FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

FAO Netherlands Partnership Program (FNPP)

PROCEEDINGS OF A PARTICIPATORY PLANNING WORKSHOP FOR INTEGRATED WATER RESOURCES MANAGEMENT IN MKOJI SUB-CATCHMENT, TANZANIA

Mbeya Peak Hotel, Tanzania, 15th - 17th January 2004

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SUMMARY

Background and methodology of the workshop

As part of the FAO-Netherlands Partnership Programme (FNPP), a regional project on integrated water resources management has been started in the Mkoji sub-catchment, a rural area in the southwest of Tanzania. The purpose of this project is to explore the practical implications of integrated water resources management (IWRM), especially for the vulnerable groups. The project is implemented in a participatory fashion, in line with the principles of IWRM. As part of the project, a three-day stakeholder workshop has been organized as a first step in moving towards a comprehensive IWRM strategy for the Mkoji sub-catchment. Representatives of different stakeholder groups were invited to jointly identify their priorities and strategies for addressing the IWRM problems in the area.

The stakeholder workshop followed after an initial participatory assessment of the current situation in the Mkoji sub-catchment. This assessment consisted of an analysis of the available data on water resources and uses, a household survey and a participatory problem analysis through focus group discussions. The main focus in the workshop was on discussion and deliberation among the participating stakeholders, using a combination of small-group and plenary discussions. In order to provide all the participants with a shared level of understanding, these discussions were preceded by short presentations, outlining the main findings of the initial assessment as well as the main concepts of IWRM.

The discussions were organized around three principles, one for each day of the workshop:

i) Identifying and structuring problems and solutions;
ii) Strategy formulation, elaborating the most promising solutions by assessing their relevant impacts and implementation aspects;
iii) Providing starting points for follow-up activities after the workshop, selecting promising activities and reflecting on the different roles that participants could play in their implementation.

There was an active participation of stakeholders throughout the workshop, illustrated by a high turn-out for all three days of more than thirty stakeholder representatives. Generally the prepared format to guide discussions and structure the workshop worked well, although it was noted that issues related to demand management received relatively less attention and might need more attention in future activities. The enthusiasm and the input of the participating stakeholders indicate that there are good conditions to continue the process towards IWRM in the Mkoji Sub Catchment.

Workshop outcomes related to the formulation of an IWRM strategy

The outcomes of the discussions among the stakeholders indicate that there is a broad awareness of the need for improved water management and that the stakeholders are generally supportive to the implementation of IWRM principles. This is illustrated by the wide range of issues that emerged from the discussions on the first day. These issues are related to the water shortages that occur especially during the dry season, the conservation of water sources, water harvesting and water distribution, the formation of Water Users Associations and their Apex organization, the existing system for the allocation of water rights, education and training and the need to control the increased water demand.

Similar to the wide range of problems, also a broad base of promising solutions has been identified by the workshop participants. These problems and solutions are largely in line with the previous participatory assessment undertaken as part of the FNPP-project. However, the workshop participants placed a clear emphasis on certain areas:

- Rainwater harvesting, especially through the construction of small charco dams
- Institutional strengthening, especially through training and education and through the formation and strengthening of Water User Associations
- Additional focal points that emerged were the need to review the existing system of allocation and control of water rights, and activities that were directly related to reducing demand.

In identifying follow up activities, stakeholders showed a strong commitment to work on activities related to training and education and rainwater harvesting. Therefore, these activities should receive priority in planning follow-up activities. Concerning the rainwater harvesting and the construction of small dams, there should be a further assessment of their potential, assessing the conditions for successful implementation and their likely impacts in more detail. Related to institutional capacity building, issues that should receive immediate attention are the training and education of local water users and the allocation of water rights. In addition, based on both the stakeholder workshop and the focus group discussions, a key issue is to support the establishment and functioning of local stakeholders' organizations, especially in the Middle and Lower Zones of the Mkoji sub-catchment.

These activities, as well as the other issues that emerged during the workshop, provide building blocks that can be integrated in the regular district policies and plans and they suggest the areas where the national level government organizations can play a strong facilitating role. In addition, the FNPP stakeholder workshop offered a platform where different stakeholders could meet to discuss their problems and ideas. Hopefully this experience will stimulate the stakeholders to follow up and initiate a platform for a more regular exchange of views in the future.

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LIST OF ABBREVIATIONS

CWP	Crop Water Productivity
DADP	District Agricultural Development Plan
FAO	Food and Agriculture Organization of the United Nations
FNPP	FAO-Netherlands Partnership Programme
IWRM	Integrated water resources management
MAFS	Ministry of Agriculture and Food Security
MATI	Ministry of Agriculture Training Institute
MSC	Mkoji Sub Catchment
MWLD	Ministry of Water and Livestock Development
RBWO	River Basin Water Office
SUA	Sokoine University of Agriculture
SWMRG	Soil Water Management Research Group
Tsh	Tanzanian shilling
WUAs	Water User Associations
WWF	World Wide Fund for Nature Conservation

1. INTRODUCTION

1.1. Background

Enhancement of the productivity of water in various mosaics of crop production is a key intervention in reducing poverty levels among the agricultural based rural livelihoods. The Food and Agriculture Organisation (FAO) of the United Nations has been at the forefront of exploring such opportunities and supporting the agricultural based livelihoods.

FAO is implementing the FNPP component on "Water and Food Security: Integrated Water Resource Management for Vulnerable Groups" in Tanzania. The main thrust is to promote and apply the concept of integrated water resources management with special attention to vulnerable groups (IWRM-VG), to assure that strategies directed towards the disadvantaged will at the same time contribute to protect the environment through efficient utilization of natural resources.

As a step towards implementing IWRM, FAO has initiated a comprehensive study that is carried out in the Mkoji sub-catchment within Mbarali and Mbeya Rural Districts in order to get a better understanding of the opportunities to enhance crop water productivity so as to achieve food security. As part of this program, FAO requested the Soil Water Management Research Group (SWMRG) of Sokoine University of Agriculture (SUA) to expand its activities of assessing water use and formulating water resource management strategies in Usangu plains (within the Great Ruaha River Basin), to include a comprehensive water use and productivity assessment and IWRM – VG strategy for the Mkoji sub-catchment.

The first part of this comprehensive assessment consisted of a review of available water use and productivity and the execution of a household survey in the sub-catchment. This review was followed by a participatory problem appraisal through the use of Focus Group Discussions with stakeholders. The third part of the project was to hold a stakeholders workshop for Mkoji sub-catchment with the purpose of discussing the findings and proceeding towards an integrated water resources management plan. This report summarizes the workshop proceedings.

1.2. Objectives of the workshop

1.2.1. General Objective

The general objective of the workshop was to provide an opportunity for stakeholders in the Mkoji sub-catchment (MSC) to produce an initial analysis of IWRM issues and concerns and to show how principles of IWRM can be translated to management strategies including practical actions.

1.2.2. Specific Objectives

The specific objectives were as follows:

i) To discuss the primary issues governing present water use, productivity, scarcity and conflicts and later on define a 'basket' of multiple agricultural development and crop water productivity enhancement strategies that may be applied in conjunction with IWRM to raise the overall water use efficiency and productivity in the Mkoji sub-catchment.

ii) To induce and facilitate the formulation of an IWRM strategy and development plans by stakeholders of the Mkoji sub-catchment that can be incorporated by the Mbarali and Mbeya – Rural District Councils in their District Agricultural Development Plans.

2. METHODOLOGY

2.1. Organization of the Workshop

2.1.1. Workshop Components

The workshop consisted of two main parts. The first part included a discussion of issues and options that were identified by stakeholders during the previous Focus Group Discussions in the Mkoji sub-catchment. This part covered one day and participants discussed and defined the primary issues governing water use and productivity in the Mkoji sub-catchment and suggested a 'basket' of appropriate development options that may alleviate water shortages and increase the overall water use efficiency and productivity.

The second part covered IWRM planning, which involved integrating of multi- sector use through multi-strategy planning. This part covered one-and-a-half days and participants deliberated and defined a multi-component IWRM strategy for the Mkoji sub-catchment based on the outcome of the discussions in the first part of the workshop. The detailed workshop programme is shown in Appendix 1.

2.1.2. Workshop Participants

The key institutional stakeholders that participated in the workshop included the Rufiji Basin Water Office, Ministry of Water and Livestock Development, Ministry of Agriculture and Food Security, District Water Engineers, District Irrigation Officers, District Agricultural and Livestock Development Officers, Southern Highlands Zonal Irrigation Office, District Administrative Secretary and World Wildlife Fund for Nature. The National Institutions included MATI Igurusi Training institute, Uyole Agricultural Research Centre and Kapunga Rice Farm. These were expected to contribute on the strategies of mitigating the problems identified in the discussion.

In addition a number of key stakeholders among water users of Mkoji sub-catchment were involved. These included representatives from the different Water Users Associations (WUA) at irrigation scheme and village level as well as representatives from the Apex Organization of Mkoji sub-catchment, Farmer Field School group representatives from Galijembe and some key stakeholders from the stream management committees. A list of all the participants and the institutions they represented is shown in Appendix 2.

2.2. Workshop methodology

2.2.1. General framework for workshop activities

The purpose of the workshop was to discuss the main issues concerning IWRM in the Mkoji sub-catchment and to facilitate the formulation of an IWRM strategy. Therefore, the core of the workshop consisted of participatory planning through discussions among the stakeholder representatives. In order to bring participants to the same ground of understanding,

presentations were made on the subjects to be discussed for the day. After those introductory presentations, most time was devoted to discussions among participants.

The group discussions were organized to follow the general principles for strategic planning. Strategic planning can be seen as a cyclic process, consisting of different phases that are implemented in an iterative way. For IWRM, the following phases can be recognized[1]:

i) Assessment of the current situation (where are we now?)
ii) Identification of problems and concerns, setting the agenda for the future (where do we want to be)
iii) Identification and analysis of options to address priority problems (how can we get to where we want to be?)
iv) Choice and implementation of options
v) Monitoring and evaluation of impact of implemented options

The first two phases of this cycle had already been covered by previous FNPP activities, i.e. the comprehensive assessment and the participatory problem analysis. The outputs of these activities were presented during the first part of the workshop to provide a starting point for the group discussions. However, to ensure a common ground for planning, these first two phases were also covered during the group discussions on the first day. During these phases, participants were free to raise any concerns they had, guided by a structural format as outlined below. The third phase, identification and analysis of options, required most time, and was covered on the second day of the workshop to provide the core of an IWRM strategy for Mkoji sub-catchment. Finally, during the third day of the workshop, specific attention was given to the choice and implementation aspects.

A further elaboration of the followed methodology during the workshop is provided in the following sections. The background slides are shown in Appendix 3 while the details on the composition of discussion groups and group assignments are presented in Appendix 4.

2.3. Group assessment of current situation and main problems and concerns

Four discussion groups where formed for the discussion and analysis of IWRM concerns. Each group consisted of approximately ten persons, representing different stakeholders. FNPP Team members of Sokoine University of Agriculture (SUA) were also participating in these groups, functioning as experts to support and facilitate the discussions.

Within each group, each individual was requested to bring forward one or two concerns and explain them shortly to the group, resulting in a pool of some ten to twenty concerns. These concerns were then prioritized using a group voting procedure (Appendix 5). Next, each group selected two of their priority concerns for further discussion and analysis[2]. This discussion was intended to provide more insight into the relations between various IWRM problems, constraints and options in the Mkoji sub catchment.

The discussions were facilitated through the use of problem trees, consisting of three specific layers. They started with the identified priority concern, followed by an identification of

[1] This cycle is presented in many planning handbooks and its application for IWRM is described for instance in G. Le Moigne, A. Subramanian, M. Xie, S. Giltner (eds.) A Guide to the Formulation of Water Resources Strategy. World Bank Technical Paper Number 263, November 1994.

[2] The selection of these concerns was presented to the workshop facilitators for approval, to co-ordinate that the resulting set of problem trees covered different issues and concerns; however, in the end it appeared that adjustments were not necessary and each group worked with the problems of their initial choice.

specific constraints or sub-problems that contributed to this concern. The third step in the construction of problem trees then consisted of the identification of promising options to address the identified specific sub-problems and constraints. As a last step in their analysis, groups were asked to identify promising focal areas within their problem trees, identifying the options that they considered to be most promising to address their priority concern. An illustrative example of such a three-layered problem tree is shown in Figure 1.

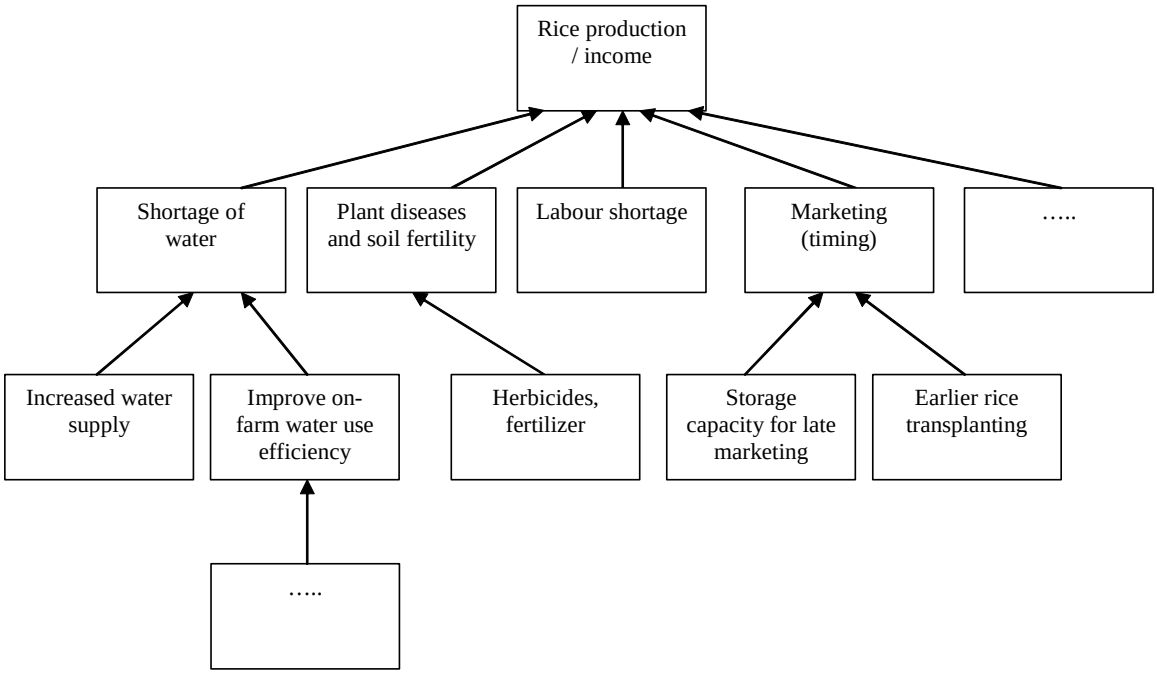


Figure 1: Illustrative example of a problem tree

2.4. Preparation of IWRM strategies

At the end of the first day, the results of the group discussions and analyses were presented in a plenary session to function as input for the group activities on the second day. These activities focused on the identification and analysis of options to be included in a comprehensive IWRM strategy for Mkoji sub-catchment. The activities on the second day were preceded by a short introduction of supply and demand management concepts and of the main institutions involved in IWRM in Mkoji sub-catchment, to give the participants specific starting points for their discussions.

Five new groups were formed, again consisting of eight to ten participants representing different stakeholders. The actions contained in the problem trees of the previous days could be used as building blocks for these strategies, as well as additional actions that participants considered necessary. To focus the group discussion and to facilitate comparable output between groups, two evaluation tables were provided. One table provided the framework to evaluate the impacts of the options; another table provided the framework to evaluate different institutional aspects related to their implementation. The basic frameworks are shown in Table 1 and 2.

Table 1: Impact table for selected options

	Space Where? (Upper, Middle, Lower)	**Time** When? (dry/ wet/ both)	**Stake-holders** Who benefits?	**Social** Impact on equity?	**Econ.** Impact on livelihood/ productivity	**Environm.** Impact on environm./ sustainability	**Water resources** Impact on availability of water resources	**Other effects** Negative impacts
Action 1								
Action 2								
…								
…								

Table 2 Institutional implementation table for selected options

	Primary responsible stakeholder (who and what)?	**Main supporting stakeholders (who and what)?**	**Financial costs government org. (and for who?)**	**User costs (labour and user fees)**
Action 1				
Action 2				
…				
…				

2.5. Final voting for options and action statements by stakeholder groups

At the end of the second day, each group presented its IWRM Plan and the specific actions in it. After the five plans were presented, at the beginning of the third day, participants could select the most promising actions in the presented plans through a plenary voting procedure. For this voting, each participant was given three votes, two of which (s)he was free to place at any action that (s)he considered to be the most important, and one of which should be placed on one of the actions where the participant was listed as a primary responsible stakeholder.

After the voting, the stakeholders were asked to identify the actions that were within their own capabilities and that they were most motivated to work on. For this purpose groups of similar stakeholders were formed, such as water users in the upper zone, training institutes or central government experts. Each group was asked to prepare an action statement, stating a short-term and a long-term action that they proposed to undertake to implement some of the workshop's findings. This last part could then serve as an action list for each of the participants, providing an initial focus for follow-up activities after the workshop.

3. CONTENTS OF WORKSHOP PRESENTATIONS

In order to bring participants to the same ground of understanding presentations were made on the subjects to be discussed for the day. This was done to stimulate discussions and solicit contributions from workshop participants. There were a total of four presentations. Three were presented on day one and one on day two of the workshop.

An introductory presentation of FNPP was given after opening the workshop. Concepts of Integrated Water Resources Management (IWRM), Productivity of Water in Agriculture (PWA) and issues arising from the preliminary findings of previous activities of the FNPP were presented in day one. An introduction to demand and supply management and to the institutional context of water resources management was presented in day two of the workshop. Summaries of the presentations are presented in this section. The presentations were given in Kiswahili and were supported by English slides, shown in Appendix 3.

3.1. Concept of Integrated Water Resources Management

The presentation served as a general introduction to integrated water resources management (IWRM), with specific reference to the situation in the Mkoji sub-catchment. The competing water needs in Mkoji sub-catchment, the increasing water scarcity and the recent institutional reforms all show the complexity of managing water resources and underline the need for an integrated approach. A systems perspective on IWRM was presented, identifying four sub-systems: social, economic, environmental (or physical), and institutional. These sub-systems are all related and need to be considered as integrated parts of one IWRM-system. In analysing these IWRM-systems, also dimensions of space (location) and time (season or period) need to be considered, as water uses and farming systems differ across space and time. Furthermore, different stakeholders are involved, each with a different role in water management and with different interests and views of the situation. These stakeholders should ultimately determine the priority of various water needs by distinguishing between essential needs, priority needs and preferred needs.

Reviewing all these concepts, it is clear that establishing an IWRM plan is a difficult task that needs co-ordination, deliberation and making well-informed choices. Therefore, a general strategic planning procedure was adopted as a basis for this workshop, consisting of five iterative steps: (i) assessment of the current water situation, (ii) identification of problems and concerns related to IWRM, (iii) actions and strategies to address these problems and concerns, (iv) implementation of actions, and, (v) monitoring and evaluation of the impact of these actions.

3.2. Concepts of Productivity of Water in Agriculture

The presentation introduced the concept of productivity of water first by looking at the global situation and then narrowing down to MSC perspectives. Further, it introduced that the ability to increase food production fast, to keep pace with population growth, has been one of the greatest achievement of humankind. However, the cost of this achievement is the water crisis that many people are facing. The water crisis is indicated by water scarcity, competition, pollution, loss of plant and animal species and persisting malnutrition.

During the introduction of the concept it was clearly stated that, generally the value or productivity of water for industrial and domestic uses is much higher than that of agriculture.

Due to this fact, there is pressure to share water within and between different sectors. This could be exemplified by the fighting for water between crop producers and livestock keepers or between domestic and livestock keepers especially during the dry season in the Mkoji sub-catchment. Hence improving productivity of water is an important step in solving this crisis, among other things because it can mitigate scarcity and reduce competition over water; it allows for food security and puts less strain on nature.

To enhance the understanding of the concept to workshop participants, the productivity of water in agriculture (PWA) was generally defined as the ratio of benefits (physical, economic, social or environmental) to the amount of water depleted. The benefits referred to here include for example the kilogram of yield produced, income generated (Tsh, $), number of jobs created due to the presence of water, and the value attached to good health for example as a result of presence of water. Clear identification of the boundaries in crop water productivity definition was pointed to be important for the definition to hold. Also some generic paths that can be applied for increasing productivity of water in agriculture were outlined to the participants.

The presentation of the concepts of PWA was supported by summary results of the crop water productivity analysis of the MSC from the FNPP Project. In summary the crop water productivity indicated a distinct variation within and between the different locations of the MSC both under rainfed and irrigated conditions. Also there was inter-crop variation of water productivity within individual locations. For example water productivity for maize crop was 0.55kg/m3, 0.28kg/m3 and 0.66kg/m3 for upper, middle and lower MSC respectively. Considering inter-crop variation for grain and high value crops in the middle MSC under dry season irrigation, the values of CWP were 0.34kg/m3, 0.27kg/m3 and 1.10kg/m3 for maize, dry beans and tomatoes respectively. Several factors contribute to the differences in CWP values obtained between and within different locations of the MSC. The differences in climatic conditions, water availability and its allocation, soil conditions and variability are some of the possible major contributing factors for crop water productivity variation between locations. On the other hand timing of crop planting, crop varieties and socio-economic factors might be some of the major contributing factors for CWP variations within location for different crops.

The results from the analysis also indicated that increase in physical CWP does not necessarily mean increase in economic[3] water productivity. The main contributing factors behind increased economic water productivity were increase in crop yield and favourable farm gate price of harvested crop. These factors may influence CWPs differently between different time window periods depending on demand and supply of production parameters and the harvested crop. The maize crop in such arrangements that had higher physical CWP (0.85kg/m3) compared to dry beans (0.45kg/m3) under irrigated condition in upper MSC, its economic productivity (0.14$/m3) was lower than that of dry beans (0.15$/m3) as indicated in Appendix 3. These variations are mainly due to the differences in farm gate prices, which was about 165Tsh/kg for maize and 350Tshs/kg for dry beans[4].

Variations in CWPs have important implications on the strategies for integrated water resources management. They indicate the need to design a basket of strategies that targets

[3] Economic productivity in this case means the value of water in Tsh or $ obtained from the sale of harvested crop under farm gate prices. In this case crop sale prices might not be representing the true value of a crop if sales were made under perfect market conditions.

[4] The exchange rate used during the period of analysis was 1US$ = 1030 Tsh.

specific location considering the diverse socio-economic groups found in MSC. This is important because strategies that may work well in one location of the sub-cathment may not equally apply to another location where crop performance, physical and socio-ecomic conditions including their vulnerability are different.

As a general conclusion from CWP analysis in the MSC it was found that:

i) The CWP values for the middle MSC were generally the lowest in all the three zones under rainfed crop production compared to those in the other crop production domains. The CWPs for high value crops (e.g., tomatoes and onions) were also higher than those of cereals (cf. maize, wheat and millet), beans and groundnuts under similar conditions.
ii) The CWPs for irrigated tomatoes, onions and potatoes were generally higher than those of irrigated grains. With exception of onions, CWPs for irrigated crops in upper zone were higher than those in the middle zone.
iii) CWPs for rice crop in the middle and lower of MSC were relatively higher than the average CWP of 0.18kg/m^3 for rice recorded in the Usangu Plains.

3.3. Preliminary Findings of FNPP Assessments

This presentation focused on the preliminary findings of the FNPP study on comprehensive assessment of water resources of the Mkoji sub catchment and the results of the participatory problem analysis. It highlighted the methodology of the study and gave an overview of current water uses, conflicts, problems and strategies for addressing these problems. The methodology for the study included analysis of climatic, runoff and ground water data, analysis of typology of livelihood and farming systems in the sub catchment, assessment of cropping pattern and productivity of water and participatory identification of problems through Focus Group Discussions (FGD).

The preliminary findings show that there are regular water use conflicts within and among the different water use sectors. These sectors include irrigated agriculture, livestock, domestic and environmental needs. Others include fishing activities, brick making and hydropower. Problems associated with the water resources in the sub-catchment were classified into economic, social, environmental and institutional problems. There are economic problems related to low prices and marketing problems for agricultural produce and related to the lack of possibilities to obtain the required inputs for agricultural production (such as fertilizers and financial credits). Social problems related for instance to poor accessibility to water especially at the lower zone of the catchment, inadequate potable water for livestock and domestic needs, gender inequality in relation to water use in the area, among others. Environmental problems relate to the continuous degradation of water resources at the upper catchment due to for instance cultivation in riverbanks, cutting and burning of trees and planting of water consuming Eucalyptus trees in the riverbanks.

The institutional problems have to do with a lack of collective bargaining power among water users and a lack of definite comprehensive water development plans for the area. The institutional capacities at the village level were also identified as a problem because there is relatively little institutional capacity in most village governments when it comes to water resources management. In some villages Water User Associations are being formed, but these associations are still young and in the formation stage. They do not yet have the mandate or the resources necessary to take up their tasks. Furthermore, in the middle and especially the lower zones of the Mkoji sub catchment, WUAs are not yet being formed. In these areas, there still is an institutional gap when it comes to water resources management. As a result,

stakeholders in these villages are also under represented in the formal institutions for IWRM at the regional level.

Strategies for addressing these problems included a need for a form of regular dialogue on water allocation and management among sectors and stakeholders in the whole sub catchment, review of the establishment of Apex organization for water users in the sub catchment, application of demand and supply management approaches, introduction of low-cost irrigation and water and labour saving technologies in the area.

3.4. Demand and Supply Management and Institutional Roles for IWRM

This presentation focused on the demand and supply management of water and the roles various institutions can play towards Integrated Water Resource Management (IWRM). Since there is just one water resource pool in the catchment with multiple uses and users, there is a need for a strategy for distributing and sharing this common pool resource to meet all uses and users. This strategy should address how much water goes to where and when. Allocation could be based on the order of essential, priority and preferred needs.

There is a need to know how much water resources in the area we can control (manage) for supply and how. This is essential because meeting the water needs of the users depends on how we can control the water supply and the need to share scarce resources during the dry season. In sharing the available flow, there is a need to restrict individual supplies to meet all essential and priority needs, and application of supply schedule to serve all needs and users based on the principles of fairness and sharing burden. This will need an improvement to the conveyance efficiency through canal maintenance and construction, and construction of water harvesting and storage facilities. Although restricting water supply in the time of scarcity hurts, if we manage to produce more with less water it hurts less. We can thus bring our actual water need closer to actual available water supplies. The principle of demand management entails reducing water needs and producing more with less water (i.e. increasing water productivity). This could be achieved through cultivating less area with high value crops, on-farm management, fertility management and sound agronomic practices.

An integrated water resources management strategy for Mkoji requires the involvement of all institutional stakeholders. In adopting a supply management approach, the River Basin Water Office (RBWO) could take a co-coordinating role in water rights and allocation; the Apex and WUAs could take a leading role in water scheduling and distribution plans; conflict resolutions could be handled by the RBWO and Apex WUAs. Water conveyance, storage and harvesting could be coordinated by the District, RBWO and the Ministry of Agriculture and Food Security (MAFS). In the demand management approach, the Districts through the District Agricultural Development Plan and the Apex WUAs could take a coordinating role in an IWRM strategy. The Research and Training Institutes could provide technical support, the MAFS could provide support for the Districts and the WUAs could participate and support the strategy.

4. RESULTS OF PARTICIPATORY PLANNING ACTIVITIES

4.1. Identification and analysis of priority concerns

Workshop participants were divided into mixed groups of approximately ten participants to deliberate on the main concerns affecting water management and use in the Mkoji sub-catchment. A long-list of IWRM concerns was created and ranked. The results are shown in Appendix 5. The concerns were mainly related to water demand and supply management. Some were general concerns not directly linked to demand and supply management of water but did have policy and development implications. Examples of the latter are agricultural products marketing problems, poverty, poor road infrastructure and availability of agricultural inputs. The concerns on the long-list were then prioritised and the most critical ones are listed in Table 3 below.

Table 3 List of priority concerns deliberated by groups on day 1

Group	Concern
GROUP I	Management of water distribution in the dry season Increase of irrigation activities in middle and upper zones Conservation of water sources
GROUP II	Degradation of water sources Some stakeholders not involved in MSC Apex organization Government giving little weight to rainwater harvesting
GROUP III	Lack of water harvesting and conservation infrastructure Little education among water users Water scarcity
GROUP IV	Water shortage and poor distribution Unrealistic allocation of water rights Poor water distribution

The top two priorities among the concerns were structured into problem trees. These were used to analyse cause and effect and the relevant concerted actions necessary to solve the pertinent problems. A total of eight problem trees were developed (Appendix 6). Due to time constraints, only the four most important problem trees (one from each group) were discussed in the plenary session. However, all eight-problem trees were displayed in the workshop room to serve as a basis for further analysis of actions during the second day.

As a last step, groups were asked to select the most promising actions from their problem trees, which are shown below (Table 4)

Table 4 Actions deliberated by the groups on day 1

Group	Actions
GROUP 1	Rain water harvesting Conservation of water sources Use conservation agriculture practices Involvement of all stake holders in the MSC All stake holders should be educated
GROUP 2	Formulate elaborate land use plans Provide security and conservation measures to water sources Formulate and enforce byelaws Set aside livestock grazing areas
GROUP 3	The government should make concerted efforts to assist in rain water harvesting and water conservation
GROUP 4	Review available water resources Review water right to conform to available water resources Involve water users in allocating water right

4.2. Formulation of IWRM strategies

Day two was dedicated to work on IWRM strategies for Mkoji sub-catchment. Based on the problem trees and the priority list of actions established during the first day, promising actions were combined into a strategy. For each of the selected actions an analysis of impacts and implementation aspects was done. Details of the resulting impact and implementation tables are shown in Appendix 7.

In reviewing the impact tables shown in Appendix 7, one can note that the contained impact scores are generally positive. This means that participants expected positive contributions from all actions on all sub-systems: the only negative impacts in most cases are the implementation costs. Trade-offs did not clearly surface from the workshop discussions and this suggests that the participants avoided some of the hard and difficult choices during their discussions. This might be due to the fact that the limited times available, and possibly also the used format, were not sufficient to allow for a detailed analysis of more complex impacts.

For the implementation of actions, a large range of responsible actors is identified, ranging from local water users (such as farmers and livestock keepers), to district and national government agencies, international donors and NGOs. However, the *primary* responsibility for implementation is in most cases placed with local water users, village government or WUAs. These results underscore the importance for local water users to organize themselves into WUAs to be able to more effectively take up their responsibility for water management actions. The government, through local government and RBWO, should encourage further formation of water users associations to improve water management and use.

4.3. Voting for priority actions and implementation

4.3.1. Voting for priority actions

At the start of the last day of the workshop, participants identified the priority actions contained in the IWRM strategies that had been developed during the previous day. As discussed in Chapter 2, this voting covered two aspects: general priority of actions and priority of actions for which participants had primary responsibility for implementation. The detailed results of voting are shown in Appendix 8 and a summary of these results is shown in Table 5.

Table 5 Summary of voting results concerning priority actions

Type of action	General priority votes	Responsibility votes
Water supply - rainwater harvesting & dams	31	15
Institutional capacity building and training of WU	14	10
Administration and control of water rights	11	3
Reducing water demand	10	1

(Note that each of the participants could identify two actions for the general priority voting. In addition they could place one "responsibility vote", to be placed only on actions where the voter had implementation responsibility. FNPP-project members of SUA and FAO did not participate in the voting.)

The water supply related actions mentioned in Box 3 consisted mainly of training various stakeholders on rainwater harvesting techniques and the construction of small charco-dams and irrigation infrastructure. There was also considerable support for institutional capacity building, consisting among others of improving the water management practices by the primary water users (for instance through training) and the formation and strengthening of Water User Associations. The training of water users and the general water management improvements were not further detailed in the prioritization, and therefore might refer to both demand and supply management issues. The importance of the institutional issue of water rights covers the review of water rights, as well as the development of improved monitoring and control devices to ensure that allocated water rights are properly administered. Finally, the water demand management actions consisted of a reduction of the water demand of exotic high water-consuming trees and a reduction of land under irrigation.

The voting results in Table 5 show that generally there is a shared awareness on the need to implement a broad range of IWRM activities, both addressing supply and demand management issues and both "software" (training and institutions) and "hardware" (infrastructure, irrigated lands). This is an encouraging basis for further elaboration of IWRM plans.

4.3.2. Voting for priority responsibilities and preparation of action statements

As a last part of the workshop, participants were asked to reflect on their own role in the implementation of IWRM actions. In addition to the ordinary voting for actions, participants were also asked to assign priorities to actions for which they themselves had been identified

as a stakeholder with primary responsibility for implementation. The results of this voting are contained in the last column of Table 5 above.

This last column of Table 5 shows that, when it comes to implementation, the majority of stakeholders are most motivated to work on supply management actions and institutional capacity building and training. Demand management and activities related to water rights appear to be lower on the priority list of most stakeholders when it comes to implementation, even though these activities are recognized as being important. This is illustrated by the differences between the second and the third columns for water rights and demand management actions in Table 5.

The low score of 'responsibility votes' for water rights is probably due to the fact that only a few participants were allowed to vote for these actions, because it was considered to be the primary responsibility of the RBWO. Furthermore, the apparent preference for the implementation of supply management and training activities can be understood when one realizes that reducing water demands or establishing and enforcing water rights are by no means easy tasks. These actions might limit some of the existing water uses and might affect the existing balances of power and responsibilities among stakeholders. If actions on improved water supply or training of water users would be sufficient, one would rather avoid potentially painful or upsetting actions in the areas of water demand reduction. Nevertheless, the considerable support for institutional capacity building activities provides a promising starting point to provide the necessary balance between supply and demand management activities in the future.

In addition to the voting procedures, stakeholders of similar identity prepared short statements on their short-term and long-term plans for implementation of priority actions in their groups. The results of this last activity are detailed in Table 6 below.

Table 6 Short-term and long-term plans for implementation of priority actions

Stakeholder group	Short-term plan	Long-term plan
Water Users (Upper zone of MSC)	Cut and uproot water depleting trees and plant environmental friendly trees	Construct rain water facilities and store in charco dams
Water users (Middle and Lower zone of MSC)	1.Reduce farm areas according to available water resources 2.Educate farmers on the importance of matching land areas with available water resources	Construct charco dams for water storage
District experts	Train farmers/ water users on water management and use	Construct charco dams for water storage
Training Institutes and NGO's	Train village extension officers and water users land and water Management	Train village extension officers and water users on conservation and improvement of catchment areas
Central Government experts	Rain water harvesting in charco dams	Train the community and water users in upper MSC on National Water policy and the long term plans by the government on use of water resources

Table 6 confirms the notion that there is most support for implementing actions related to the construction of water storage facilities (charco dams) and training and capacity building. Both these actions attracted a lot of votes as shown above and were again mentioned by almost all groups in their action statements. This means that both capacity building among water users and the construction of charco dams should receive priority in follow-up activities. The possibilities and constraints related to both activities should be explored, identifying the opportunities and constraints and the cost and benefits related to for instance the construction of charco dams. The workshop outcomes suggest clear focal points for follow-up investigations in which water users, Districts, MAFS, MWLD and the RBWO all should play a role.

5. DISCUSSION OF RESULTS AND THE WAY FORWARD

5.1. Priority areas of action for participating stakeholders

The workshop results show that the participating stakeholders are well aware of the need for water resources management actions in several areas, both related to water supply, demand and institutional developments. This provides an encouraging basis for further elaboration of IWRM plans in the near future.

When it comes to priorities for specific water resources management actions among stakeholders, two areas stand out from the prioritization at the end of the workshop. There is clearly a widespread support among stakeholders for the implementation of water storage and rainwater harvesting structures, mainly through the construction of charco dams, and there is a strong support for actions related to institutional capacity building and training of water users.

Related to institutional capacity building, the workshop participants recognized the need to form and strengthen Water User Associations and expressed a concern over the coverage of the WUAs Apex organization. The need for institutional capacity building is especially urgent for the water users in the middle and lower zone of the Mkoji sub-catchment. In the upper zone WUAs are being formed and are being included in the Apex organization, but in the lower zone such developments are still absent. Training needs cover various aspects of water management, but specific attention seems to be needed for areas of water demand management, as these seem to be under appreciated currently.

In addition to the two key concerns of water supply infrastructure and institutional capacity building, also specific institutional actions related to water rights administration and, to a somewhat smaller extent, actions related to demand management surfaced as important priority areas. All these actions therefore should be addressed in future planning activities, first of all to gain more insight in their positive and negative impacts and in the possibilities for implementation. For instance, the apparent enthusiasm for the construction of water supply infrastructure such as small dams and groundwater wells might improve the situation for local water users, but care should be taken that such structures do not further reduce the availability of water to other users.

5.2. The way forward

The FNPP stakeholder workshop covered the first three elements in the IWRM planning cycle: inventory of the current situation, problem analysis and identification of actions to address these problems. Implementing the promising actions for IWRM in the area requires that also subsequent steps are taken up and the workshop results provide some promising starting points to do so.

The workshop provides an inventory of stakeholders' concerns and priorities that can be used by different organizations as a legitimate basis for their future IWRM activities. For instance, they suggest issues for inclusion in the District Agriculture Development Plans that have to be established on a yearly basis through a participatory process. The results also provide various local stakeholders with possibilities to prioritize their short-term activities, as they have in fact already done during the last day of the stakeholder workshop.

The workshop results underline the importance of institutional activities and the need to organize water users, especially the vulnerable groups in the middle and the lower part of the Mkoji sub-catchment. However, it is unlikely that these local water users have the ability to take up these institutional activities without external support. Therefore, local level institutional strengthening is one of the areas where there organizations like RBWO, MAFS and MWLD can play an important facilitating role.

Finally, the FNPP stakeholder workshop offered a platform where different stakeholders could meet to discuss their problems and ideas. Hopefully this experience will stimulate the stakeholders to follow up and initiate a platform for a more regular exchange of views in the future.

6. APPENDICES

Appendix 1 Workshop Programme

Day 1 (15th January 2004)

Time	Activity	Responsible
8.00 –9.00	Registration	Evelyn Mwenga
9.00 – 9.15	Opening and Introduction	Henry Mahoo
9.15 – 9.30	Background to FNPP	Gerardo van Halsema
9.30 – 9.45	Concept of IWRM	Leon Hermans / Japhet Kashaigili
9.45 – 10.00	Concept of PWA	Makarius Mdemu
10.00 – 10.15	Tea Break	All
10.15 – 11.00	Issues arising from preliminary findings of FNPP study Current water use in MSC Problems Strategies	Charles Sokile and Kasele Sydney Steven
11.00 – 11.20	Introduction to group work	Leon Hermans, Gerardo van Halsema, Henry Mahoo
11.20 – 13.00	Group discussions on concerns	G1, G2, G3, G4
13.00 – 14.00	Lunch	All
14.00 – 15.45	Group discussion (continued)	G1, G2, G3, G4
15. 45 – 16.00	Refreshments	All
16.00 – 17.00	Group presentations	G1, G2, G3, G4
17.00 – 17.15	Closing	Henry Mahoo

Day 2 (16th Jan 04)

Time	Item	Responsibly
8.00 –9.00	Registration	Evelyn Mwenga
9.00 – 9.15	Opening and Introduction	Henry Mahoo
9.15 – 9.45	Presentation demand/supply management and institutions	Gerardo van Halsema / Kossa Rajabu
9.45 – 10.00	Introduction to group assignments	Hermans/Van Halsema/ Henry Mahoo
10.00 – 10.30	Tea Break	All
10.30 – 13.00	Group work	Groups
13.00 – 14.00	Lunch	All
14.00 – 15.00	Preparation of group presentations	Groups
15.00 – 16.30	Group presentations of IWRM Plans	Groups
16.30-17.15	Ranking and wrap-up of results	All

Day 3 (17th 01 04)

Time	Item	Responsibly
8.00-9.00	Voting on IWRM actions	
9.00 – 9.15	Introduction to final group work	Henry Mahoo
9:15 – 9:45	Group elaboration of action statements	Groups
9.45 – 10.00	Presentation of group action statements	Groups
10.00 – 10.30	Wrap up and summary of follow-up plans	Henry Mahoo/ Gerardo van Halsema /Participants
10.30 – 10.45	Closing	Henry Mahoo and Gerardo
10.45 – 11.00	Refreshments	All

Appendix 2 List of participants

S/N	Name	Organization/Institution
1	Henry Mahoo	Team Leader, SWMRG SUA
2	Gerardo van Halsema	FAO Technical Officer
3	Leon Hermans	FAO Associate Professional Officer
4	Boniface Mbilinyi	SWMRG SUA
5	Alphonce Mganga	Research Associates, SWMRG SUA
6	Makarius Mdemu	"
7	Kasele Sydney Steven	"
8	Igbadun Henry,E	"
9	Zakaria J.Mkoga	"
10	Japhet Kashaigili	"
11	Kossa Rajabu	"
12	Kadigi Rubeni	"
13	Charles Sokile	"
14	Zawadi Mwakyokola	MAMREMA, Kimani Mbarali
15	Moshi Sankunja Mgojwa	Mwatenga village representative (Mid zone MSC)
16	Amina Mwampanda	"
17	Juma Mwakanyamala	Mahongole village representative (mid zone MSC)
18	Richard Mgwadila	Ukwaheri village representative (lower zone MSC)
19	Philemoni Jonasi	Madundasi village representative (Lower zone MSC)
20	Langson M Mwansanga	Ikhoho village representative (mid zone MSC)
21	Joseph R Mendamenda	Inyala village representative (mid zone MSC)
22	Leonard Muliahela	DALDO, Mbeya Rural District, Mbeya
23	Kristian J Mapunda	DALDO, Mbarali District, Mbeya
24	Anna J Mwahalende	District Water Engineer, Mbeya Rural
25	Reginald Mlinga	District Irrigation officer, Mbarali
26	Maronga Y Msuya	District Irrigation officer, Mbeya Rural
27	Issah Anania Kyando	Ipatagwa Irrigation scheme chairman
28	Peter Masolwa	World Wildlife Fund office representative
29	Omari Wahure	MAFS Sociologist
30	John Kaduma	Zonal Irrigation office representative
31	Zakaria Malley	SHARDI Uyole, Mbeya
32	Jackson Mwakasege	DCDO, Mbarali District
34	Mgoda Bevelina	DCDO, Mbeya Rural
35	Abel Nicodemu Maganga	Chairman, Apex Water Users Association Mbeya rural
36	Mariam Japanese	Ruanda- Majenje Irrigation Scheme
37	Welner Jacob Mponda	District Administrative Secretary, Mbeya rural District
38	Damson m. Mthangu	District Administrative Secretary, Mbarali District
39	Idrisa Msuya	RBWO – Rujewa
40	Patric Mkingafwile	Farmer Field School, Galijembe (Tujitume group
41	Wilbroad Mosha	MATI Igurusi, Tutor
42	Emmanuel Abel Malila	Farmer Field School, Galijembe (Tujitume group
43	Rajabu Abdalah Mweta	
44	Frank Jacob Zumba	Farmer Field School, Galijembe (Hushile group
45	Ezekiel Franzis Mpogole	Treadle Pedal Pump technician, Morogoro
46	Alphonce James	Farmer Field School, Galijembe (Hushile group
47	Mr.Haule	MWLD, Maji Ubungo DSM

Appendix 3 Presentations

Power-point slides of presentations are available upon request.
Please contact: Gerardo.vanHalsema@fao.org
or Leon.Hermans@fao.org

Appendix 4 Composition of Discussion groups and group assignment

Group Composition Day 1

Group I

Alphonce Mganga
Makarius Mdemu
Moshi Sankuja Mgonjwa
Damson M. Nthangu
Ezekiel Franzi's Mpogole
Amina Mwampanda
Frank jacob Zumba
KristianJ Mapunda
Rajab Abdalah Mweta

Group II

Zakaria Mkoga
Japhet Kashaigili
Philimon Jonasi
Emanuel Abel Malila
Leonard M.E. Muliahela
Wilbroad Mosha
Joseph Richard Mendamenda
Patrick Mkingafwile
Idrisa A .Msuya
Welnel jacob Mponda

Group III

Kasele Sydney Steven
Igbadun Henry E
Langson M. Mwansanga
Mariam Japanese
Maronga Y Msuya
Petro Masolwa
Abel Nicodem Maganga
Issah Anania Kyando
Jackson A Mwakasege
Kadigi Reuben

Group IV

Charles Sokile
Kossa R.M Rajabu
Richard Mgwadila
Reginald E Mlinga
Omari Wahure
John Kaduma
Zawadi Mwakyokola
Anna J Mwahalende
Zacharia Mkoga
Juma Mwakanyamale

Group Assignment Day 1

Introduction to group discussion on IWRM concerns

FNPP Workshop Mkoji Sub-Catchment

15-17 January 2004

Group discussions

- Discussions in different small groups of 6-8 persons, covering distinct roles and positions in IWRM Planning:
  - District government officials
  - Local stakeholders at the village level (upstream and downstream)
  - External experts
- Purpose:
  - Get out the **main** concerns
  - Get insight into the relations between various concerns, constraints and actions in IWRM

Identify and rank objectives

- Every group member brings in 3 concerns
  - Concerns: issues that you find important to address in the sub-catchment, problems, what needs changing, what needs fixing, etc.
- Review concerns together for overlap/clustering
- Rank concerns
  - Every member is assigned three points, can give every concern one or more of these three points
- After ranking:
  - Draw lines between essential, priority and preference needs
  - Select highest ranking concerns for elaboration.

Select concerns for elaboration

- Select high-ranking concerns
- Selected concerns should be:
  - Sufficiently interesting for further analysis
  - Both should be sufficiently different, at least address another sub-system (e.g. if first objective is related to social issues, then second should be economic/environmental/institutional)
- Split the group in two for practical working on problem-trees (one each)

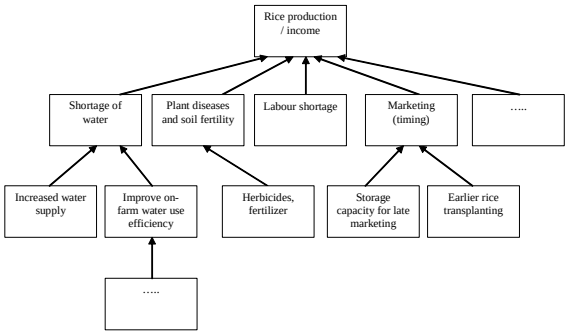
Construct problem trees

- Purpose:
  - Structuring concerns, constraints and actions, gaining insight into relations between main aspects of a problem.
- Function:
  - Enhance preciseness of problem formulation
  - Identify sub-problems, constraints and interventions
  - Identify promising and less promising focal points

Elements in problem trees

- Start with **concerns**
- Assess the main **constraints or sub-problems** related to this concern
- Assess possible **solutions** to address sub-problems and constraints
  - At the top of the diagram is the basic concern
  - At the basis of the diagram are solutions: areas for intervention and possible actions
- Identify promising **focal** areas

Example: rice production for income



Finalizing group work

- Discuss each other's problem trees
- Review the first list of group concerns together: does it need clustering or "cleaning-up"?
- Review the revised list to establish your group's 3 key concerns that you want to take to the plenary session
- Select problem tree that best covers the key concerns to present to the group

Practical

- All groups elect chairman and reporter
  - Chairman guides the discussion and keeps track of time
  - Reporter is responsible for taking notes for the final presentation
- Report findings back to plenary group in short presentation (max. 10 minutes)
  - Three key concerns
  - One selected problem tree

Time table group work

11:15-12:00	Identify concerns
12:00–13:00	Prepare problem trees
13:00-14:00	Lunch
14:00-14:30	Discuss results within groups
14:30-15:00	Review list of concerns and select 2-3 key concerns
15:00-15:15	Prepare final presentation

Group Assignment Day 2

Preparation of IWRM Plans

FNPP Workshop Mkoji Sub Catchment

15-17 January 2004

Preparing action plans

- New groups, mixed stakeholders this time
- Each group develops an Integrated Water Resources Management Plan:
  - Consisting of specific actions
  - Covering the whole Mkoji Sub-Catchment
  - Taking into account the essential needs, priority needs and preference needs

Identifying actions

- Identifying specific actions that seem promising to address yesterday's priority concerns
- Develop actions pair-wise:
  - one for supply management,
  - one for demand management
- For each action, assess:
  - Impacts and effectiveness
  - Implementation and institutional aspects

Issues of Water Supply Management

- Water rights & distribution (equity & fairness)
- Improve conveyance efficiency (canal maintenance and construction)
- water scheduling for scarce periods (restricting supply and sharing the burden)
- water storage and harvesting (dams, ponds, chaco-dams)

Issues of Water Demand Management (Rainfed & Irrigated)

- Agro-forestry in upper catchment (efficient production and increase water resource capacity in dry season)
- Dry/mulch paddy cultivation
- conservation agriculture in rainfed crops (fertility, water and labour management)
- residual moisture cropping systems in lower/middle catchment (nitrogen fixation?)
- on-farm water and fertility management
- concentration of high value crops in dry-season to restricted command area (restrict conveyance losses and make irrigation scheduling easier)
- deficit irrigation management in dry season

IWRM concepts

- Sub-systems:
  - Social
  - Economic
  - Environmental
  - Institutional - *how?*
- Dimensions:
  - Space
  - Time
  - Actors

Impact table for actions

	Space Where? (Upper, Middle, Lower)	*Time* When? (dry/ wet/ both)	*Actors* Who benefits?	*Social* Impact on equity?	*Econ.* Impact on livelihood/ productvty	*Environm.* Impact on environm./ sustainablty	*Water resources* Impact on availability of water resources	*Othe effec* Neg impa
Action 1								
Action 2								
…								
…								

Institutional: implementation table for actions

	Primary responsible actor (who and what)?	Main supporting actors (who and what)?	Financial costs government org. (and for who?)	User costs (labour and user fees)
Action 1				
Action 2				
…				
…				

Organization

- Again, each groups appoints its own chairman and reporter
- Each group gets 15 minutes to present their work
- Presentation should at least include:
  - Impact table of actions
  - Implementation table of actions
- Plenary presentations start at 15:00

Suggestions

- Use yesterday's problem trees and tables for input into your discussion
- Keep especially the essential and priority concerns in mind
- Ensure that your plan covers the whole basin: all subsystems, actors, locations and periods
- Consult experts for questions related to specific actions

Appendix 5 Ranking of concerns (day 1)

Group I

	CONCERN	SCORE
1	Unsuitable use of water in MSC	6
2	Water conflicts	6
3	Lack of agricultural inputs and markets for villagers situated a distant from the highway	4
4	Lack of water for livestock in Mbarali District	3
5	Lack of knowledge for water reservoir construction	3
6	Lack of participation of stakeholder in productivity of water	3
7	Increase of irrigated agriculture in upper and middle zone of MSC	2
8	Bad use of water affecting agricultural production and electric	1
9	production	1
10	Lack of knowledge for rain water harvesting	1
11	Poor management of water distribution in dry season	1
12	Degradation of water sources	1
13	Not planting water loving trees around water sources	1
14	Misuse of water	1
15	Cutting of indigenous trees around water sources	
16	Cultivation around water sources and planting trees which absorb much water	1 0
17	Poor varieties of crops grown in dry season	0
18	Lack of water for domestic and livestock use in lower zone in dry season Lack of water at the Ruaha national Park	0

Group II

	CONCERN	SCORE
1	Degradation of water sources	9
2	Some stakeholders not involved in MSC apex organization	5
3	The Government not accord rainwater harvesting the weight it deserves	4
4	Lack of water reservoir	2
5	Lack of agricultural inputs	1
6	Unreliable markets	1
7	Lack of extension officers	1
8	Traditional beliefs in agricultural industry	1
9	Lack of credit facilities	0
10	Use of low technology facilities for farming	0
11	Lack of irrigation infrastructure	0
12	Lack of education for water and land uses	0

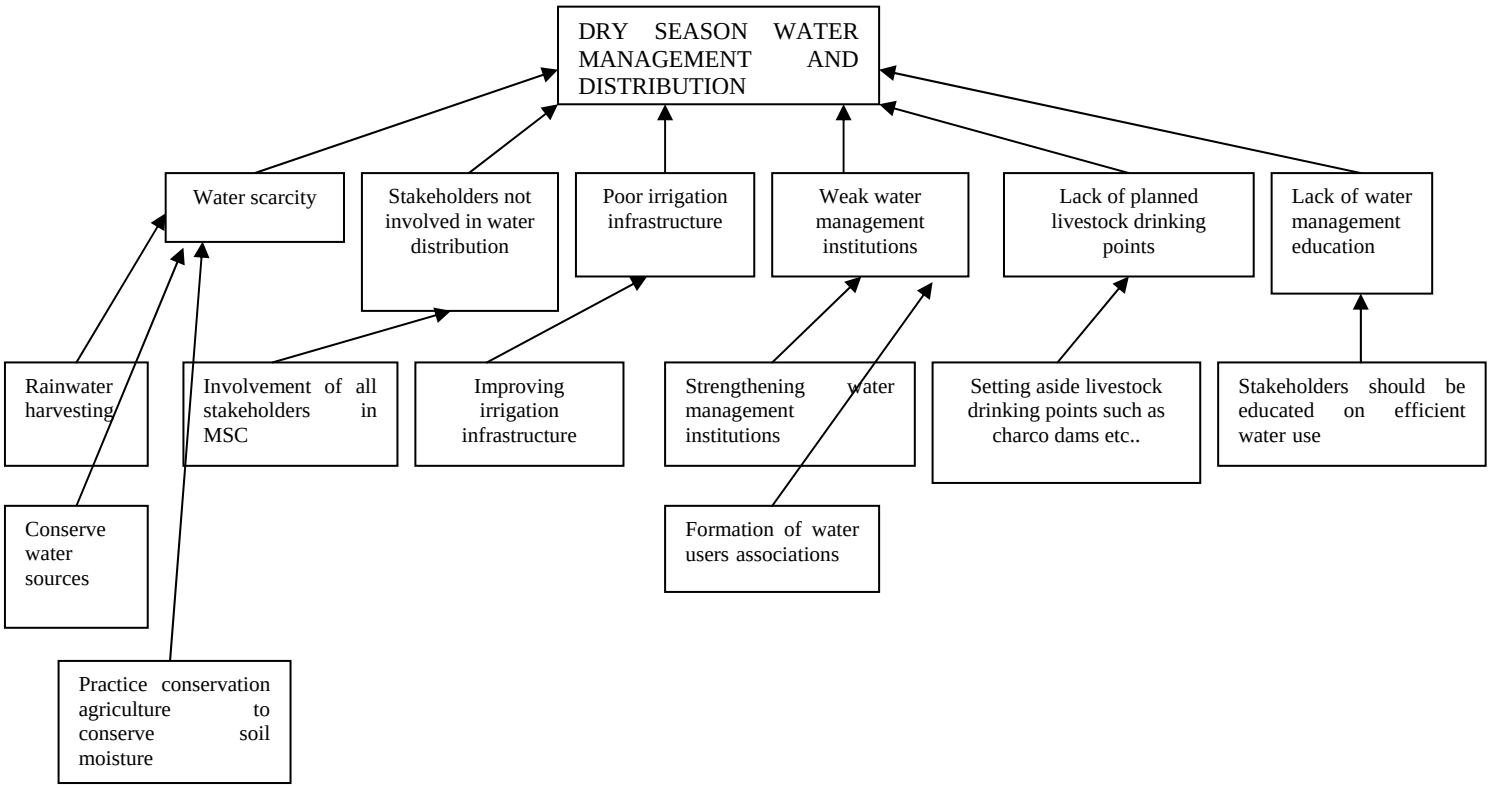
Group III

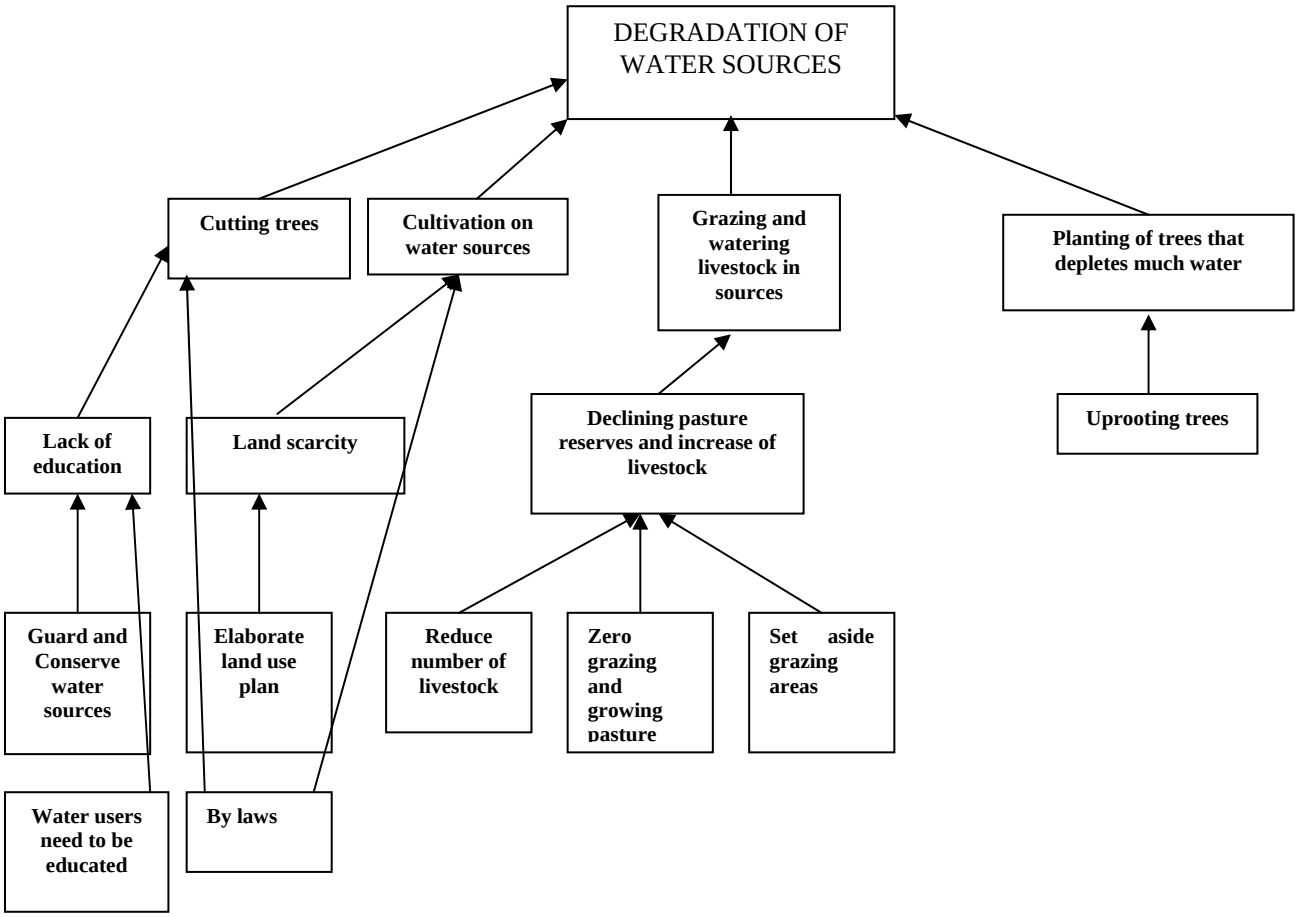
	CONCERN	SCORE
1	Lack of infrastructures for water harvesting and storage	6
2	Water shortage dry/ wet season	5
3	Environmental degradation	4
4	Misuse of water	3
5	Lack rural roads of good	2
6	Water use conflicts	1
7	Conflicts between farmers and livestock keepers	1
8	Poor management of the bylaws for proper use of water	1
9	Lack of research on productivity of water in agriculture	1
10	Lack of education for water users	0
11	Lack of modern irrigation infrastructures	0
12	Lack of legal and strong water users institution for management of the water use	
13	Lack of soil erosion conservation measures in lower and elevated land	0
14	Lack of stockists for agricultural inputs close to farmers	0
15	Water pollution caused by chemicals used by farmers and livestock	0
16	keepers	0
17	Wild fire and cutting trees from water sources	0
18	Lack of water users fees	0
19	Low prices of farmers	0
	Lack of stakeholders participation on fate their livelihood (e.g.	0
20	establishment of Usangu and Kipengere game reserve)	0
21	Lack of capital for buying agricultural inputs	0
22	Lack of registration for the WUA	0
	Lack of perennial crops	

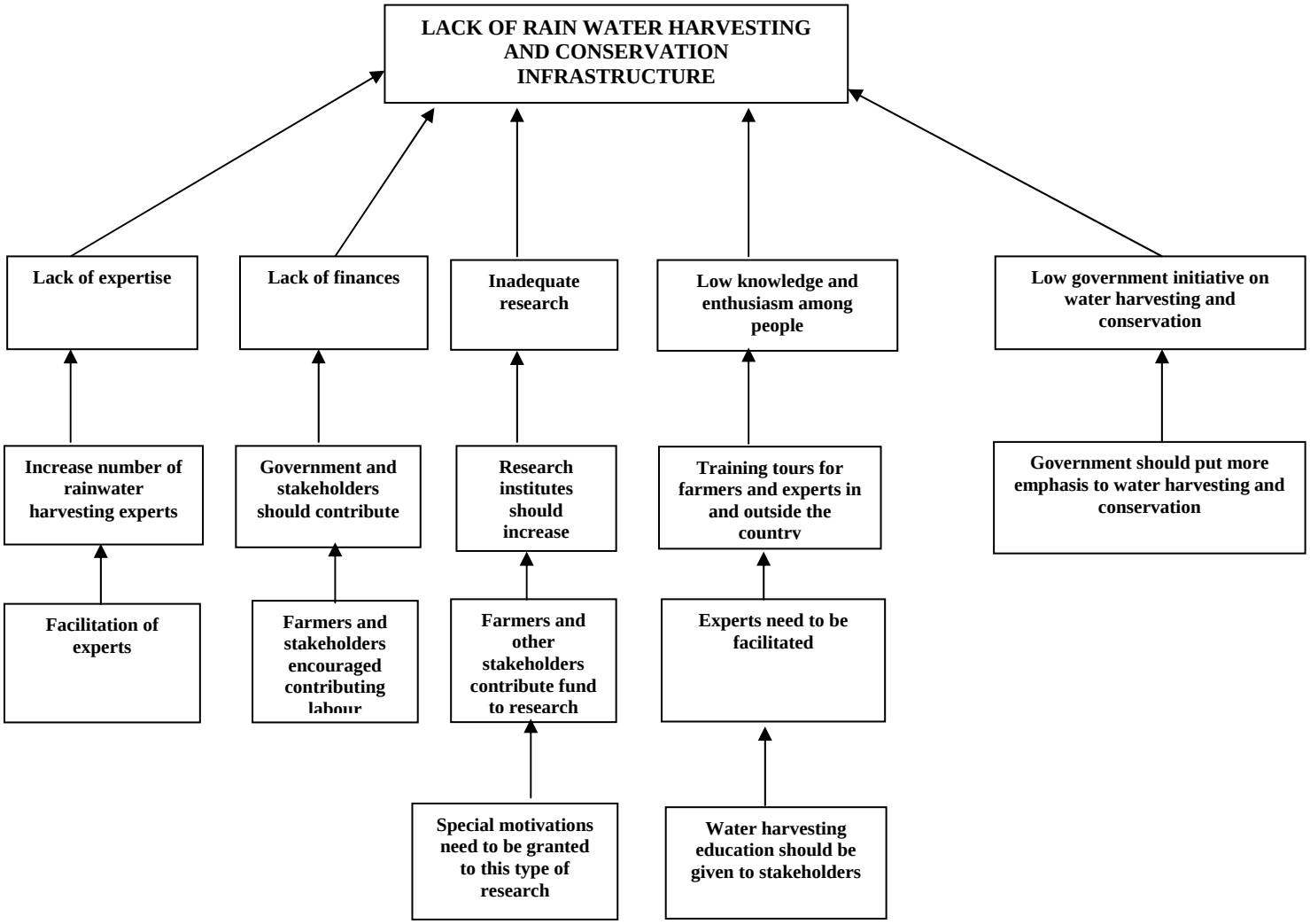
Group IV

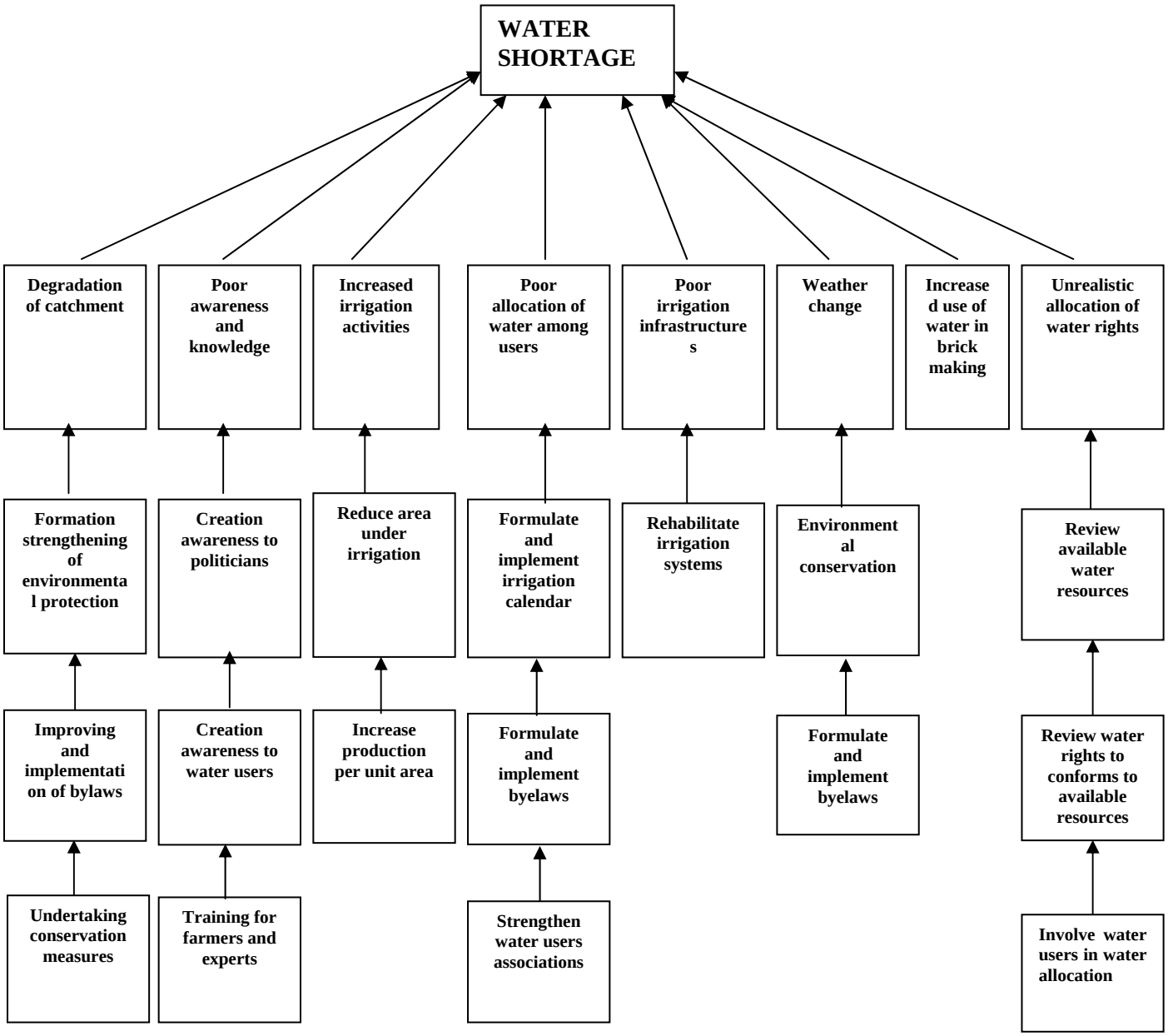
	CONCERN	SCORE
1	Water shortage dry/ wet season	11
2	Poor water distribution	5
3	Poverty	4
4	Unrealistic allocation of water right	4
5	Poor organization of water users	3
6	Upstream and middle irrigated agriculture during dry season	2
7	Low productivity in agriculture	1
8	Low level of knowledge in water use	0
9	Poor resource management	0
10	Unsustainable use of natural resource	0
11	Poor involvement of water users in offering water rights	0
12	Poor water use efficiency	0
13	Water use conflicts	0
14	Market problem	0

Appendix 6 Problem Trees




DEGRADATION OF WATER SOURCES
Cutting trees
Cultivation on water sources
Grazing and watering livestock in sources
Planting of trees that depletes much water
Lack of education
Land scarcity
Declining pasture reserves and increase of livestock
Uprooting trees
Guard and Conserve water sources
Elaborate land use plan
Reduce number of livestock
Zero grazing and growing pasture
Set aside grazing areas
Water users need to be educated
By laws


LACK OF RAIN WATER HARVESTING AND CONSERVATION INFRASTRUCTURE
Lack of expertise
Lack of finances
Inadequate research
Low knowledge and enthusiasm among people
Low government initiative on water harvesting and conservation
Increase number of rainwater harvesting experts
Government and stakeholders should contribute
Research institutes should increase
Training tours for farmers and experts in and outside the countrv
Government should put more emphasis to water harvesting and conservation
Facilitation of experts
Farmers and stakeholders encouraged contributing labour
Farmers and other stakeholders contribute fund to research
Experts need to be facilitated
Special motivations need to be granted to this type of research
Water harvesting education should be given to stakeholders


WATER SHORTAGE
Degradation of catchment
Poor awareness and knowledge
Increased irrigation activities
Poor allocation of water among users
Poor irrigation infrastructures
Weather change
Increased use of water in brick making
Unrealistic allocation of water rights
Formation strengthening of environmental protection
Creation awareness to politicians
Reduce area under irrigation
Formulate and implement irrigation calendar
Rehabilitate irrigation systems
Environmental conservation
Review available water resources
Improving and implementation of bylaws
Creation awareness to water users
Increase production per unit area
Formulate and implement byelaws
Formulate and implement byelaws
Review water rights to conforms to available resources
Undertaking conservation measures
Training for farmers and experts
Strengthen water users associations
Involve water users in water allocation

Appendix 7 Impact and implementation results table

Group Actions Impact Table

Group	Action	Space	Time	Actors	Social	Economic	Environ-mental	Water resources	Other Effects
		Where? (Upper, Middle, Lower)	**When? (Dry, wet or both seasons)**	**Who benefits-?**	**Impact on equity**	**Impact on livelihood / productivity**	**Impact on environment / sustainability**	**Impact on availability of water resources**	**Negative impacts**
1	1. Inventory of current water flow data	U, M, L	Dry, Wet	RBWO (River basin officei)	+ + +	+ + +	+ + +	+	None
1	2. Review water rights	U, M, L	Dry, Wet	RBWO	+ + +	+ +	+ + +	+	None
1	3. Develop water control and monitoring infrastructure	U, M, L	Dry, Wet	Water users	+ + +	+ + +	+ + +	+	None
1	4. Improve water management and use	U, M, L	Dry, Wet	Water users, environment, RBWO	+ + +	+ + +	+ + +	+ + +	None
1	5. Encourage water users associations	U, M, L	Dry, Wet	Water users, environment, RBWO	+ + +	+ +	+ + +	+	None
1	6. Construct rain water harvesting dams for people and livestock	M & L	Dry	Water users, environment, RBWO, researchers	+ + +	+ + +	+ +	+ + +	Affect natural vegetation
1	1. Plant water conserving tree around water sources	U, M, L	Wet	Researchers, councils, water users, RBWO, environment	+ + +	+ + +	+ + +	+ + +	None
1	2. Formulate and enforce water conservation byelaws	U, M, L	Dry, Wet	Researchers, councils, water users, RBWO, environment	+ + +	+ + +	+ + +	+ + +	conflicts
1	3. Cut and uproot water depleting trees	U & L	Dry, Wet	Researchers, councils, water users, RBWO, environment	+	+ +	+ + +	+ + +	Loss of fire wood source
1	4. Train farmers /water users water conservation technics	U, M, L	Dry, Wet	.Researchers, RBWO, water users, MWLD, MAFS, Local Government	+ + +	+ + +	+ + +	+ + +	none
2	Rain water harvesting	M & L	Dry (construct	Domestic use, livestock keepers	0	+	+	+	Accidents, Water borne diseases,

			-dams) Wet (harvest)	and agric.(horticulture)-middle&lower					Conflicts
2	2 (a) Uprooting water depleting trees	U & M	Dry, Wet	All Stake holders	+	- ; -Less firewood; -Less timber &; - building poles	+++	+++	Less firewood, less timber & less building poles
2	2(b) Planting indigenous trees	U & M	Dry (just prior to rains)	All stakeholders	+	+ -More water	+++	+++	
2	Review water right	U, M, L	Dry, Wet	Domestic water use, Livestock keepers, irrigators and fisheries	+	+	++	+++	-
3	1:stakeholders to be trained on rain water harvesting	Upper	Dry	Upper & lower water users	+++	+++	++	+++	0
3	2:Introduce by-law for water sources conservation	Upper	Dry, Wet	All water users	+++	+++	+++	+++	0
3	3:Train WU on contours	Lower	Dry	Domestic users,Livestock keppers & irrigators	+++	++	++	+++	0
3	4:Drill bore holes & Charco dam construction	Lower	Dry	Domestic uses, Livestock keppers & Irrigators	+++	++	++	+++	-
4	Educate society on national water policy	U, M, L	Jul-04	MSC society lower; Usangu GR; RUAHA NP; TANESCO; Industries; RBWO	0 / ++	0 / +++	0 / +++	0 / +++	
4	Government should direct funds to construction of water harvesting infrastructure	U, M, L	Jul-04	MSC society	+ / +++	+ / +++	+ / +++	+ / +++	
4	Government should increase experts to train farmers on water harvesting techniqes	U, M, L	Jul-04	Middle, Lower	+ / +++	++ / +++	+++	+++	
4	Farmers be encouraged to contribute to construction of dams	U, M, L	Jul-04	Middle, Lower	+++	+++	+++	+++	
4	Train farmers on rain water harvesting	M & L	Jul-04	Middle, Lower	+++	+++	+++	+++	

4	Construct rain water harvesting dams	M & L	Dry	Farmers, Usangu GR, RUAHA NP, TANESCO, Industries, RBWO	++	+++	+++	+++	Malaria, Bilhazia, Typhoid
5	1. Reduce irrigated land	U, M, L	Dry	Lower zone water users	Water available lower zone, equity improved	Yields reduced upper zone and increased lower zone	Improved environmental protection	+++	Unplanned economic activities endanger environment
5	2. Form and strengthen water user associations	U, M, L	Dry, Wet	Water users, Government, Experts, Donors	Reduce water user conflicts, water user solidarity	WUA financial ability improved, More sustainable yields	Environmental sustainability impeoved	Water equity improved	Current beneficiaries may revolt/resist changes
5	3. Produce low water demanding crops	U, M, L	Dry, Wet	Irrigators	Recuce water user conflicts	Improved food security	Improved environmental protection	Water equity improved	Farmers selection of crops narrowed
5	4. Rain water harvesting in dams	U & M	Wet	Water users in MSC	Recuce water user conflicts	Improved yields/income, New economic activities emerge	Microclimate created around the dams, Flood mitigation	Increased river flows	Disturbed lifestyles around dams, Water borne diseases incidences increased
5	5. Improve irrigation infrastructure	U & M	Dry, Wet	Irrigators	Recuce water user conflicts	Improved yields	Prevent river bank and canal erosion	Water equity improved	Some farmers may lose land, Increased water abstraction
5	6. Train stakeholders various fields of water management	U, M, L	Dry, Wet	Reduce water users conflicts	Recuce water user conflicts	Increased yields, Farmers /livestock keepers increase resources	Environm. education spread among people, Improved environm. protection	Improved water supply	Government need to incur expenses

Group Actions Implementation Table

Group	Action	Primary responsible actor (who and what)	Main supporting actors (who and what?)	Financial costs government org. (and for who?)	User cost (labour and user fees-people)
1	1. Inventory of current water flow data	RBWO	Local Government SUA	$$	
1	2. Review water rights	RBWO	Local Government), SUA, FA0, NGO	$	1
1	3. Develop water control and monitoring infrastructure	RBWO	, MWLD, MAFS, Local Government (Serikali za mitaa), FA0, SUA	$$$	2
1	4. Improve water management and use	Water users	Watumia maji, RBWO, Local Government (Serikali za mitaa)	$$	2
1	5. Encourage water users associations	Local Government (District focal team)	Local Government, MWLD, MAFS, RBWO, WWF, FA0, NGO	$$	3
1	6. Construct rain water harvesting dams for people and livestock	Waret users	Local Government, MWLD, MAFS, WWF, FA0, NGO, SUA	$$$	3
1	1. Plant water conserving tree around water sources	Water users	Local Government , researchers	$$	3
1	2. Formulate and enforce water conservation byelaws	Water users	Local Government WWF, SUA, NGOs	$$	2
1	3. Cut and uproot water depleting trees	Tree owners	researchers, MWLD, MAFS, Local Governmen	$	3
1	4. Train farmers /water users water conservation technics	RBWO	Water users , RBWO, MWLD, MAFS, NGOs, WWF, Local Government	$$	1
2	Rain water harvesting	WUA	-Expertise, technical support (Mbarali District council); Zonal Irrigation Unity Mbeya (technical support); SUA (technical support); Rufiji Basin Water Office (technical advice); WWF (Financial Assistant); FAO (Financial Assistant); MWLD (Financial & technical support)	$	3
2	2 (a) Uprooting water depleting trees	WUA	Mbeya rural and Mbarali District council (technical support)	$	2
2	2(b) Planting indigenous trees	WUA	Mbeya rural and Mbarali District council (technical support)	2$	3
2	Review water right	RBO: Establish current river flows.	Mbeya rural & Mbarali District council (DALDDs, DWEs &DAS)-Expertise; Apex/WUA-local knowledge	2$	
3	1:stakeholders to be trained on rain water harvesting	District Facilitators Team	Water users organization leaders and ward executive officers	$$$	2
3	2:Introduce by-law for water sources conservation	Water users	Expertise and District facilitators team	$$	3
3	3:Train WU on contours	Expertise for agriculture & dams	Extesion officers of the locality	$$$	2

3	4:Drill bore holes & Chaco dam construction	Wataalamu wa kuchimba visima na malambo	Villages	$$$	2
4	Educate society on national water policy	Village government; Water users	MATI IGURUSI,UYOLE	$	1
4	Government to direct funds to construct water harvesting infrastructure	Village government, Water users	Central government, councils, Donors	$$	2
4	Government to increase experts to train farmers on water harvesting techniques	Village government, Councils supervise	Central government, councils, Donors	$$	3
4	Farmers be encouraged to contribute to construction of dams	Water users	MOWLD LOCAL GOVERNMENTS	$$	3
4	Train farmers on rain water harvesting	Water users/farmers to participate	Local government, SUA, MATI Igurusi, Donors to assist finances	$$	2
4	Construct rain water harvesting dams	Water users, Extension officers to be trained in use	Local governments, MOWLD/MAFS, Agricultural training institute Uyole/Igurusi, SUA/UDSM, Donors	$$$	3
5	1. Reduce irrigated land	Village government, Water users	Central government, councils, researchers, donors	$	1
5	2. Form and strengthen water user associations	Village government, Water users	Central government, councils, researchers, donors	$$	2
5	3. Produce low water demanding crops	Village government, councils supervise	Central government, councils, researchers, Donors	$$	3
5	4. Rain water harvesting in dams	Water users	MOWLD	$$$	3
5	5. Improve irrigation infrastructure	Water users/farmers to participate	Local government, Ministry of agriculture to contribute expertise, Donors to assist finances	$$	2
5	6. Train stakeholders various fields of water management	Water users, Extension officers to be trained in water use & management	Local governments, MOWLD/MAFS, Agricultural training institute Uyole/Igurusi, SUA/UDSM, Donors	$$	3

Appendix 8 Results of Voting for Priority Actions

ACTIONS	Priority action	PRY RES	SEC RES.	
GI				
1. Inventory of current water flow data	**1**	**0**	**0**	**A**
2. Review water rights according to available resources	**0**	**1**	**0**	**B**
3.Develop water control monitoring devices to ensure abstraction according to water right	**1**	**2**	**0**	**C**
4.Improve water management	**3**	**6**	**0**	**D**
5.Encourage formation and strengthening of WUA	**1**	**0**	**0**	**E**
6.Construct dams for rainwater harvesting	**1**	**0**	**0**	**F**
G2				
Construction of chaco dams	**7**	**2**	**0**	**F**
Uprooting water depleting trees planting indigenous trees	**7**	**0**	**0**	**H**
Review Water rights	**9**	**0**	**0**	**B**
G3				
1:stakeholders to be trained on rain water harvesting	**8**	**2**	**0**	**I**
2:Introduce by-law for water sources conservation	**0**	**0**	**0**	**J**
3:Train WU on contours	**1**	**0**	**0**	**K**
4:Drill bore holes & Charco dam construction	**7**	**1**	**0**	**L**
G4				
Educate society on national water policy	**0**	**0**	**0**	**M**
Government should direct funds to construction of water harvesting infrastructure	**1**	**1**	**0**	**N**
Government should increase experts to train farmers on water harvesting techniques	**1**	**2**	**0**	**O**
Farmers be encouraged to contribute to construction of dams	**1**	**1**	**0**	**P**
Train farmers on rain water harvesting	**1**	**2**	**0**	**I**
Construct rain water harvesting dams	**0**	**1**	**0**	**F**
G5				
1. Reduce irrigated land	**3**	**0**	**0**	**Q**
2. Form and strengthen water user associations	**2**	**1**	**1**	**R**
3. Produce low water demanding crops	**0**	**1**	**0**	
4. Rain water harvesting in dams	**0**	**1**	**0**	
5. Improve irrigation infrastructure	**4**	**2**	**0**	
6. Train stakeholders various fields of water management	**7**	**0**	**2**	