Leaflet | MK | | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 1,000,000 | |
| Sub-total | MK | 0 | 800,000 | 800,000 | 800,000 | 800,000 | 800,000 | 4,000,000 | |
| Project Monitoring & Evaluation | | | | | | | | | |
| Spare parts to RDP | MK | | 500,000 | 300,000 | 400,000 | 400,000 | 900,000 | 2,500,000 | MK50,000 x 2bikes per RDP |
| Fuel for RDP | MK | | 1,000,000 | 600,000 | 800,000 | 800,000 | 1,800,000 | 5,000,000 | MK200,000 per RDP per year |
| Evaluation Meeting | MK | | 249,600 | 220,800 | 216,000 | 220,800 | 321,600 | 1,228,800 | MK1600/nightx3nights |
| Transportation to Eva. Mtg | MK | | 52,000 | 46,000 | 45,000 | 46,000 | 67,000 | 256,000 | MK1000 per person |
| Sub-total | MK | 0 | 1,801,600 | 1,166,800 | 1,461,000 | 1,466,800 | 3,088,600 | 8,984,800 | |
| Above Total | MK | 22,230,000 | 21,826,400 | 21,764,400 | 20,803,000 | 22,064,400 | 25,232,200 | 133,920,400 | |
| Contingency (10% of above) | MK | 2,223,000 | 2,182,640 | 2,176,440 | 2,080,300 | 2,206,440 | 2,523,220 | 13,392,040 | |
| Total in MK | MK | 24,453,000 | 24,009,040 | 23,940,840 | 22,883,300 | 24,270,840 | 27,755,420 | 147,312,440 | |
| Total in US$ (1US$ = MK110) | US$ | 222,300 | 218,264 | 217,644 | 208,030 | 220,644 | 252,322 | 1,339,204 | |

## 7.3 Alternative Dissemination Mechanism (Minimum Cost Implementation)

As it has been described above, the high performance dissemination mechanism is programmed to disseminate smallholder irrigation development to all over the country in five years. It may be, however, true that the required cost estimated for the program is so high that the government of Malawi could be stranded to allocate in time. On the other hand, it is also true that according to the experience from the verification project, smallholder irrigation technique can be spread without intensive care such as trainings and study tours as long as extension officers and farmers get motivated with the ideas of how to develop smallholder irrigation. With this regard, here an alternative dissemination program whose required cost is minimum is presented.

### 7.3.1 Program Management Unit

Program Management Unit particularly for smallholder irrigation development should be maintained with minimum person-month schedule. It would be necessary that the Management Unit should be equipped with such experts as: 1) Program Management cum Human Resource Development and 2) Project Monitoring cum Logistics. The office of the

unit should be situated in the headquarters of DOI, and the DOI should provide secretariat function to the unit. Experts of irrigation development and agriculture development arranged in the high performance mechanism are not specifically assigned in this case but officers specialized in such expertise in relevant ADD and RDP should work well hand in hand with the project management unit.

### 7.3.2 Publicity Activities

Under the minimum cost implementation arrangement, there will be no program for trainings. No study tours by using mini-bus and no tools will be provided to EPAs either. Study tour will be substituted by on-foot field day. The farmers should arrange construction tools, and in most cases agriculture tools such as hoe and panga only will be available. Expecting the potential of the extension officers and farmers in the country, this minimum cost dissemination program centers on publicity activities: provision of leaflet and posters and broadcasting radio program.

The leaflet and posters prepared by the Study can be useful dissemination tools. The Management Unit will print leaflet and distribute to ADDs and ask ADDs to distribute the leaflet up to EPA level. ADD and RDP staff regularly meet every month and also RDP staff visits EPA at least once per month when they distribute the salary of EPA staff. Therefore, the bundle of leaflet can be distributed from ADD to EPA without incurring additional cost. The posters can be reached to all of the 186 EPAs in the same way and the posters can also be utilized as picture stories. The posters were made with a set of five A-2 sheets. Since No. 2 to No. 5 of the posters show the process of how to construct weir, how to make bocashi compost manure and how to make improved cooking stove, extension officers can use these as explanatory tools i.e. picture stories.

Radio broadcasting can be another way of publicity activity. In Malawi, radio program for agriculture is produced by Agriculture Communication Branch (ACB) office and broadcast through Malawi Broadcasting Cooperation (MBC) everyday except Saturday with 5 to 50 minutes each. Most of the farmers nowadays have radio. According to a baseline survey carried out under this Study, 43% of the 360 sample farmers own radio, and by site 20% to as high as 60% of the farmers answered that they listen to the agriculture program. The average frequency to listen to the program was around 3 times a week. The program management unit should contact ACB office which will be assigned to produce publicity program of smallholder irrigation program. The publicity program will be broadcast by MBC.

### 7.3.3 Extension Mechanism

This program will not carry out any intensive training for AEDOs, but still utilize the resource persons who are the ones the JICA study team has worked hand in hand through the implementation of the verification project. There can be about 30 resource persons who are AEDO/ AEDC/ irrigation and assistant irrigation officers inclusive of the counterparts from the DOI headquarters. They are already experienced in developing smallholder irrigation, and of them 12 staff have been trained as trainers. These 12 staff are the ideal resource persons to promote smallholder irrigation development.

The program management unit should make necessary arrangement of dispatching these staff, especially the 12 trainers, to their neighboring RDPs to explain the concept and methodology for smallholder irrigation development. These staff further extends the explanatory missions to other RDPs after the neighboring RDPs appear with a lot of developed irrigation sites. The Management Unit will bear the transportation cost and allowances/ lodging of the resource persons since the recurrent budget allocated in each RDP would not be enough sourcing such expenses.

### 7.3.4 Cost Required

In estimating the cost required for this minimum cost implementation, there are some assumptions such as: 1) remuneration of the two experts of program management unit is excluded since they are to be concurrently government officer, 2) vehicles should be arranged by DOI and only fuel cost is born by the program, 3) allowances of irrigation and agriculture experts in the relevant ADD and RDP who are supposed to work with the management unit should be arranged by their office, etc.

In summary of this program, the total project cost is estimated at around MK8.8 million or US$80,000. Provided that the dissemination reaches to cover all the RDPs in 10 years though very much dependent on the motivation of the officers and farmers, the annual cost is calculated at about MK880,000 or US$8,000. Table 7.3.1 shows the breakdown of the required cost. Although the program demands particular development budget apart from recurrent one, it is considered that the required cost is much less than the case of high performance implementation. It is a recommendation that the government of Malawi could seek the source of the project cost from HIPC fund unless any other appropriation would suit the significance of the project.

**Table 7.3.1 Project Cost for The Alternative Dissemination Program**

| Component | U. Price (MK) | Amount | Cost (MK) | Remark |
|---|---|---|---|---|
| Program Management Unit | | | 2,394,000 | |
| Transportation | 7,500 | 260 | 1,950,000 | Distribution of materials, monitoring & evaluation |
| Allowance / Lodging | 1,600 | 90 | 144,000 | |
| Office Equipment | | | 300,000 | Include stationeries |
| Publicity Activities | | | 5,000,000 | |
| Posters | | | 3,000,000 | |
| Leaflet | | | 1,000,000 | |
| Radio Progam Production | 100,000 | 10 | 1,000,000 | |
| Trip of RDP / EPA Officers | | | 569,400 | |
| Transportation | 7,500 | 26 | 195,000 | |
| Allowance / Lodging | 1,600 | 234 | 374,400 | |
| Above Total | | | 7,963,400 | |
| Contingency (10%) | | | 796,340 | |
| Total in MK | | | 8,759,740 | |
| Total in US$ (1US$=MK110) | | | 79,634 | |
| Annual Cost (10 years program) | | | 875,974 | in MK |
| | | | 7,963 | in US$ |

## 7.4 Implementation Disciplines

This sub-chapter presents issues that have to be undertaken in implementing smallholder irrigation development. These issues are based on lessons learnt from the implementation, observation on the field, interviews to the farmers, discussion during workshops, etc.

### 7.4.1 Materials in Locality

The verification projects throughout the 2-year have tried to establish the irrigation facilities in the farmers' locality, which is to utilize the locally available materials as much as possible. Locally available materials are: wooden log, twig, bamboo, reed, clay soil, grasses, etc. Most of the materials are actually available in the locality, and it would rather be easy to list up the foreign materials that the projects had to use. The foreign materials used are: chemical fibered sacks, plastic paper, PVC pipe, and rubber string made from inner part of tire.

Chemical fibered bags were given to Ngoni club and Mtuwanjovu club by the concerned RDP by using HIPC fund. The sacks were aimed to divert the stream water into the canal. Ngoni club received 22 sacks and they also supplemented 14 sacks, while Mtuwanjovu club received 15 out of which they used 10 sacks in 2003. A problem showed up in Ngoni site for which some bags were stolen and the weir became unable to raise the water to the necessary level. The farmers then discarded the bag weir, and opted a brush dam supported by trigonal props. Though chemical fibered bags are very convenient in constructing weir, it is a direct cost, say MK 40 – 50 per sack, and may have a problem of being stolen.


Sand bag dam but finally discarded


Instead of the sand bag dam, A brush dam was finally opted

To minimize leakage from canal bridge and porous canal sections, plastic paper was used. Intake bridge at Mtsetse site and canal bridges at Duwu, Tilime, etc. used plastic paper. Sandy canal sections in Tikolore and Ngoni sites were lined with plastic paper. Since most farmers in those areas have plastic paper, which is for tobacco shed, it was not difficult to avail. For those canal sections, plastic paper could be well used since it is already available in most villages


Plastic paper, already available in r ural area, used for canal bridge

and very effective in term of waterproof.

PVC pipe was provided to Mtuwanjovu site and Msambaimfa site from the concerned RDPs. The PVC pipe for Mtuwanjovu was used for a road crossing, and for Msambaimfa it was for gully passing. Since farmers do not want to buy such foreign material, it is recommended to adopt a local technology instead of using such expensive fabricated material. In case of road crossing, stone protected passage can be applied as in the case of Duwu site, Mankhamba site, etc., unless otherwise the road is not designated one. As per gully passing, canal bridge made of locally available material lined with plastic paper can be applied. Photos below right hand is the canal bridge in Mtsetse site crossing over another stream, which was made of bamboos, twigs, grasses, clay soil, and plastic paper.


Stone made road crossing


Canal bridge made of bamboo, grasses, and thereon plastic paper and clay soil

Rubber string was used in Ngoni site to tie up the trigonal props (see photo below left). The rubber string is made by stripping the inner part of a tire which is very durable and strong. The string is therefore a recycled material from old tire, and the cost is not much expensive; say MK 100 – 200 per 10 pieces x 1 m long. However, this was also stolen in the Ngoni site. To avoid this problem, a string locally made of sisal plant is recommended. This sisal string is very familiar in most of the rural area, and often


Tied up by string made of inner part of tire, but stolen


Sisal string commonly used in rural area

used to tie horizontal members on the grass wall of grain storage. Though the durability of sisal string is not as strong as the tire's one, it can well stand throughout a season.

There are sites located in sloppy topographic land such as Katema, Tikolore, Loyi, Chikhasu, etc. Feeder canals in these areas, which convey water from the main canal to the on-farm, should have a certain protective measures from soil erosion. Farmers themselves have invented measures by utilizing local materials; that are banana sheath lined feeder, mini check dams set up along the feeder, and stone lined feeder.

Summarizing above, irrigation facilities for smallholder farmers could be well constructed by using locally available materials only. Facilities made of locally available materials can also be disseminated from farmer to farmer easily, whereby many farmers can be benefited from such irrigation rather than being waited until someone like outside donor comes. Though PVC pipe and chemical fibered bags are very effective, there is a risk of being stolen and these foreign materials can easily be substituted as the verification project tried. To minimize leakage from canal, clay soil should firstly be searched, and if not available, plastic paper could be used which is already available in the farmers' locality in most cases. The price of the plastic paper is about MK25 per meter and most farmers can actually afford.

### 7.4.2 Canal Alignment with Simple Tool

One of the constraints of why smallholder irrigation has not much been constructed so far is the difficulty of aligning canal according to the contour of the topographic condition. The simplest way of aligning canal may be to follow the water flow by gravity; namely, 1) dig the canal from the diversion point for example a 10 meter distance, 2) let the water flow in the dug canal, 3) deepen the canal and/or shift the canal alignment toward lower side (stream side), if the water does not well run, 4) repeat the process until the canal reaches the planed end point and good water flow in the canal has been achieved.

Letting the water run by gravity into the canal is very simple, but the procedure may end up with too gentle slope of the canal bed and might result in stagnant water in the canal. Otherwise, canal alignment might end up in too close to the stream, narrowing the potential irrigable area unnecessarily. On the other hand, conventional method of setting up canal alignment is to use survey equipment. This method is very accurate. However this method

depends on the availability of the equipment and also requires survey technicians, which in most cases go beyond the capability at the front line office which is EPA.

This Study therefore has devised a simple mean of setting up the canal level by using "line level", which costs only about US$ 3 and is already familiar in the field of land conservation in Malawi. Using line level in aligning canal that should have a constant longitudinal gradient is a bit different from conventional way of usage, but still very simple and not cumbersome at all. Interval of the two poles for the line level should preferably be 5 meter, and one side of the tied points should be 0.5 – 1 cm higher than the other (this differs from conventional usage of the line level). Pole with higher tied point should always be placed foreside, not like conventional alternate placing. 0.5 cm difference in 5 meter gives 1:1000 gradient suitable for gentle topography like dambo, and 1 cm difference gives 1:500 gradient adaptable for sloped topography.

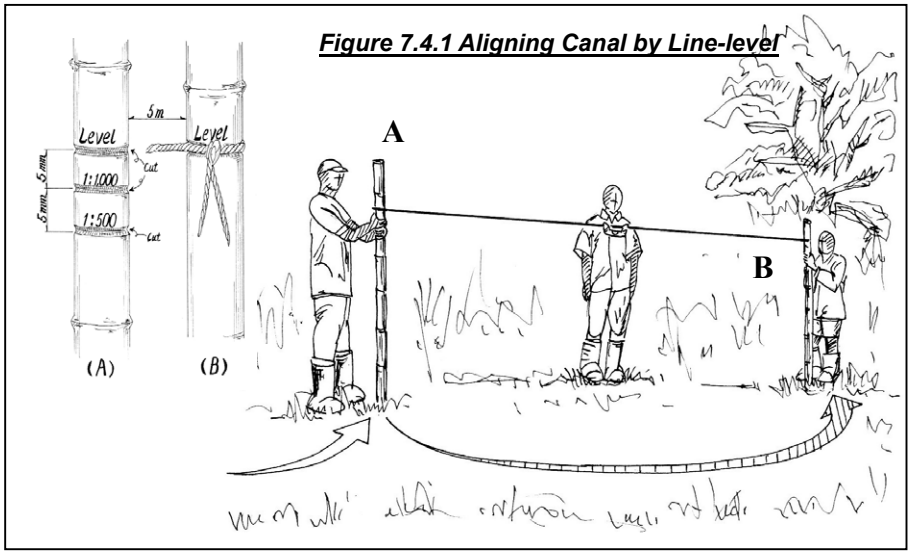




*Figure 7.4.1 Aligning Canal by Line-level*

According to the experiences in the fields from the verification projects, it takes for the farmers only half an hour to get used to the line level. With an on-the-job-training at the site, the farmers easily become able to operate the line level. After getting used to the line level, the Team usually has left the line level to the farmers. The farmers in some sites started canal extension by using the level even without the presence of the AEDOs. This canal alignment with line level greatly helps farmers to have optimal service area that can be best served by gravity. It is therefore recommended that line level should be used in aligning canal in case that the planned canal goes beyond certain length, say 50m.

### 7.4.3 Site Development

Developing smallholder irrigation sites exclusively depends on the natural resource that is water. Needs for irrigation from the farmers therefore do not always meet the commencement of smallholder irrigation project. Potential in terms of stream flow as well as topographic condition, whether gravity diversion is feasible or not within the farmer's self-effort, should be examined as the first step. Difficulty is that discharge record is not available for those relatively small streams. No one knows in fact how much the flow is to

decrease toward the end of dry season.

Though farmers may inform the reduction of the flow towards end of the dry season to about half or about one third, there is a tendency to always underestimate the retarding ratio, which inevitably causes abandonment of part of irrigated area. This may be caused by too much expectation of the development and in cases there might be an expectation of free input such as seed and fertilizer to come with irrigation development. Therefore, it is recommended that at least at first year the development should not be ambitious or rather start with relatively small area; say assuming the flow to reduce to less than one fifth or even to one tenth. Generally, sites located near the source of stream is not retarded much while sites located far downstream from the source usually have bigger retarding rate[2].

There may be a series of potential sites located nearby along a stream. Sometime after farmers have started irrigation development at a specific site, upstream farmers in the same stream may start irrigation development by seeing their peer's development. This may cause water deficit for the downstream site, creating water dispute among the concerned. Stream diversion as its nature always favors upstream sites thereby downstream farmers often result in at the mercy of the upstream farmers even if the downstream farmers who started irrigation earlier express their water right.

Village headman or group VH being involved, they may agree rotational allocation of the water between the sites. This arrangement will work to resolve the water dispute to some extent. However, water flow itself is limited in most of the smallholder irrigation potential sites. An arrangement therefore should be taken into account in case that there are several potential sites located nearby along a stream. The development in this case should always be tried from the upper most reach and then proceed to downstream according to the water availability.

Scramble for water may be expected to become a vital problem if all the villages in an area are to have their own smallholder irrigation schemes at the same stream. It needs to plot a map of all the irrigation schemes and also investigate major use of water (domestic use) in the area, to monitor the progress and to be prepared for a place for discussion (ex. workshop) among the stakeholders in the same stream. Impact on other use of water such as for drinking and washing also needs to be closely examined and as need arises AEDC/AEDO should arrange a venue of discussion wherein the concerned villagers are expected to devise mitigating measures such as rationing of water, reducing of irrigation area, etc.

### 7.4.4 Planting on Water Availability

A recognized method to calculate crop water requirement uses "reference crop evapotranspiration, ETo" established by modified Penman method. Figure 7.4.2 below shows reference crop evapotranspirations at different metrological stations in Malawi by using the modified Penman method[3]. As heading to summer season, the ETo increases with October being the maximum but once rainy season comes, the ETo starts decreasing because

[2] In Bwanje site, the flow at the beginning of July usually becomes less than 10 % after two month.

[3] Source: Agro-climatic Resources Inventory, 1988 and 1990. Years that the data available are: 30, 30, 20, 24, and 14 for Chipita, Chitedze, Chichiri, Karonga, Salima and Ngabu stations respectively.

of less radiation despite the high temperature during rainy season.

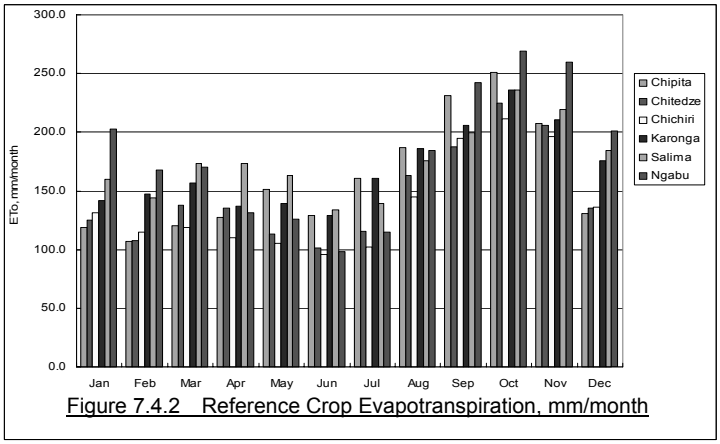



Figure 7.4.2 Reference Crop Evapotranspiration, mm/month

Kc, so called crop coefficient, converts the ETo into the crop evapotranspiration which is the net water requirement specific to the crop planted. The crop coefficient varies chiefly according to the kind of planted crop and the stage of crop growing. The stage usually consists of four; initial, development, mid, and late with the mid being the highest. An example of maize is given in the right figure.

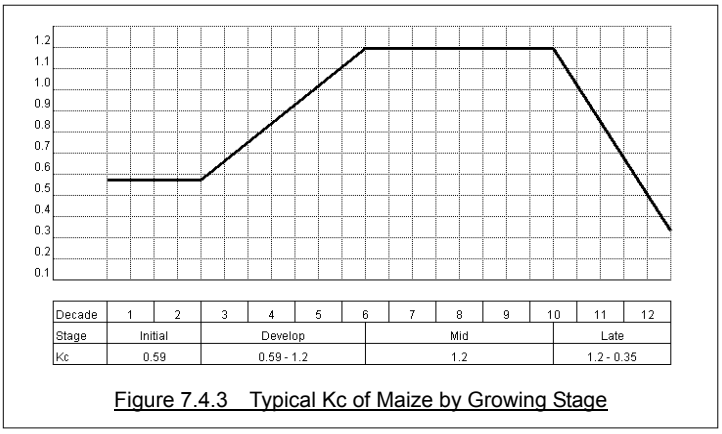



Figure 7.4.3 Typical Kc of Maize by Growing Stage

Dry season irrigated agriculture can start as early as the beginning of May if the farmers start constructing irrigation facilities right after they have finished rainy season's harvesting. On the other hand, latest chance to plant dry season crop may be at August since farmers have to harvest by the beginning of December that is the season to prepare for rainy season agriculture (in case that the land is solely used for irrigation agriculture tried in Tilime and Katema, they can plant anytime).

As briefly presented above, crop water requirement depends on not only crop growth stage but also climatic condition. This means water requirement of a crop will vary depending on when to plant. If mid stage of the crop growth occurs during high ETo period, in most case October, peak water requirement for the irrigation will also increase. Figure 7.4.4 shows net water requirement for maize depending on when it is planted (ETo referred to the meteorological data at Chitedze research station).

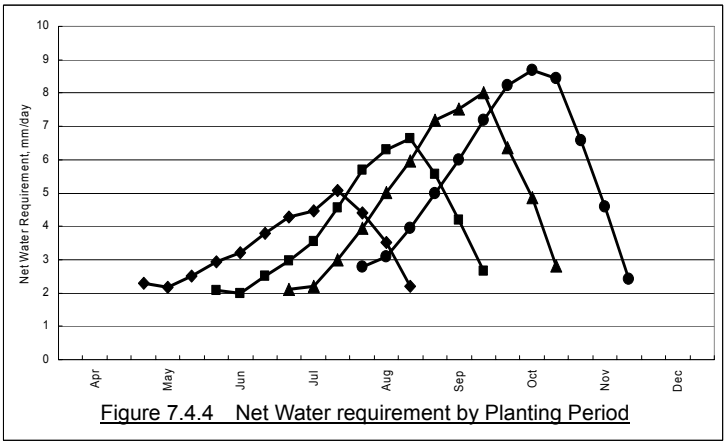



Figure 7.4.4 Net Water requirement by Planting Period

The peak water requirement increases as the planting season becomes late. If maize is planted in early May, the peak net water requirement occurs in late July at 5.07 mm/day while it increases to as much as 8.69 mm/day when it is planted in early August (increased by 71%). Applying irrigation efficiency of 0.5 well suitable for smallholder irrigation, the net water requirement is converted into gross that is the amount to be required at the diversion point.

In case of early May planting, the gross peak is 1.17 l/s/ha taking place in late July while it is 2.01 l/s/ha at mid October when planted in early August (see Table 7.4.1).

Stream discharge becomes less and less toward the end of dry season, and marks the lowest in October or early November in most cases. Almost all the streams suitable for smallholder irrigation development do not have reliable stream flow record, so that no one is sure how much flow decreases as time goes toward October. However, observation at the 1st generation sites indicates that the flows in the leanest period would be less than half to as little as one-fifth as compared to that of the beginning of dry season though it is very much dependent on the vegetation of catchment area.

Table 7.4.1 Peak Water Requirement for maize by Planting Period

| Planting | Peak NWR mm/day | Peak NWR l/s/ha | Gross, l/s/ha Eff. 0.5 | peak period |
|---|---|---|---|---|
| early May | 5.07 | 0.59 | 1.17 | late July |
| early June | 6.63 | 0.77 | 1.53 | late August |
| early July | 8.00 | 0.93 | 1.85 | late September |
| early August | 8.69 | 1.01 | 2.01 | mid October |

NWR: Net Water Requirement

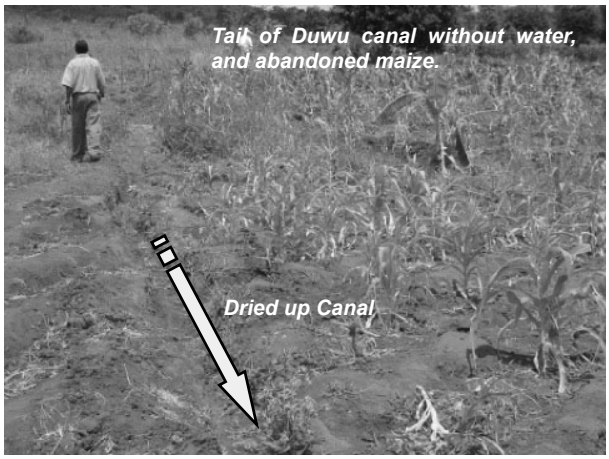
Therefore, late plating faces two difficulties of: 1) more peak water requirement, 2) while less water available in the stream. This case took place in many verification project sites in year 2003. Physical facilities construction was often commenced in June – July due to necessary pre-arrangements of setting up of working group, provision of necessary tools, etc. The planting in year 2003 was consequently done in July to August in many sites.

Most of the sites, on the other hand, have not been fully developed based on the land available due mainly to the time constraint. This has in turn helped many sites of not facing sever water shortage despite the late plating. However, there are sites that the farmers unfortunately abandoned a part or even whole of the crops due to the water shortage. These sites which have faced sever water shortage are as follows:

**Table 7.4.2 Sites hit by Severe Water Shortage in 2003 Dry Season**

| Site | Abandoned | Situation |
|---|---|---|
| Mchiku<br>TA = 0.65 ha | 100% | The water was completely dried up in late October. The farmers therefore abandoned whole crops. |
| Mtsetse<br>TA = 0.25 ha | 20 % | Of the two diversion sites, upstream site was completely dried up in mid October 2003. However the farmers constructed another brush dam further upstream, thereby saved most crops. |
| Duwu<br>TA = 1.56 ha | 30% | The stream water has been getting less and less, especially after farmers started using treadle pump in the upstream area. The water shortage finally had the farmers abandon the tail portion of the irrigable area. |
| Chimphonongo<br>TA = 1.92 ha | - | Though the canal ceased conveying water in early October 2003 due to the water shortage, the farmers started watering crops by watering can that has sometime already been practiced. The farmers thus managed the crops by watering can. |

Of above sites, Mchiku was the worst whereby the farmers had to abandon the whole crops. There was a story specific to this site. Though the Team was always been stressing since the kick-off workshop that JICA does not provide any free seeds and fertilizers, there could have been farmers, according to an information, who thought they were given free seeds and fertilizers as having been done in many NGO and donor assisted projects. This thought might have driven them to report exaggerated stream flow.




Taking above into account, it is strongly recommended: 1) to start planting as early as possible from the view point of water availability in the stream, though temperature in cold places may not allow some crops to be planted, 2) do not develop full potential area in the first year, for example limit the development area to less than half of the potential, because no one is sure of how much stream water becomes finally less, and 3) do not depend on the report of stream flow from the farmers since they might exaggerate the stream flow expecting handouts to be brought by project.

Gross peak water requirements in aforementioned Table 7.4.1 give an idea of how much area can be irrigated by 1 litter flow per second; that is the reciprocal of the requirement. As most smallholder irrigation sites do not have storage pond, the irrigation cannot utilize the flow available during nighttime but daytime only. Therefore half area of the reciprocal should be considered as irrigable area with 1 litter flow per second. Table 7.4.3 can be referred when one needs to know how much area can be irrigated with the available water. Noted is that as the figures in the table are based on climate data in Chitedze research center, adoption to northern and southern parts of Malawi should be modified.

**Table 7.4.3 Irrigable Area with 1 litter Water per Second**

| Planting | Gross, l/s/ha | 1/ Gross | 1/ Gross/ 2 | irrigable area in acre by 1 l/s |
|---|---|---|---|---|
| | Eff. 0.5 | ha/l/s | ha/l/s | |
| early May | 1.17 | 0.85 | 0.43 | 1.01 |
| early June | 1.53 | 0.65 | 0.33 | 0.78 |
| early July | 1.85 | 0.54 | 0.27 | 0.64 |
| early August | 2.01 | 0.50 | 0.25 | 0.59 |

### 7.4.5 Irrigation Method: Basin or Furrow

Smallholder irrigation almost exclusively adopts surface irrigation methods for on-farm. Surface irrigation system conveys water to the farmland by an overland gravity flow. This method is categorized into: 1) basin, 2) furrow and 3) border strip irrigations. Of them, border strip hardly applies to small lands, therefore the discussion below focuses on the first two methods: basin irrigation and furrow irrigation.

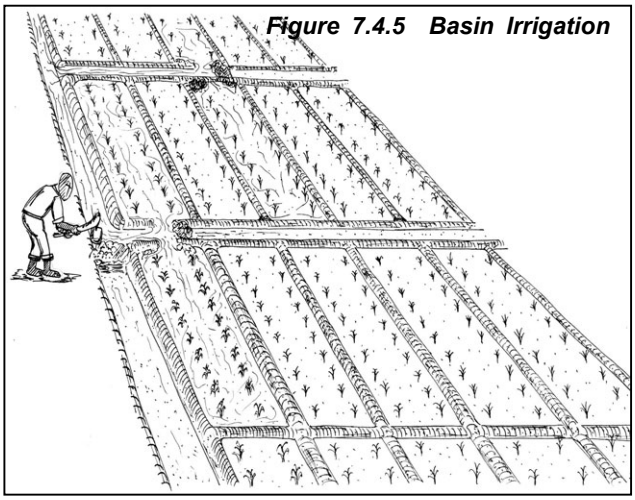


***Figure 7.4.5 Basin Irrigation***

Basin irrigation is often referred to as sunken bed irrigation since the basin is a horizontal area of land surrounded by earthen bunds and totally flooded during irrigation. Basin irrigation is the most common type of surface irrigation, and is now getting familiar as treadle pump is being promoted widely in Malawi. This irrigation method is suited for any kinds of crops such as row crops, orchard, wheat, alfalfa, rice, etc., as long as water logging does not last for very long (water logging

should not be more than 48 hours).

The basin varies in size from as small as 1 – 2 $m^2$ to even over 1 ha depending on the topographic condition, soil condition and farmers practice. In cases where the land is sloped or undulated, the basin tends to be small and rectangular, and may require terracing. Though treadle pump irrigation usually accompanies a small sunken bed of 1.2 m x 3 m, gravity fed irrigation can enlarge the size of sunken bed to 1.2 m x 5 m, 1.2 m x 10 m, 2.4 m x 10 m, and even more. As per the efficiency of on-farm irrigation application, basin irrigation could achieve as high as 80% when it is properly leveled and well managed.

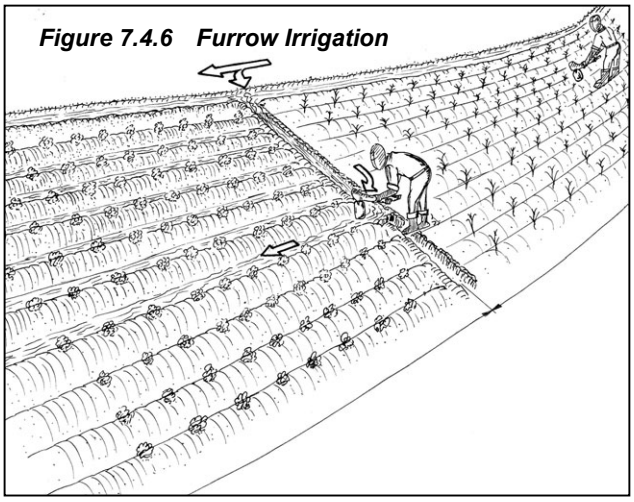


***Figure 7.4.6 Furrow Irrigation***

Furrow irrigation system looks like commonly used ridged rain-fed agriculture since it consists of furrows and ridges. The furrow irrigation is best suited to row crops such as maize, beans, onions, tomatoes, potatoes, etc. The water is led to the furrow that should be on a uniform longitudinal slope, and capillarity moves and lifts the water into the ridges. Farmers could easily adopt this furrow irrigation since they are already very used to making ridges and furrows for their rainy season agriculture. This irrigation, however, sometimes gives a risk of localized salinization in the ridges if the soil contains salt.

In general, a spacing of 0.3m and 0.6 m of furrows has been proposed for coarse soils and fine soils respectively. Heavy clay soils may allow up to 1.2 m spacing. As most of the farmers are already practicing ridging during rainy season, that spacing can be adapted under this irrigation as well (usually 0.6 – 0.9 m spacing with recommendable spacing of 0.75 m in case of maize). The minimum and maximum slopes for furrows should in general be 0.05% (1/2000) and 2% (1/50) respectively. As per on-farm application efficiency, furrow irrigation could reach 70%, which is about 10 % less than the basin irrigation.

As briefly discussed above for the both on-farm irrigation methods, the suitable method in a site depends on the site conditions especially on the topography and farmers' practice. From the viewpoint of efficient water use, basin irrigation is recommended as this irrigation method could avail of the water for crops about 10% more than furrow irrigation. However, sloped topographic condition requires heavy land leveling work and often terracing to convert the slope into a series of cascaded basins.

If a topographic condition is associated with 4% slope (1/25) or more which is very commonly found in highland areas of Malawi, the width of a terrace cannot go beyond about 2 m. This means that almost every basin would result in accompanying terracing. Terracing done for the irrigation purpose may not stand against heavy rains during rainy season. Hence, most farmers may have to put the terracing back to commonly applied ridged farm for rainy season agriculture, which can stand more against heavy rains.

In fact, there are many cases in the verification sites that land owners have given a condition in lending their land to the members who do not have land in the service area. The condition was that basin should be demolished and put back to normal ridged & furrowed farm or otherwise the existing ridges prepared for last rainy season agriculture should not be disturbed. This condition has made members very reluctant to construct standard basins, at least 1.2 m width enough for two rows planting, and resulted in making quite narrow basin, say only 30 – 40 cm, which was actually the furrow in the last year.

Therefore, on sloped lands, say more than 4% slope, furrow irrigation may be much preferred by the irrigators and in deed adaptable. The spacing of the furrow can follow the rainy season's ridging spacing; preferably 75 cm or a little less than that. Ridge height, equally to furrow depth in other way around, should be around 20 – 25 cm in order for capillary to lift the water toward ridge. Standard height of ridge adapted during rainy season is usually 30 cm, and this height is so high that capillary may not be able to wet the soil around the seed.


***Furrow Irrigation***

Furrow length can be 5 m in the shortest case and to as long as 10 meters depending on the consistency of the gradient and the length of the plot owned by the farmer. Limiting factor of furrow length may be the length of the plot since the service area is usually divided into pieces, say 0.05 – 0.1 ha each as an example, and lent to many members. Another factor of determining the length of furrow is water volume available. If the water volume is very critical, say less than 3 l/s, furrow length should not be long; preferably to be 5 m or even less, otherwise it takes too long to fill up the furrow and results in great water loss.


***Basin Irrigation***

In case of flat lands such as Dambo areas, lower parts of hilly areas and lands in Rift Valley floor, basin irrigation can be best suited. Smallest size of sunken bed could be 1.2 m x 5 m, and can be enlarged depending on the leveling and the size of the plot owned by the farmer. Water volume available may limit the size of basin; namely, if water volume is very critical, say less than 3 l/s, the size should be small such as 1.2 x 5 m or even 1.2 x 3 m taking into account the time required to fill up the basin.

Though basin irrigation is very suitable for flat land, Dambo area is often associated with water logging problem especially near the stream. In this case, furrow irrigation can be applied instead of basin and drainage may also be required. Dambo area may

adopt basin irrigation in its higher elevation where water logging does not take place, which is close to the main canal, and furrow irrigation in the vicinity of stream.

### 7.4.6 Cluster Development

There are about 30 % vacancies in the posts of front line extension officers in Malawi. ORT does not well meet expenses to be required for effective extension activities. An example is that technical officers in RDP are usually limited to 250 km per month for the reimbursable mileage. Limited supportive capacity of administration could be a constraint for extending the smallholder irrigation scheme over the irrigation potential areas in the Country. Taking into account this situation, facilitating farmers onto the irrigation development should always be planned under minimum level of budgetary allocation. A smallholder irrigation scheme should therefore be implemented with several neighboring potential sites as a cluster.

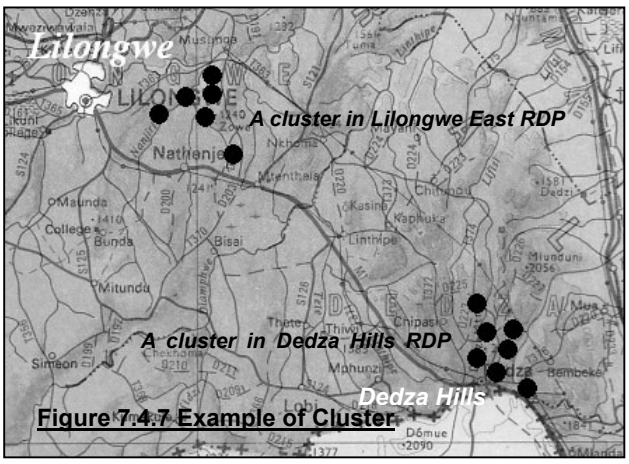



Figure 7.4.7 Example of Cluster

The verification project in year 2003 has undertaken four clusters: two in Kasungu ADD and two in Lilongwe ADD. The two clusters in Lilongwe ADD are located in Mpenu EPA in Lilongwe East RDP and Kanyama EPA in Dedza Hills RDP as shown in the right map. The cluster development minimizes necessary expenses for study tour, most of which is accrued from transportation. Under this cluster development, farmers for a site can visit the others even on foot, and vice versa, creating an opportunity of learning from fellow farmers and getting motivated each other. As several projects are to be developed almost simultaneously under the cluster concept, so called hearsay effect will work. Dambo village in Lilongwe East RDP started an irrigation project by hearing and seeing the neighboring village's irrigation development that was Duwu site. They actually named their club *Zakumva (hearsay)*.

Cluster development will also diminish wait-and-see attitude which is often seen whenever new movement is about to start. When Kankhuza villagers in Dedza Hills RDP saw two irrigation development taking place in their vicinity, which were Mtsetse and Mtanda sites, they got quickly motivated and even accused the village headman of not conveying the information of the two sites in time. Potential irrigator farmers being influenced each other, the cluster development could prime up a momentum of smallholder irrigation development covering a certain area. Therefore whenever starting smallholder irrigation development in an area, potential sites in the area should be all identified and clustered in a group(s), then the AEDO in charge together with RDP irrigation officer and AEDC being advisor should start.

### 7.4.7 Study Tour to Step Forward

Study tour, carried out through the verification projects, is a very powerful catalysis to strengthen and disseminate smallholder irrigation scheme within the area and to other areas. Double effects can be expected from study tour. The owners of a smallholder irrigation

project could be proud of showing their achievement to other farmers and become more positive in their activities, while the visitors could learn and be motivated by seeing the achievement of the peers. The visitors often become so confident enough that they can start using similar techniques and constructing smallholder irrigation schemes.

Farmers at Duwu site thought it was too difficult to construct a weir to tap stream water using only local materials when the Study Team first explained the idea. However, a study tour to Mgunda site in Lilongwe East RDP where the farmers had constructed a weir by their own initiative raising the water level as high as 1.5 meter got Duwu farmers very motivated. They got together quickly, and embarked on the construction of their irrigation facilities.


***A Study to see fellow farmers' achievement: A Brush Dam***

Most potential irritators did not believe whether and how furrow irrigation works, thereby they were all about to try basin irrigation even on a sloped hilly area. For example, potential irrigators at Mtsetse site in Dedza Hills RDP had a study tour to Duwu site where farmers were doing both basin and furrow irrigation. After Mtsetse irrigators saw how capillarity moves water from furrow into ridge and confirmed that the inside soil was wet by putting their hands into the ridge, they understood the effectiveness of the furrow irrigation and adopted it indeed.

Compost manure is now strongly recommended by the GOM, yet very few farmers have adopted due mainly to long decomposition time at least more than 2 months and cumbersome process to make. Balangombe site in Lilongwe East RDP, where Mankhamba and Tigwirizane clubs were doing irrigation, is one of the advanced irrigation areas and once pit compost manure was demonstrated during an agriculture show in July 2003.


***At last, a farmer started compost manure making.***

The Study Team found, however, that no one had actually made his/her own compost manure by him/herself. Then, Balangombe farmers were taken to an innovative farmer who lives near the City of Lilongwe and was practicing an organic agriculture using compost manure mainly. After seeing the effectiveness of the compost manure, one of the farmers said he at last realized that cultivation twice a year definitely results in further exploitation of the soil

fertility and started making compost manure by his own which improves soil physical characteristics.

Many pilot projects in agriculture in the past did not extend so much to the other areas. The reasons could be non-participation of the farmers, unmanageable size of the projects, planning without long-term vision, financial un-viability, project design which cannot be reproduced, etc. The Study Team advocates making irrigation as a culture therefore a smallholder irrigation scheme should be designed to extend to other areas in a sustainable way. In line with this, study tour should be considered as a very powerful tool of disseminating smallholder irrigation.

Study tour in this Study can be categorized into three patterns: 1) within the cluster, 2) beyond the cluster and 3) the ones especially for the local leaders. Since transportation cost is relatively big, study tour should firstly be arranged within the cluster. This Study proposes cluster development for which several irrigation projects closely located each other are being implemented. With this arrangement, farmers who live near the sites can visit their neighbors even on foot, and that can lower the transportation cost significantly.

Since most of the sites within a cluster are expected to commence almost simultaneously, most of the sites may follow more or less same progress stage. Though the effectiveness of study tour is obvious, visitors' expectation sometimes cannot be met since they are usually very eager to see advanced form of development. In this case, study tour beyond the cluster may have to be arranged. Upon the request from the farmers as well as AEDOs who themselves are very eager to see their fellow officers' achievement, this study tour beyond cluster should be arranged. After they have learned an advanced form of development, here comes their turn that they invite nearby farmers to show what they leant.

Several AEDCs and AEDOs pointed out that vertical government line from the Ministry, ADDs, RDPs to EPAs is not good enough to disseminate smallholder irrigation scheme to a large extent. In this regard, local government line in parallel with the vertical government line must be involved. Local leaders such as TAs, GVHs and Councilors are expected to become the proponents of smallholder irrigation development. These local leaders, taking an opportunity of attending local development committee meetings, can point out how smallholder irrigation benefits the people whereby becoming a good catalysis to disseminate especially beyond cluster.

Above those all advocate how important study tour is. Seeing is believing. Study tour works as a venue of learning. Study tour has double effect; good for the visitors and also for the host. Given study tour, local leaders can be a good catalysis for wider dissemination. Then, additional impact of study tour can be seen in even AEDOs. Several AEDOs involved in verification projects said that they have never seen the field out of his/her RDP or ADD. By observing other areas and other practices, AEDOs are able to have more objective and broader view of things. AEDOs, as same as the project staff engaged in smallholder irrigation development, can become more positive in pursuing their activities.

### 7.4.8 Establishment of Farmer Organization and the Internal Set up

The process of implementing a smallholder irrigation project starts with participatory kick-off workshop. Following the kick-off workshop, feasibility workshop and then planning workshop will be held. Through the workshops, preliminary plan of the diversion structure will be discussed and preliminary canal alignment will also be done on the site. Then, the participants will formulate the action plan of activities for the implementation. Also, during the workshops the selection of the responsible persons should be conducted for each activity. These responsible persons could be potential leaders who will be the candidate of the committee members, including the chairperson, of their irrigation club.

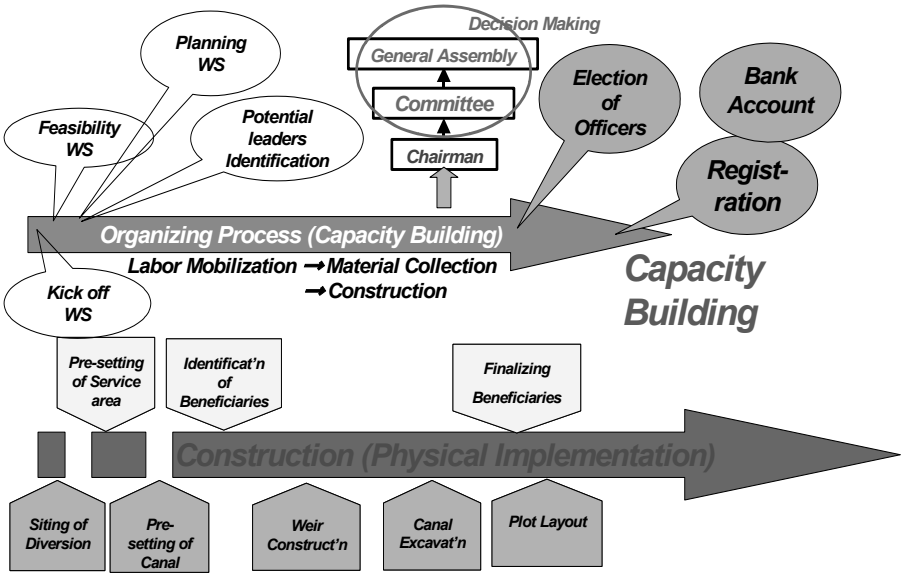



**Figure 7.4.8 Organizing Process and Project Implementation**

As to building an organization, the official registration or officers' setting-up is often made in advance to starting the activities; or start the activities right after the selection of the potential leaders in the initial process of the establishing of the organization. This Study proposes the latter approach (see the figure left), for which middle to latter half of the whole process of building the organization will proceed parallel to the implementation of the project. In this case, the potential leaders are given roles of mobilizing the fellow villagers for labor work and arranging the local materials such as wooden poles, twigs, grasses, clay soils, etc., with strong leadership for organizing the members through the whole process. As for the potential leader, so to speak, it is as if taking examinations for becoming a leader in real meaning through on-the-job-training.

On concerning the important matter, such as cash contribution in case, it should be discussed and decided in the villagers' meeting and not in the workshops mentioned above that may have a possibility of calling only a limited number of participants. If there is an existing organization which is also expected to lead the irrigation project, its general assembly meeting should be mobilized and not just committee members' meeting since there is a great possibility that the chairperson will behave beyond his/her authority for their decision-making. It is noteworthy that the chairperson has also only one vote for decision-making as same as other members. The decision-making by the consensus in the villagers' meeting or in the general assembly would be the process, which the outsider should intervene properly.

At the time of completion of their responsibility such as local material collection, cash payment in case, and mobilizing fellow farmers for the construction, the activities could be

said as being well done on the way. In a sense, it could be said that the potential leaders pass the hardest process of implementing the project. In this stage, most of the villagers will already recognize who is appropriate for the chairperson, and other members of the committee such as vice-chairperson, secretary, treasurer, etc.

So, here comes a time to carry out the election to decide the committee members. This election is actually a superficial procedure since all the members who have been working with the potential leaders must be aware who should lead the organization. Upon setting up the committee members, the irrigation club now holds the general assembly to ratify the constitution and by-laws by all the members and in the end they may register the organization officially. In case of handling certain amount of cash, the registered organization can now open a joint bank account under the name of the chairperson, secretary and treasurer, which is a joint account.

Upon setting up of the committee, role and authority on planning, decision-making and implementation in the irrigation club should be clearly defined and recognized by all the members. Simply speaking, those three roles and authority should not be concentrated in the committee but decentralized. For example, when an irrigation club thinks about the following dry season crop, they go through a process of planning of water use and allocation, decision-making of the plan, and execution of the approved plan, and those authorities must be independent.

Planning will be done by a group like agriculture development group or water management group formed by volunteers or elected persons within the club and decision on whether to execute the plan will be made by the General Assembly or the Representative Committee. General assembly is composed of all the membership. Representatives from irrigation blocks such as upstream, mid-upstream, mid-stream, etc. usually form the Representatives Committee. Either the general assembly or the representative committee does the decision-making according to the significance of the issue[4].

Under the Representatives Committee, Management Committee is formed consisting of the chairman, vice chairman, secretary, treasurer, and auditor (this means the committee most often referred to in Malawi). The Management Committee will be in charge of the execution or day-to-day management according to the decision made by either the Representative Committee or the General Assembly (see Figure 7.4.9). In case that the irrigation scheme is very small, the Representatives Committee composed of only several members can act as the Management Committee as well as be in charge of planning: that may be most of the cases in smallholder irrigation schemes (see Figure 7.4.10). In this case, groups in charge of planning shown in the Figure 7.4.9 are no longer needed, making the organization very simple.

Difficulty concerned with irrigation club is that Management Committee members come out from the members of the Representatives Committee or the General Assembly in case of small irrigation club. For private companies, directors in charge of decision-making and

[4] Example is next season's water distribution can be decided by the Representatives Committee but issues entailing cash, which is very important, should be decided by the General Assembly.

managers in charge of execution are different personnel. Managers execute plans according to the decision made by the directors, at which there is a clear demarcation between decision-making and the implementation. However, as per irrigation club, the members of the Management Committee including the chairperson are selected from the members of the Representatives Committee or the General Assembly.

Although the chairperson is the chief executive officer which entails the authority in implementation, he/she has only one vote in decision-making in the Representative Committee and in the General Assembly as well. Sometimes the authority and duty of the chairperson are mixed up. To prevent the authorities from being abused and promote transparency of the organization, such idea of decentralized organizational setting-up should be extended to all the membership; that is the management committee in charge of execution and the representative committee or the general assembly in charge of the decision-making.

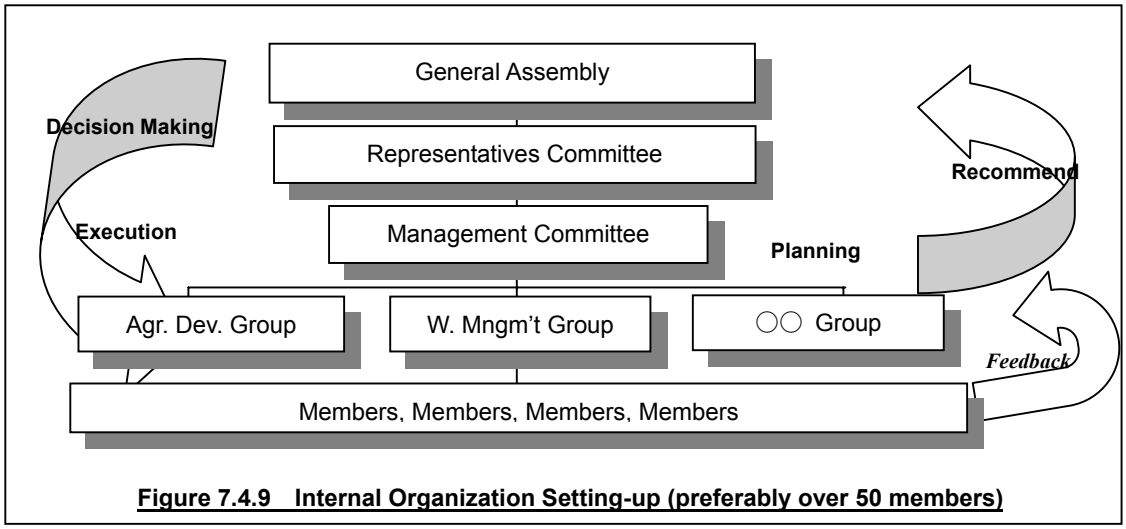



**Figure 7.4.9 Internal Organization Setting-up (preferably over 50 members)**

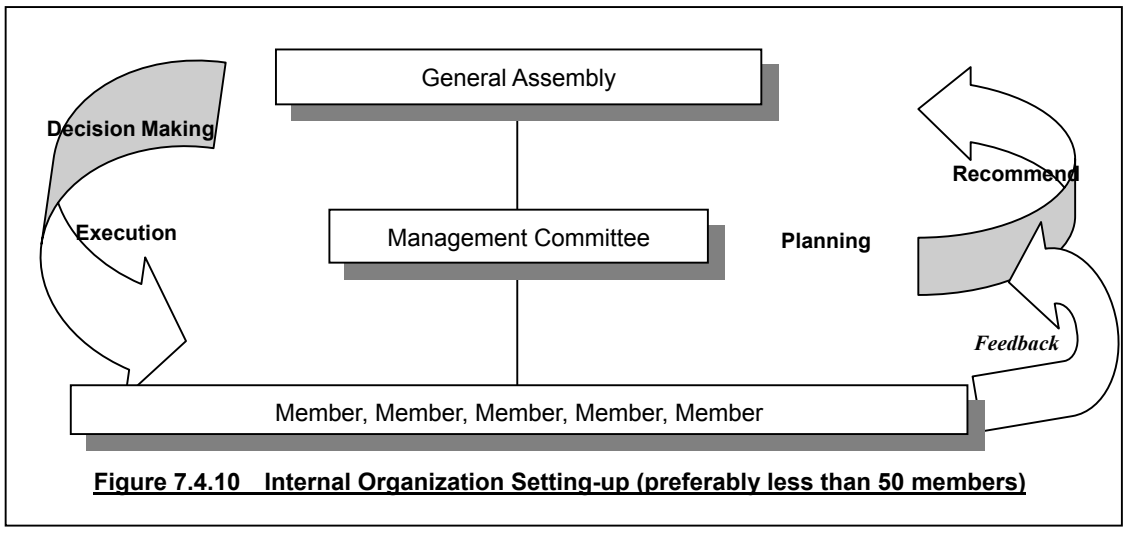



**Figure 7.4.10 Internal Organization Setting-up (preferably less than 50 members)**

The quality of leadership, more than any other single factor, determines the success or failure of an organization. The remarkable success of some of the farmer's organizations can be attributed largely to the leaders and the kind of leadership that they have used. Leadership is a process of influencing individual or group of individuals to achieve a collective response to resolve a particular problem or any given situation.

Collective style of leadership is a kind of leadership wherein the leading group organ, the Management Committee, stands as the united center of leadership under which all important issues are collectively tackled and resolved by all the members. The united effort and integrated action of the members to perform their respective tasks promote initiative and reliance of every member in carrying out decisions by the collective. Under collective leadership, monopoly of one or few in making decisions and in running the organization is avoided.

Basically, Collective Leadership is the application of the principle of democratic centralism by the club's leadership. In essence, this is the interplay of democracy and centralism or of freedom and discipline.

> *WHAT IS DEMOCRACY: Democracy is a system of exercising authority over farmer organization wherein the general membership holds the ruling. In case of the irrigation club the ruling power or authority is the general assembly composed of all the membership. All the important issues must be ruled by this general assembly.*
>
> *WHAT IS CENTRALISM: Centralism is the principle or system of centralizing power or authority. In the irrigation club centralization is lodged in the Management Committee. Thus, the implementation of the irrigation club's policies, guidelines, the O&M responsibilities or all activities of the irrigation club for that matter is being centralized by the members of the committee.*

Democratic-Centralism is the principle wherein utility of democracy and centralism or of freedom and discipline is the basis or guide of the leaders as well as the members of the club in the discharge of their functions and in the accomplishments of the assigned tasks. The system of democratic centralism is a distinct feature of irrigation club in its operation. Simply saying, any decisions must be decided democratically by the general assembly but once the decision is made the decision must be implemented in a centralized way under the supervision of the Management Committee. This mechanism ensures the irrigation club complete or total orientation with the fellow farmers' participation of regulation making process and in carrying out O&M tasks. Four rules that ensure organizational unity based on the principle of democratic-centralism are:

1) The individual is subordinate to the Irrigation Club. This means that the interest of the individual is under the interest of the Irrigation Club. Everyone must follow the club's constitution and by-laws, guidelines and rules of the club and all decisions and agreements made without personal reservations,

2) The minority is subordinate to the Irrigation Club. This means that the decision made on behalf of the whole club is based from the majority of the members. If ever there are other positionings of the minority these should be subordinated with the majority's collective decision,

3) The lower organ is subordinate to the higher organ. This means that the decision and rules set by the higher organs which represent the broader scope of the club must be followed by the lower level. For example if the Representatives Committee which is the

higher organ promulgate a regulation, irrigation blocks which are the lower organs are bound to abide by the regulation.

4) The whole Irrigation Club is subordinate to the general membership. This means that all decisions and policies coming from the general membership, as the lead organ, must be followed by all members of the Irrigation Club, of course inclusive of committee members.

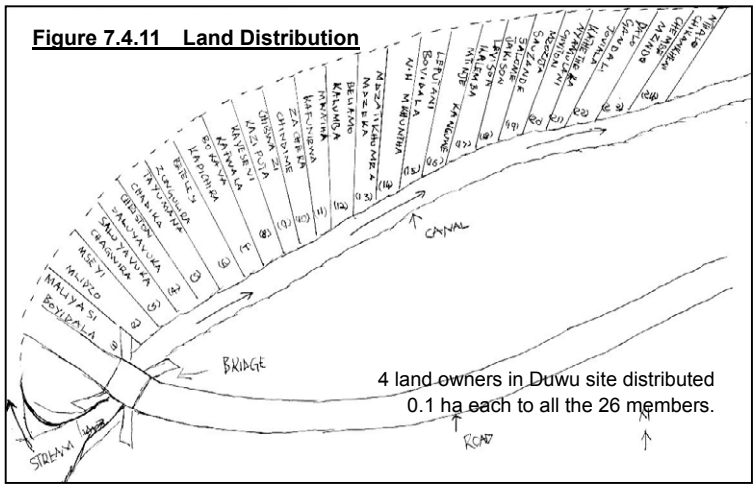
### 7.4.9 Public Equity: Land Distribution and Related Issues

Irrigation obviously cannot serve all the villagers simply because irrigation cannot serve all the land but limited areas only according to the topography. Also the amount of water available for irrigation in most of the potential sites is limited, so that only less than one tenth of the whole villagers may have land within the potential service area in many cases. Refereeing to examples of the verification projects, there are only 4 landowners in Duwu site, 1 in Zakumva, 2 in Mgunda, 1 in Mchiku, 3 in Loyi, and so on. This situation may create jealousy to the haves, that is the land-owner in the potential service area.

To the have-nots, a mitigation measure is to divide the potential service area into small plots and rent out to them, who are the farmers not having any land in the irrigation service area, either free or with a minimal rental fee only during dry season. This measure was observed in Mgunda irrigation site in Lilongwe East RDP, which was initiated and implemented by the farmers themselves. Given the strong leadership of the VH, the 2 landowners in the potential service area agreed to divide their lands into pieces and lend out to the 11 have-nots free of charge during dry season.

Same arrangement was done in many verification sites such as Duwu, Tikolore, Tilime, Mtsetse, Mchiku, Gontha, etc., free of charge in most cases[5]. Service area of Duwu site, which is owned by only 4 landowners, was divided into 0.1 ha each and distributed to all the 26 members, and same kind of arrangement was done to all the 81 members of Tikolore Club and 52 members of Gontha Club, etc. There were 642 membership for the 22 verification sites developed in 2003 dry season while the landowners were only 170. This means as many as four times members than the landowners have been accommodated in the services areas in 2003 dry season. This

**Figure 7.4.11 Land Distribution**




[5] The rent for dry season irrigation land is free in most of the sites, except Ngoni in Lilongwe East RDP and Msambaimfa in Ntchisi RDP. At Ngoni site, originally the rent was as high as MK1,500 per 0.1 ha, but after the mid-term review workshop on August 11, 2003, committee members, two VHs and others had a meeting to discuss the rent and decided to make the rent free for the resident farmers. The fee at Msambaimfa site is MK200 equivalent to price of a local chicken according to the members. Though members are required to pay MK20 for Tikolore Club and MK100 for Gontha Club, these are a member fee, and not rental fee.

arrangement definitely contributes to the equity among the villagers; hence during the stage of further extension of smallholder irrigation development same arrangement should be introduced.

There is a concern about the land distribution. In Malawi, chemical fertilizer has long been applied with little measures of physical improvement, so that the soil has been already fatigued almost over the country especially in population congested areas. Irrigation agriculture, which in most cases uses the same land twice in a single year, exploits the soil fertility even further. Should the condition be left without taking any measures of improving the soil fertility, it would create social problem and the land owners would no longer be willingly to lend out the land to the others. Therefore, measures of supplementing the soil fertility and improving the soil physical characteristics, such as application of compost manure, should be strongly recommended to the irrigators. Therefore, the idea of dividing and lending out the irrigable area to members should always accompany a mean of not further exploiting the soils.

### 7.4.10 Role of the Traditional Local Leaders in Irrigation Development

When a group activity like irrigation development starts, the farmer beneficiaries normally form a club. The formation of club with election of the committee members has already become a custom in most villages in Malawi; hence there are often several club-based activities already in villages. When the villagers elect the committee members of the club, the village headman (VH) or the group village headman (GVH) cannot stand as the candidate for the committee members, but he or she facilitates the election.

Traditionally VHs as well as traditional authorities (TAs) and GVHs are entrusted to manage customary land, allocate land to villagers, set social norms and rules, mediate problems within their jurisdiction. Experiencing the transition of rural society such as from subsistence economy to market economy, it seems that the authority of VH is now differentiated from that of the past time and local norms are getting weaker in recent days. However, local leaders are still respected and any development activities without involving the village headman usually do not work. Since there are some decisions in villages for which only the village headman can make, it is necessary for the irrigation club to be well in accord with the VH.

VH has the authority to distribute the lands in his/her territory to the villagers, especially in case the irrigation service area has not been yet vested to anybody. Even if the irrigation service area belongs to somebody, VH could advise the owner to lend out a part of his/her lands to the others who are the have-nots in the service area. Land issues occurred in Mtanda, Mtsetse and Mchiku sites in Dedza Hills RDP, Loyi and Tikolore sites in Dowa RDP, and Ngoni in Lilongwe East RDP, etc. Several landowners refused to rent their land in those sites and an owner even filled up a part of excavated canal at 180m out of 320m in Mtanda. Those issues have been solved with the initiative of the concerned VH. Therefore smallholder irrigation development should involve the VH from the initial stage[6].

[6] Most VHs have a difficulty in communicating in English. Appointing a secretariat who can command English among the villagers may take advantage of facilitating the communication during workshops.

In case there are several villages involved in an irrigation club, GVH plays an important role as a mediator. If an irrigation scheme extends to several villages, its development should always be well informed to the GVH since the on-set. Likewise, if an issue beyond a village takes place, mediation between the concerned VHs may not work. For example, cattle from other villages have damaged the maize field of Loyi and Tikolore sites in Dowa RDP. Committee members of each club reported the incident to the GVH together with their VH, and the GVH did the role of the mediator.

Obviously, there was difference of the strength of local leadership. Since AEDOs usually know the situation very well and it is not so difficult to see the local leadership through a series of meetings/workshops such as kick-off, feasibility, and planning, attention should be paid to sense if local leadership is strong enough to mediate probable disputes such as land distribution and water scramble. If local leadership seems not strong, a study tour should be arranged to see other areas where local leaders are well discharging their duty rather than just administering a leadership training. Leadership training itself may disgrace the leadership the VH/GVH may be thinking well esteemed; therefore outsiders like donor and also AEDOs should arrange an opportunity where the VH/GVH can learn how to improve the leadership. This kind of education study tour could enhance the local leadership and the relationship with the villagers as well.

### 7.4.11 Land Size on Member Report and Actual One

Service area realized with smallholder irrigation is usually very small, rather defined as micro scheme ranging from less than one hector to several hectors only. Most of the irrigated areas hardly go beyond five hectors. The total intended area for the 23 sites of the 1st generation verification project was 63.3 ha while actually irrigated net area remained only 36.5 ha, 58% of the intended. Given the total membership of 642, actually irrigated area per farmer was therefore only 0.06 ha in average. Why actually irrigated area remained small as compared to intended area was: water shortage having taken place in October and November, not enough time to develop although canal was extended enough to cover the intended area, existence of unusable land within the intended service area, overestimation of land made by AEDOs and farmers report, etc.

Farmers and AEDOs can always measure the length of canal while extending the canal by using five meters interval line-level. Length perpendicular to the canal is not, however, measured in most cases. In these cases, the perpendicular length may be very often over-reported, thereby resulting in overestimation of the area developed. To know the area of irrigated land precisely, a couple to several perpendicular lengths to the canal alignment should be measured, otherwise one may result in overestimation of irrigation area.

Farmers report on land area is not accurate very often either. Farmers are usually quite sure how much they have produced or harvested from their farmland. However, when the question comes to “area”, the answer to how much he/her owns becomes very unclear. Table 7.4.4 shows a comparison of 20 examples of the size of dry season farmland between interview and direct measurement made in 2004 dry season. In most of the cases, farmers

Outsiders like donor who usually communicate in English should always pay due attention how well VH is following and aware of what is happening in workshops.

replied the size of farmland much bigger than the real figures. In average, they replied 2.3 times bigger area than the actual. A farmer even replied as much as five times more than the area he had actually cultivated. This is mostly because they just reply a quarter (1/4) acre when it is small and a half (1/2) acre when they think it is a little bit bigger, irrelevant to the mathematical numbers of 1/4 or 1/2.

**Table 7.4.4 Examples of the Size of Dry Season Farmland**

| Club | Name | Data from Interview | | Actual Measurement | Difference |
|---|---|---|---|---|---|
| | | acre | ha | ha | % |
| Ngoni Club | V.H. Kalandani | 1/4 | 0.1 | 0.035 | 288 |
| | Mr. Shemamasika | 1/4 | 0.1 | 0.105 | 95 |
| | Mr. Yobu Chinthuza | 1/1 | 0.4 | 0.192 | 208 |
| | Mr. Kang'ono | 1/4 | 0.1 | 0.063 | 158 |
| | Mr. Masalimo Kari | 1/4 | 0.1 | 0.046 | 219 |
| | Mr. Yamikani | 1/4 | 0.1 | 0.078 | 128 |
| Tilime Club | Mr. Marko Kathewela | 1/2 | 0.2 | 0.050 | 403 |
| | Mr. Elias Mwanza | 1/4 | 0.1 | 0.056 | 179 |
| | Mr. Freckson Machova | 1/4 | 0.1 | 0.026 | 380 |
| | Mr. Maganizo Chizalo | 1/4 | 0.1 | 0.022 | 450 |
| | Mr. Jalison Marko | 1/4 | 0.1 | 0.020 | 505 |
| | Mr. Lintoni Kangwanda | 1/4 | 0.1 | 0.048 | 208 |
| | Mr. John Chakana | 1/4 | 0.1 | 0.042 | 238 |
| | Mr. Gilyamu Chisale | 1/4 | 0.1 | 0.039 | 260 |
| | Mr. Liversoni Faliyoti | 1/4 | 0.1 | 0.054 | 185 |
| Gontha Club | Ms. Zeresi Aroni | 1/2 | 0.2 | 0.069 | 290 |
| | V.H. Chikware | 1/2 | 0.2 | 0.059 | 339 |
| | Mr. Gaveni Chindozi | 1/4 | 0.1 | 0.060 | 167 |
| | Mr. Solomon Chinkhande | 1/4 | 0.1 | 0.053 | 190 |
| | Mr. Marisani Aroni | 1/2 | 0.2 | 0.052 | 384 |
| | Average | | 0.135 | 0.058 | 231 |

If one asks the farmers how much area they own or cultivate, the one may be given very exaggerated figure (though not intentionally exaggerated), resulting in the overestimation of the irrigated area. To know precise service area, actual measurement should always be done on the ground or one may have exaggerated figure. On the other hand, how much the farmers have harvested can be answered very precisely since they are well aware of the amount, which they consume, by means of how many sacks or oxen carts. Therefore, without verifying the area in the field, one must not discuss the yield that is subject to production over the area. Depending on the area reported by the farmers may result in very much underestimated yield. Precise yield should be based upon sample survey, or at least the area should be measured in the field.

### 7.4.12 Appropriate Farming under Irrigation

Forms of ridge and basin should be decided by considering of water availability, types of crop, direction of sunshine, cropping patterns, topography, soil types, crop pest, working efficiency, economic efficiency, environmental situations, etc. Especially, forms of ridge and basin influence much on effective use of irrigation water. Inappropriate forms of ridge and basin are sometimes found under existing irrigations, and measures are given of the following:

#### 1) Appropriate Form of Ridge

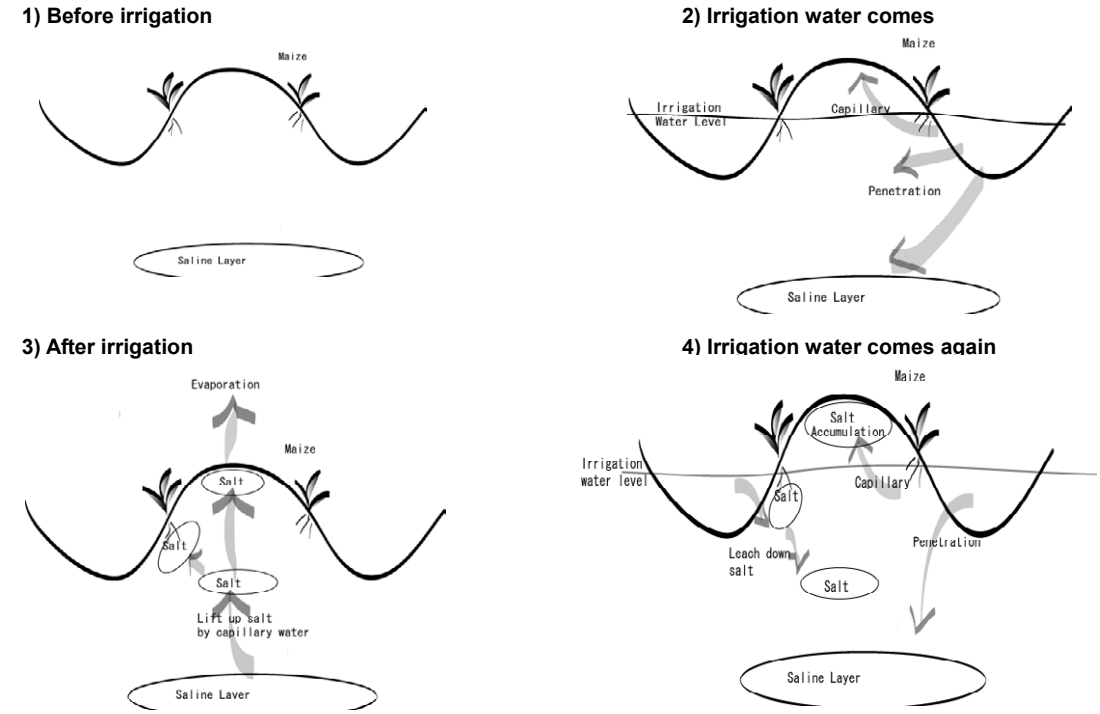
In Malawi, contour ridge method is found in many places in order to reduce erosion and to avoid excessive humidity in rainy season cultivation. This counter ridge can be utilized for furrow irrigation in dry season cultivation. In fact, since farmers can reduce construction work of farm ditches, furrows in rainy season are used as farmland irrigation canals in many cases. In some cases, excessively high ridges are found as farm irrigation canals which are 30 cm high same as rainy season agriculture. Under this condition, water scarcely takes place to the seeds planted on top of the high ridges, which as a result causes late germination and late growth in the initial stage of crops.

The purpose of contour ridging should be distinguished by season. In rainy season, the purpose is to avoid excessive humidity, and to reduce velocity of surface water on the field so as to reduce erosion, while in dry season the purpose is to provide effectively irrigation water by using the furrow. Suitable height of ridge/ depth of ditch should be about 20 cm in order to provide the irrigation water evenly and effectively.

### 2) Appropriate Planting against Salinity Problems

In dry season cultivation, soil salinity problem, in which salt is deposited on surface of farmland, is sometimes found. Irrigation water may bring up salt, if the soil originally contains salt, to the surface areas of the ridge by capillarity, while there is no water such as rain to leach down the salt. Thus, the movement of salt is one way, which means that it just goes up and is accumulated little by little. This salt accumulation gives damage to the crop especially if the crop is planted on top of the ridge. On the contrary, in cases that the crop is planted on the side of ridges or planted in basins, the planted areas are always directly exposed to irrigation water, so that the salt is leached down and soil salinity problems hardly take place. Where salt problem is expected, side planting or basin plating should be practiced.

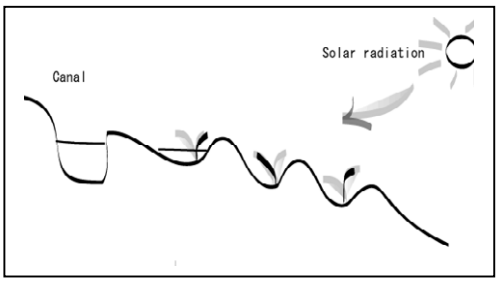
**Figure 7.4.12 Salt Accumulation in Irrigation Farming**




### 3) Ridge considering of Solar Radiation

If crops are planted on the side of ridges considering of the soil salinity problems as above-mentioned, amount of solar radiation, which plant can receive, is indispensably influenced by height of the ridges, planted places on the side of ridges and direction of the ridge. Inappropriate forms and planting methods possibly reduce the solar radiation and give bad influences on the plant growth in initial stage. Maize planted on almost bottom of the

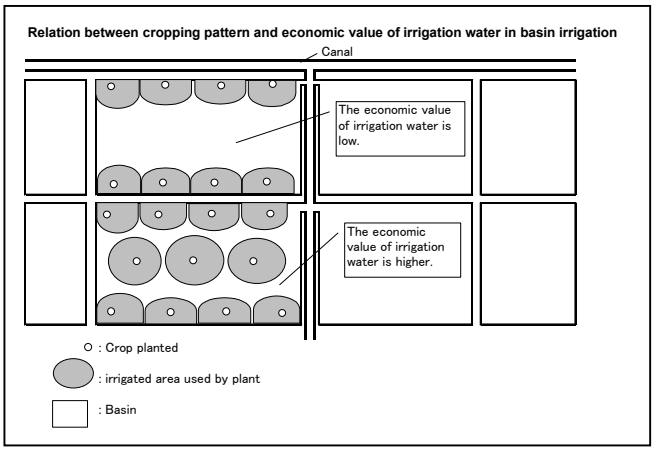
side of ridge in the northern side slope seldom get direct solar radiation until plant's height has become over the top of the ridge. Plants in the northern side slope should not be planted at the bottom of the ridge and also the ridge should not be high, preferably less than 20 cm.




### 4) Forms of Basin on Crop Type and Planting Density

In cases, just 2 lines of maize planted on both sides of 90 cm width basin were found during verification, and there was a big space in center of the basin. The farmers said that other crops would be planted at ending stage of the maize. The dispersion of the planting timing is an effective method to reduce the risk of uncertain precipitation in rainy season. However, in irrigation agriculture, the dispersion may sometimes reduce the economic value of irrigation water since water in the center space of the basin is not used for anything. In irrigation agriculture, in the view of enhancing economic value of irrigation water, it is important to use effectively irrigated space.

Mixing cultivation of maize and legume on same ridge/basin is recommendable considering of maintaining soil fertility, while, unless size of ridge/basin and planting space are considered well, competitions between maize and legume possibly happen relating to availability of water, amount of solar radiation, amount of soil nutrient, availability of space, and so on. Size of ridge/basin should be decided by number of line, type of crop, and so on.




### 5) Special Causions of Maize Cultivation in Dry Season

Since it is windy in Malawi in September and October, if maize is in the flowering stage in such windy season, the pollen might be blown away by wind resulting in no pollination. In dry season cultivation, maize in the flowering period should be irrigated more frequently than usual in order to add humidity not only around the root but also around the upper part of plant body. If the condition around flower is too dry, the pollen tube cannot extend well and as a result the fertilization is not done, even though the pollination is done. This is one of the reasons of low productivity taking place even under irrigation, therefore more frequent irrigation should be applied during flowering stage.

### 6) Improvement of Soil Texture and Fertility

Irrigated farming gives opportunity to cultivate crops during dry season, but on the other hand it exploits soil fertility due to a year-round cultivation. Continuous cropping without any measures causes serious land degradation. Most of the beneficiaries in the verification project sites have been farming in a leased land on condition that the leased land should be

returned to the owner during rainy season. If land degradation were caused by dry season cropping and left over, the landowners would no longer be willing to lend their land. In order to establish sustainable irrigated farming system, it is due required to keep and even improve the soil fertility as well as the texture.

Application of chemical fertilizers is an option to improve soil fertility. Especially, chemical fertilizer gives quick effects and provides required nutrients accurately. Although chemical fertilizer cannot improve soil physical characters and it is very expensive for smallholders, most farmers prefer applying chemical fertilizer only. Many farmers buy fertilizer and apply it to farmlands without improving the soil texture. If the soil does not contain much organic materials, most fertilizer applied may be washed away without being used by crops, since the capacity of fertility retaining is low in such a kind of soil conditions. Therefore, the Government has been promoting compost manure application through extension activities by AEDOs as a low-cost option for fertilization.

Demonstration of compost making had been done by AEODs in parallel with irrigation development. Composts demonstrated were pit and Chimato in most of the cases. However, this method has not taken root except Tikolore and Tilime where over 60 and 45 pits had been made respectively. Why compost has not been well diffused are:


*A Typical Pit Compost*

- Comparing with chemical fertilizer, effects of compost seem to be little and/or to appear late.
- It is a hard work to carry compost to farmland, since compost is generally made nearby farmer's house, and generally should be applied in a large amount (water is usually available around house, and not available around field used for rainy season agriculture because these are mostly located on upland).
- There is little animal manure available, because population of cattle has been decreasing due mainly to drought, thieves, etc.
- Compost is often not available when it is necessary, because making compost takes a lot of time; for example pit-compost method requires 3 months and Chimato method needs more than 2 months (about 2.5 months).

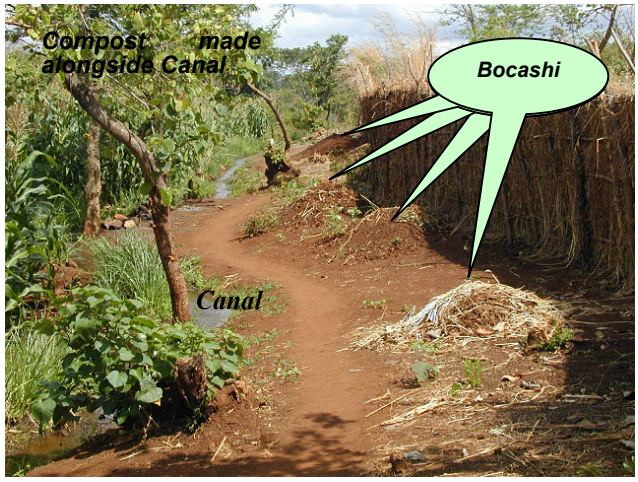
To cope with above-mentioned constraints, "Bocashi" compost which is a kind of quick made and quick effect compost has been introduced in the verification project sites. Bocashi needs only 2 to 3 weeks to be decomposed, quite shorter than other conventional composts of 2- 3 months. Why making Bocashi process is so short are to: 1) incorporate virgin soil which contain a lot of active microorganisms to facilitate the


*Bocashi Making in Gontha Site*

decomposition of the materials, 2) keep the temperature less than 50 centigrade in order not to kill microorganisms (periodical turning up is required in this regard), and 3) aerobic condition in the material heap accelerates microorganism's activities.

In conventional way of making compost, soil is collected from any place; including farm soil. Farm soil does not contain much active microorganisms because of UV from sunshine. Conventional composts are usually left rising of the temperature of materials, and in so doing most effective microorganisms die once. After the temperature has decreased to favorable temperature, other microorganisms come in and start to work/ decompose again, which means a lot of time to complete the decomposition process.

Bocashi has another unique process, which is to incorporate yeast. Yeast can be arranged in the farmers' locality from local beer residue (masese). During the decomposition procedure, yeast takes nitrogen from the materials, and uses it for their body growth. In this procedure, yeast is a kind of nitrogen storage. The nitrogen in their body of the yeast is mainly in amino acid form which is water-soluble and as a result plants take and utilize it easily. This means that the effect of the Bocashi appears relatively rapid[7]. Yeast's body also contains rich vitamins which accelerate plant growth.




Bocashi needs watering periodically, hence water availability is a key constraint or opportunity for making Bocashi with irrigation. Irrigation canal will give more opportunity to make it in their farmland, which simultaneously will solve transportation problems of Bocashi. A good example is Tilime site where the members produced about 30 heaps just alongside the canal, getting water from the canal (see photo). Compost made alongside irrigation canal could be seen at Mankhamba and Mtuwanjovu sites as well. Irrigation canal solves two of the problems of making compost; 1) water availability and 2) transportation.

As per extension, it is found that farmers, who know exactly about the benefits from application of composts/ other organic matters to farmlands, apply compost/ organic matters to soil more positively. On the other hand, farmers who do not know about the benefits and regard compost as just an alternatives of chemical fertilizer do not apply it positively and say, "Now, I don't have money so I use compost. But if I get enough money, I will use chemical fertilizer instead of compost".

The benefits of compost/ organic matter are; 1) to add fertility to soil, 2) to improve soil physical characters, and 3) cheap and made of locally available materials. Generally, the second benefit, "to improve soil physical characters", is the most important benefit, though it

[7] On the other hand, this means that the nitrogen in Bocashi is easier to leach out or to evaporate than the nitrogen in conventional compost. Therefore, Bocashi should be used immediately after completion, or it should be stored under cool condition avoiding sunshine.

is not realized well by many farmers. It is considered to be effective for diffusion of compost/ organic matter application to emphasize the point about improvement of soil physical characters and to let farmers reallize again about the benefits as pointing the following:

- *Chemical fertilizer is firstly dissolved into irrigation water, and then plant consumes the dissolved chemical fertilizer in irrigated water. However in a very hard soil, chemical fertilizer dissolved in water goes away quite rapidly and crop cannot cosume it because the water cannot stay long in such a hard soil.*

- *We apply the compost near the plant. Now, water is absorbed into that compost and stays around the plant, so now crop can consume water and also can take the chemical fertilizer dissolved in the water as well. The compost is a kind of sponge in soil and the role is so important. The farmers do not have to loose the very expensive investment that is chemical fertilizer.*

### 7.4.13 A Mean of Conserving Catchment Area: Improved Cooking Stove

Catchment area is the source of generating irrigation water. Without well preserving catchment area, irrigation systems might end up with dried canal. Generally, catchment areas in Malawi have been deteriorating to date. Though everybody recognizes the importunateness of conserving the natural environment, the issue is very cross-sectorial, straddling many human activities such as opening new lands for farming, cutting trees for firewood, generating a daily livelihood from trees, animal husbandry, etc.

Many past experiences tell us that a conservation program rarely works unless the program satisfies the people's needs, which are unfortunately often not concerned with natural environmental conservation. This fact implies that conservation program should be integrated with a project that could realize the people's needs. One more issue is to recognize that the villagers cannot rely heavily on the government due mainly to budgetary constraints. This leads to a prerequisite that self-help programs should firstly be promoted.

There should be two aspects of conserving catchment areas: one is to rehabilitate already deteriorated areas by forestation accompanied with erosion trap structures, and the other is to reduce the usage of the trees in the catchment areas. The former, which is forestation program, has been promoted by the government, NGOs, etc., including agro-forestry. In fact, such verification sites as Duwu, Ngoni, Mtuwanjovu, Chimphonongo, Kadiwa, etc. have been provided with agro-forestry seeds soon before year 2003/04 rainy season.

The latter tries to reduce the volume of firewood. Firewood is almost exclusively the soul source of cooking foods in rural areas. Therefore, provided energy efficient cooking stove, rural population could save firewood, which in turn contributes to catchment area conservation. There are several types of energy efficient stoves, amongst which a cooking stove invented in Kenya, so called Enzaro Jiko[8], has been tried during the verification project.

[8] Enzaro is the name of the place where the improved stove was firstly introduced, and Jiko means cooking stove in Kswahili. The Jiko was originally meant to improve hygienic condition by easily boiling water.

It has three cooking places connecting each other via inner channel, one for staple food, one for relish, and the last for boiling water. Boiled water definitely reduces risk of any water-born diseases, which was the original intent of how the stove came into invent. Cooking three items almost simultaneously definitely reduces firewood. Fireplaces being enclosed can also reduce the firewood. According to an experiment in Kenya, it can save firewood by half to as much as almost three quarters.

Until mid November 2003, about 20 stoves have been demonstrated in the verification sites. Interviews with the users revealed that the stove could save firewood by about two third. In any case, the stove was reported to save firewood by at least half. This means same amount of firewood can last two to three times longer than traditional three-stone cooking stove, contributing greatly to conserving their nearby catchment areas. The smallholder irrigation development should therefore always accompany with the introduction of the improved stove.

***Improved stove with three cooking places***

No direct negative impact associated with the stove is foreseen. However, there are some cases that discourage the women to install the improved stove. The stove requires water; say 5 to 7 litter, to maintain by smearing it with clay soil usually once a week to at least once in every two weeks. Water scarcity area may have difficulty to well maintain the stove. Another case discouraging the women is that stove constructed outside can be damaged by rainfall during rainy season, and some users may return to three-stone stove again. Construction of small shed (kitchen house) should be promoted or small size stove having 2 fireplaces with lower height can also be installed in the dwelling (see photo above).

***Small stove with two cooking places installed inside house***

Aside from saving firewood thereby conserving catchment area, this cooking stove has advantages that: 1) the stove is made of local materials only such as anthill soil, stones and water; 2) it saves cooking time, say about one hour for supper, as there are three fireplaces; and 3) it gives hygienic effect and more security for children. Chicken and goats longer mess the food that is cooked at higher place than three-stone stove and is placed on back-top of the stove. No child turns over food because the food is placed on the stove. Security for children is now kept so that mother feels very happy.

To pursue the stove promotion; a guide is: 1) a demonstration should be done as the first stage; 2) after the demonstration, AEDOs shall visit the villages again to facilitate several ordinary women to form a group and then construct the stove by themselves; 3) in line with regular monitoring to avoid technical error in the construction, neighboring villages should also be visited to further diffuse the stove toward deep into catchment area.

# CHAPTER 8

# CONCLUSION AND RECOMMENDATIONS

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## 8.1 Conclusion

This Study, taking the points below into account, concludes that the smallholder irrigation development approach, tried out through the Verification Project and fed-back in the Package of dissemination, can be at the core amongst remedial measures in improving food shortage prevalent in the rural areas and thereby reducing poverty the people are facing. The Government of Malawi should therefore embark, at her own cost or together with an assistance from donor country(ies), on implementing and disseminating the smallholder irrigation development program over the Country wherever irrigation potential exists as presented in this Report.

1) The smallholder irrigation development tried out throughout the verification project contributed to improving food security and generating cash income of villagers as well as building capacity of villagers and extension officers for developing irrigation. Positive impacts, for example, were observed in a way that farmers got capital out of the irrigation to invest in fertilizers to increase the production of the following rain fed crop, farmers got a better option, namely dry season crop, than non-farm jobs like firewood sales, and women also got an income source by irrigation.

2) A principle concept of this Study was not to pour external inputs to make the output look nice but to start with whatever farmers can do in their locality so that the activities can be built in a part of their everyday lives, i.e., a culture, which will be transmitted from generation to generation. This approach has been found to help develop smallholder irrigation in Malawi without much requiring outside physical assistance. The Study evidenced that the farmers in the verification project sites have well adopted the appropriate irrigation technology and have been somewhat putting it in their social context; that is culture.

3) One of the strengths that the GOM has is its extension structure already in place; ADD, RDP and EPA covering whole Country. Proceeding hand in hand with the government existing structure was another principle concept especially in disseminating smallholder irrigation development to wider spectrum. Putting the frontline officers, AEDOs, in the forefront of the development assisted by relevant supervisory offices was proved well workable to pursue wide range of dissemination of smallholder irrigation development even under budgetary constraint that the GOM is facing.

## 8.2 Recommendations

There have been a number of issues/ problems that the Study Team encountered during the Study. Through Verification Project which was a part of this Study, a number of solutions or recommendations and methodologies were arrived at. Below are some of these recommendations, which have come out after undertaking this comprehensive study. As is the case with continuous processes, the recommendations made below are by no means exhaustive and may need to be changed or modified, depending on insitu condition. However, it is believed the ones covered here nevertheless constitute a broader spectrum capable of fitting in most conditions:

1) The Study showed that in order for the farmers to fully grasp and appreciate irrigation thereby making irrigation to be a part of their culture, the facilities should be those that are constructed, operated and maintained by the farmers themselves; that is namely, no government intervention in physical sense but the Government should have a role as technical advisor. It is therefore recommended that for irrigation to take root local materials for constructing irrigation facilities should be used as much as possible. One thing recommended for construction of diversion weir is that the height of the weir should not go over our neck in order to prevent the weir from corruption pushed by water pressure. Irrigation facilities made of locally available materials are to be dismantled every time harvesting has finished and major materials such as big tree logs should be set aside for next season's usage.

2) An important issue, which was observed during the implementation of the Verification Project, is the ease of adoption by farmers by just copying after seeing what other farmers were doing. This in short can be called farmer-to-farmer extension. In certain instances, the mode of transmission may not necessarily require training of farmers but rather bringing farmers from other undeveloped area to developed area and let the farmers speak to each other. Experience has shown that farmers easily understand what their fellow farmers are saying and it is easy for them to copy. In fact from our experience, it has shown that farmers who adopt on their own have more potential in consistently sustaining and further developing their irrigation agriculture. In this regard, it is highly recommend that study tours, which provide a venue of learning from peer farmers and also each other, should be arranged on the on-set of the smallholder irrigation development. Women should be given at least equal opportunity for this tour.

3) Irrigation obviously cannot serve all the villagers simply because irrigation cannot serve all the land but only limited areas according to the topography. Also the amount of water available for irrigation in most of the potential sites is limited, so that only less than one tenth of the whole villagers may have land within the potential service area in many cases. This situation may cause other farmers' jealousy to the landowners and create social equity problem amongst concerned villagers. It is therefore recommended to divide the potential service area into small plots and lend out to the have-nots who are the farmers not having any land in the service area, either free or with a minimal rental fee. This measure was observed in many sites of the Verification Project, and contributed to equity amongst the villagers.

4) Another important point worth to be mentioned is also the land issue. Some landowners have refused to lend their lands to other people. While water is a public good, it goes to land that is a private good, causing equity issue amongst concerned villagers. Equity amongst the concerned villagers and individual interest are somewhat bipolarized issue. To amicably settle the land issue, there may be such arrangements as: allocating larger portion to the landowners, paying reasonable rental fee to the owners, due caring of the land by renters by means of applying more compost manure, etc. Local leaders should also play a distinguished role to settle. Transparency since the onset of the development should be imparted and in this regard the local leadership in terms of equity is also challenged. Taking stranded farmers by study tour inclusive of the landowners and the

local leaders to well organized area can strongly influence to solve the situation.

5) Irrigation, in most cases, if not all, over-exploits the land by intensively using the same land twice during a single year. This in true sense means that in the near short-time, the land will be greatly affected, both physically and chemically, and in the end will not be able to produce anything. This problem is further exacerbated by the farmers' tendency of applying chemical fertilizer only. Though chemical fertilizer is highly effective, it has a disadvantage of disregarding the need to improve soil physical properties. Therefore, it is highly recommended to encourage farmers to apply more compost manure. Compost manure is good in that it improves soil physical properties which consequently improves the holding capacity of the soil for chemical fertilizer. It means that compost manure is good not only as nutrients but also for improving the physical characteristics of soil so that chemical fertilizer can be well retained in the soil ready to be fully consumed by the plants. In addition, irrigation canal avails of water by nature, which is a prerequisite of making compost manure. Irrigation canal can therefore promote compost making alongside the canal, which automatically solves the problem of transporting the compost manure. Compost should be promoted in these ways.

6) As an opetion of low input agriculture, this Study has tried some botanical pesticides. *Tephrosia vogelii (Katupe) and Sesbania sesban* (Jerejere tree) are well known to control plant pest including popular maize stalk borer. 2 kg of the fresh leaves crashed is soaked in 5-liter water for 12 hours, and then the filtrated extract is sprayed to crops. This is effective to control stem bores, aphids, leaf eaters and fleas. The leaves contain rotenone, tephrosin and deguelin, which work as botanical insecticide. The half-life of these elements dissolved in 20 degree water is usually less than 1-day, and it is decomposed easily under sunshine (ultraviolet ray). However, it is recommended that vegetables applied with the botanical pesticides should be well washed before being eaten, and also irrigation water which contains such natural pesticides should not directory go back to the stream. Also, at stake is "prevention is more important than cure". Farmers usually do not apply agri-chemicals/ natural pesticides until they find certain damage by pest, and in such cases the crops will have difficulty to fully recover due to the late application of pesticides.

7) Generally in Malawi, most potential sites are located in hilly areas which are crisscrossed by rivers and streams. But unfortunately, if there are no proper soil conservation measures, land degradation will undoubtedly occur or even be accelerated which will ultimately make it unfit for cultivation in subsequent years or again, the land owners in irrigation service area will decide not to rent the land to other fellow farmers. Thus extension of smallholder irrigation should go hand in hand with land conservation measures. This may include creating a distance from the rivers to the edge of the field which should always remain under fallow, simple storm drains, vetiver grass planting along the main canal as well as along lower peripheral of service area, contour ridge and hedge, etc. Also, stone pitching as well as simple dissipater, for example made of mere sticks, along highly sloped canal should be introduced in order to prevent the canal from being eroded.

8) Catchments area at which irrigation water is generated should also be well taken care of.

This may include long-term practices that will incorporate tree planting measures like agro-forestry and short-term practices like using improved cooking stove which saves firewood. During this Study, in certain areas which have their catchments almost destroyed like some parts of Lilongwe, the Study Team introduced an improved cooking stove. This stove showed that it could save firewood by half and in some cases even three quarters, thus ensuring less trees being cut from the catchments area. The promotion of the cooking stove should go hand in hand with smallholder irrigation development, and of course the conservation can be augmented by tree planting in catchment areas. Tree nursery can be well promoted just alongside canal which can provides water in dry season.

9) There seems a tendency in conventional way of developing irrigation, which is to somewhat personalize the irrigation sites. This should be discouraged at all cost, as the farmers tend to think of the sites as belonging to a particular donor and not theirs. When this point is reached, transmission of irrigation as culture, where irrigation culture can be defined as the "continuation of transmission of irrigation practice from one generation to another generation" cannot take place. Thus, there is a need for all stakeholders in smallholder irrigation sector to come together and formulate a common modus operandi for the successful replication of smallholder irrigation development all over Malawi. Furthermore, it will reduce disunity among members whose sites are close each other but with different donors as facilitators which apply different methods of developing smallholder irrigation.

10) Participants to a wrap up workshop held on December 10, 2004 commented the approach of not providing any free seed and fertilizer pursued under this Study as: "I recommend the approach by JICA telling farmers the truth about life and not just pleasing them by short-term assistance i.e. in terms of handouts.", "The approach has instilled a spirit of self-reliance than ever before what farmers depended on handouts.", and so on so forth. The approach of not providing any free seed and fertilizer may have been very unique for the frontline officers. The Team has been thinking that those who can access the irrigation water which is really a precious natural resource can still be categorized as better-off farmers. Yet, does it make any sense of equity to give free goods to those better-off? Though the principle concept the Team has had in mind may be unique as compared to conventional approaches, this Study at least showed Malawian farmers can move ahead even without free handouts, suggesting self-reliant oriented approach which may look harsh for the farmers may have a value to try.