PRDA: A PARTICIPATORY METHODOLOGY FOR ANALYZING AND IMPROVING IRRIGATION PERFORMANCE: CONCEPTUALIZATION AND EXAMPLE OF APPLICATION IN KENYA

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ABSTRACT

In Sub-Saharan Africa, agriculture is the backbone of the economy and employs approx 70% of the active work force. Rain-fed agriculture is largely dominant and agricultural production is increasingly vulnerable to erratic rainfalls and recurrent droughts. Although irrigation development is still in its infant stage in most countries and its performance remains largely below expectations of policy planners, it is believed it has a strong potential for rural development and economic growth.

The APPIA project is implemented in several countries in Sub-Saharan Africa. APPIA is a French acronym for "Improving Irrigation Performance in Africa". One of the major activities of the project was to develop and test in the field a participatory methodology for analysing and improving the performance of farmer-managed irrigation scheme. This methodology has been named PRDA for "Participatory Rapid Analysis and Action Planning of Irrigated Agricultural Systems". A manual published by IWMI and the FAO presents the details of the methodology.

The present document aims to illustrate the approach of the project in one of the APPIA countries. This paper first describes briefly the situation of smallholder irrigation in Kenya and the numerous questions regarding the performance of such schemes. PRDA is then presented and a case study of its application in one Kenyan scheme is given. In conclusion this paper suggests a set of recommendations for effective use of PRDA based on the lessons learnt in the African countries where it was tested.

This paper discusses the issues at stake at different level: government, Water Users Association and individual farmers for successful smallholder irrigation. It highlights the following key principles of the PRDA methodology:

- A systemic approach of irrigation management using a conceptual framework including irrigation technology; individual and collective farmers' practices, institutional and economic issues;
- Adapting Participatory Rapid Rural Appraisal tools to the specific context of smallholder irrigation;

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- Establishing multi-disciplinary partnerships between farmers' organizations, engineers, agronomists, extension agents, economists, decision and policy makers;
- Acquiring a shared vision of irrigation management and of a long term sustainability of irrigation systems, including economic, social and technical perspectives;
- Promoting information, collective awareness and mutual learning processes amongst irrigation stakeholders.

Finally and based on the results obtained during the course of the APPIA project, the present document suggest that PRDA may be one tool to achieve successful participatory irrigation management that can be used by multi-disciplinary / multi purpose organization such as National Irrigation and Drainage Committees.

INTRODUCTION

In Sub-Saharan Africa, agriculture accounts for approximately 70 percent of the economically active population. In this part of the World, rain-fed agriculture is largely dominant and its productivity has been stagnating over the past forty years. Volatile rains, soil degradation together with continuous price depreciation of agricultural products on the World market explain the stagnation of rain-fed agriculture and the increase of rural poverty in Sub Saharan Africa.

Irrigation can significantly improve agricultural productivity and is unquestionably one option for economic development. However in the time of cost recovery, farmer-managed irrigation and increasing competition over the limited water resources, irrigation productivity and sustainability must be assessed with care.

It is now widely recognized that irrigation performance depends on managerial and technical capacities of the concerned communities as well as the nature of relationships between irrigation technology, institutions and economics. Hence the need for tools to understand the key factors of irrigation performance and establish partnerships with irrigating farmers and their organizations to provide them more effective and demand driven support services.

This paper relates to the experience of the APPIA project. This project was launched in March 2003. APPIA is a French acronym for Improving Irrigation Performance in Africa. ARID[1] ensures the project coordination for the West Africa component: Burkina Faso, Mali, Mauritania, Niger and Senegal; while IWMI (office for Nile Basin and Eastern Africa in Addis Ababa) implements the project together with national partners in Ethiopia and Kenya. The principal objective of APPIA is contributing to the development of a productive and sustainable farmer-managed irrigation in Sub-Saharan Africa. An important activity of the project has been developing and testing in all concerned countries a methodology named PRDA for "Rapid Diagnosis and Action Planning of Irrigated Agricultural Systems".

The present document aims to illustrate the approach of the project in one of the APPIA countries. This paper first describes briefly the situation of smallholder irrigation in Kenya and the numerous questions regarding the performance of such schemes. PRDA is then presented and a case study of its application in one Kenyan scheme is given. Finally this paper suggests a set of recommendations for effective use of PRDA based on the lessons learnt in the African countries where it was tested.

1- ARID: Association Régionale pour l'Irrigation et le Drainage based in Ouagadougou, Burkina Faso.

1. SMALLHOLDER IRRIGATION IN KENYA: ACHIEVEMENTS AND CHALLENGES

1.1. PRESENT SITUATION

At present Kenya has 105,000 Ha under irrigation for both smallholder and large commercial irrigation. As described in table 1, different types of irrigation systems have evolved in the country. Irrigation consumes approximately 75% of the available water resource of the country and covers about 2% of the total cultivated area (5.2 million Ha) and almost 20% of the irrigation potential estimated at 539,000 Ha. The agricultural sector contributes to 30% of the GDP, 56% if agro-based industries are included.

According to the Ministry of Water and Irrigation, smallholder irrigation schemes cover 62,000 Ha. It mainly consists of group-schemes (total area: 35,000 Ha) with gravity or pump water supply in which horticulture or rice crops are grown. In smallholder individual schemes (total: approx 11,000 Ha), the water supply is manual (buckets) or pump-fed (motorized or treadle pumps) from open water source and the production concentrates on horticulture crops. Centrally managed schemes (Total area: 16,000 Ha) are managed by public agencies but the process of management transfer to farmers is underway, water is abstracted by river diversion or pumping and rice is the predominant crop. In spite of such a relatively small contribution, it is believed that smallholder irrigation could play an important role in rural development, since it can potentially provide food security, income and employment opportunities.

Table 1: A typology of irrigation in Kenya

Type of scheme	Smallholder schemes			Commercial schemes
Sub-type	Individual schemes	Group-based schemes	Centrally managed schemes	–
Period of development	Rapidly increasing since the 1990s	1970s & 1980s	1950 - 1970	Rapid development in the 1980s and 90s
Number	--	About 1,000	10	--
Total area	About 11,000 Ha	35,000 Ha	16,000 Ha	43,000 Ha
Range of scheme size	0.1 – 0.5 Ha	10- 900 Ha	350 – 6,000 Ha	4 – 3,000 Ha
Average farm size per beneficiary	As above	0.25 – 1 Ha	1 – 1,5 Ha	--
Operation and maintenance	Individual farmers	Water Users Associations	Public agency (on-going transfer)	Private enterprise
Land tenure	Private	Private	Public with tenant farmers	Private
Source of funds	Farmers	Government or NGOs	Government	Kenyan and foreign investors.

Currently irrigation development is led by the private sector: smallholders and investors who supply the domestic market and export horticulture products to the European Union. Kenya has thus become since 1999 the first flower exporter to the European Union. Factors identified to have contributed to the success of vegetable, fruits and flowers production aside from favourable geography and climate are (a) improvements in transportation infrastructure, (b) Availability of low cost irrigation equipment such as pumps, (c) rapidly growing urban population, (d) an improved environment for private and international investment, (e) macroeconomic stability and realistic exchange rates and (f) development of international commercial links.

1.2. AGRICULTURAL AND ECONOMIC PRODUCTIVITY OF SMALLHOLDER IRRIGATION.

Yields are generally low when compared to FAO benchmark for Sub-Saharan Africa as indicated for some crops in table 2. Low yields result from a combination of factors: difficulty in sourcing inputs, poor access to credit, problems related to insecure irrigation water distribution, inadequate extension service and marketing risks.

Table 2: Examples of average yields in smallholder irrigation schemes in Kenya

Crops	Sweet potatoes	French beans	Cabbage	Onions	Tomatoes	Bananas	Rice
Average yield (range: t/Ha)	8 - 11	5-7	10-14	8-10	8 - 12	15 – 20 Per year	2-4
Benchmark (t/Ha)	15	10	25	25	30	40 Per year	6

Gross margin per Ha of smallholder irrigated horticulture (excluding depreciation of equipment and family labour) varies between 1,700 and 2,800 USD/Ha according to yields and type of crops grown. Thus irrigated horticulture is an attractive option for Kenyan farmers if compared to the competing rain-fed cultivation of maize where gross margins are about 570 USD/Ha. However, labour productivity remains quite low, 2 to 3 USD/family man-day, and quite comparable with labour productivity of rain-fed maize (2.70 USD/man-day) and daily rate of unskilled labour in rural areas (2 USD/day).

1.3. OPERATION AND MAINTENANCE (O & M)

O&M is the weakest link in smallholder irrigation scheme in Kenya. There are generally four causes to this problem. The fist one is poor feasibility, planning and design (especially choice of technology) of many irrigation projects. The second is the weak management structure and low capacity of Irrigation Water Users Associations. The third is shortage of funds because farmers are unwilling to pay the O&M fee because the service is poor or they have not seen clear benefits from previous payments. Finally the fourth problem is associated with siltation of canals due to poor management of river catchments.

1.4. ISSUES AT STAKE

The above raises a series of questions and demands investigation at three different levels.

- Government level
  - Policies and measures that accompany irrigation development: Extension services and research, design of training programmes, legal framework for water users association, input supply and credit, market information;
  - Improvement of preparation, design and construction of irrigation projects with a view to reduce costs and enhance benefits of irrigation development;
  - Irrigation cost recovery / subsidies policy or in other words to which extent can capital costs be covered by farmers' contribution;
  - Enabling economic environment for marketing agricultural production.
- Water Users Association (WUA) level
  - Formation of representative WUAs for negotiation with external players;
  - Capacity of WUAs for managing technical and financial aspects of operation and maintenance;
  - Operation & Maintenance charging system taking into account farmers' capacity to pay and cost recovery requirements.
- Farmers' level
  - Increasing productivity of cropping systems to make them compatible with a cost recovery approach of irrigation management or in other words so that farmers are able (and willing) to pay O & M fee;
  - Improvement of on-farm water management.

2. PRDA: PARTICIPATIVE RAPID DIAGNOSIS AND ACTION PLANNING OF IRRIGATED AGRICULTURAL SYSTEMS.

2.1. PRDA MANUAL

This paper gives only a synthetic presentation of the methodology. A manual (Van der Schans, Lempérière; IWMI-FAO-IPTRID 2006) explains in details and in a simple way how to carry out a PRDA. The manual explains the methodology in a practical manner. Chapter 1 is a general presentation. Chapter 2 summarizes the overall method and the different steps of its application. In chapter 3 the conceptual framework (the constituents of irrigation systems) is introduced. Chapters 4 and 5 give information for organizing a PRDA and some practical advices to conduct a PRDA. The tools to be used during PRDA are described in annex A. Finally in annex B, a series of Reporting Sheets are provided to write down and analyze results after fieldwork.

2.2. WHAT IS PRDA?

PRDA is an approach for analyzing and improving irrigation performance together with farmers. The diagnosis aims to identify the limiting factors of performance: irrigation productivity and sustainability. Action plan to improve performance can have three components: (a) increase capital investments and inputs, (b) improve organizations responsible for O&M, and (c) enhance individual farming skills.

PRDA methodology and tools are an adaptation of several participatory methods to the situation of irrigated agricultural systems:

- Rapid Rural Appraisal (RRA): rapid assessment according to criteria set by the researcher
- Participatory Rural Appraisal (PRA): facilitating discussion amongst farmers and sharing of information with and amongst farmers.
- Participatory Learning and Action (PLA): Farmers and researchers learn throughout the project cycle and use these lessons to engage in individual or joint action.

These participatory approaches are combined with existing methodologies for Benchmarking that have been modified to suit the scale and limited quantitative data availability of farmer- managed irrigation schemes.

2.3. TARGET PEOPLE AND ORGANIZATIONS

PRDA is primarily meant for extension organizations wanting to improve their services to irrigating farmers and their organizations. Combined results of several irrigation schemes can also be used to formulate more general policy recommendations. A PRDA team consists ideally of four people, but it may be smaller when dealing with small irrigation system. Team members should have different disciplinary background, for example: irrigation engineer, agronomist, economist and specialist of farmers' organizations.

2.4. OBJECTIVES OF PRDA

- Identify the main limiting factors of the productivity and sustainability of agricultural irrigated systems
- Evaluate extension services and other supporting services provided to farmers
- Identify interventions to improve performance
- Describe the main characteristics of selected systems in order to enable more extensive monitoring of performance in the future.

2.5. CONCEPTUAL FRAMEWORK

Irrigation performance results of interplay between irrigation technology, farmers' practices, institutional arrangements and economics. PRDA uses a conceptual model for irrigated agricultural systems to help classifying collected information in a structured

manner and process it to make a diagnosis and propose sound solutions to improve performance. For PRDA four constituents are identified to represent an irrigated agricultural system.

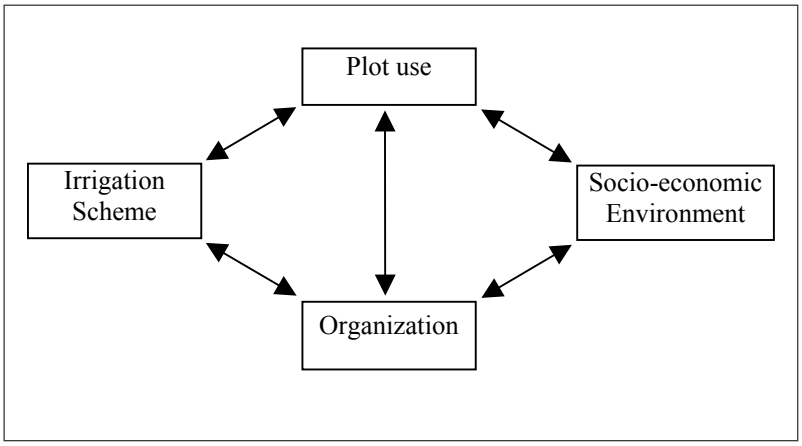

Figure 1: The four constituents of irrigated agricultural systems

2.5.1. Irrigation scheme

It is the physical system to convey and apply water to irrigated lands. **For PRDA, it is assumed that the type of technology strongly determines the manageability of the scheme by farmers and their organizations.** The constituent irrigation scheme can be seen as a sub-system with six constituents as shown in figure 2. On the left-hand side are the constituents that refer to the land; they should be consistent with each other. On the right-hand side are the "water constituents" that should be fitted to the "land constituents"; at each horizontal there is a close link between each "land constituent" and "water constituent" that should ensure the cohesion of the irrigation scheme.

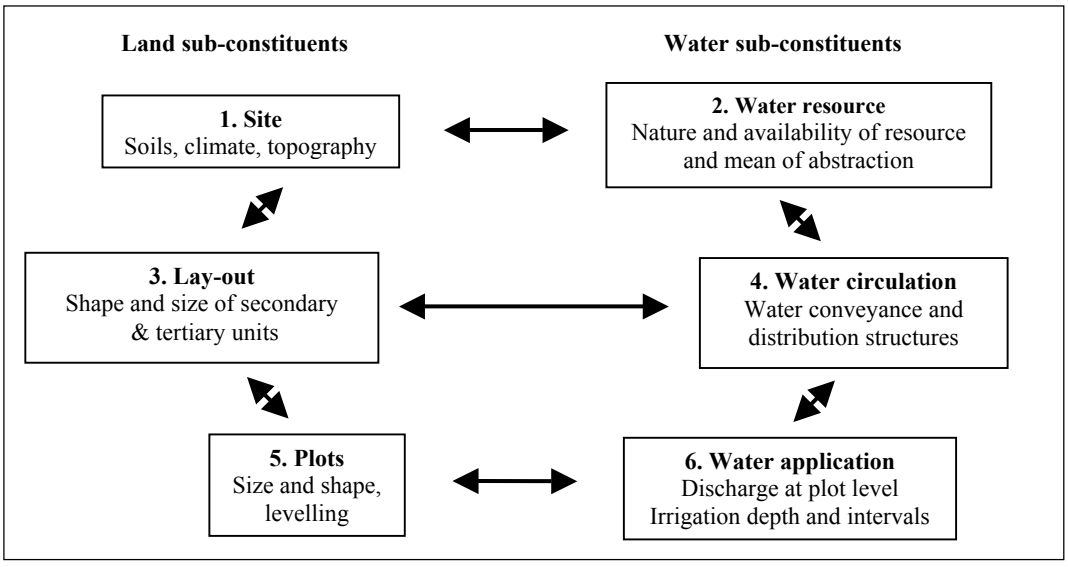

Figure 2: Sub-constituents of irrigation scheme

2.5.2. Plot use

This constituent includes all agricultural practices and production of irrigated plots. Usually decisions regarding plot use are made at household level in relation with other farming and not farming activities implemented by household members. Characteristics of "plot use" are the cropping system (type of crops, crop rotation and use of inputs, labour and farming equipment), land and labour productivity and farmers' income. PRDA does not seek to impose adoption by farmers of recommended practices such as ready-made "technology package" but rather highlights and explains the actual farmers' practices and seek opportunities for their improvement considering farmers' objectives, knowledge, skills and constraints.

2.5.3. Organization

Group-based irrigation systems imply an organization (e.g. a Water Users Association) of individual farmers who wish to undertake irrigation management related activities for their mutual benefit. For PRDA, analysis of organization involves the objectives or functions (water distribution, maintenance, planning of cropping seasons, etc.), the structure (members and organizational chart), assets (office, equipment), technical and managerial capacity to perform its functions and rules of the organization. Owing to the increasing complexity and dynamics of irrigation organisations, and to the increasing uncertainty of their economic environment, PRDA does not seek bringing ready-made solutions and one-way prescriptions or "recipes", but rather promotes effective and flexible tools and practices for technical, social and financial management.

2.5.4. The socio-economic environment

This is not exactly a constituent of irrigated agricultural systems but rather a range of relations between individual farmers and their organization with various organizations and individual, i.e. irrigation agencies, extension services, inputs providers, credit institutions, traders or cooperatives, etc.

2.6. PROCEDURE: A THREE STEPS APPROACH.

Figure 3 show details of the three steps of PRDA:

(a) Preparation: review of secondary data and consultation with farmers to seek their cooperation and with potential partner institutions that may assist in fieldwork, provide expertise and help implementing solutions);

(b) Diagnosis: collection of primary data using PRDA tools with farmers, assessment of performance, identification and ranking of constraints of productivity and sustainability and detailed analysis of constraints (causes and consequences);

(c) Action planning: Identification, assessment of solutions (their impacts, costs and benefits) and formulation of action plan.

It may not be possible to arrive at a well-structured action plan (including a logical frame) during PRDA itself, which takes less than one month. The action plan can also be finalized just before the next irrigation season with other potential partner institutions that could provide technical or financial assistance.

Table 3: Estimated time required to do PRDA on irrigation schemes of different size

Scheme size	10 ha	100 ha	1000 ha
Preparation	4 days	5 days	8 days
Diagnosis	6 days	8 days	13 days
Action planning	2 days	2 days	4 days
Total per person	12 days	15 days	25 days
Recommended team size	2 persons	2 to 4 persons	4 persons

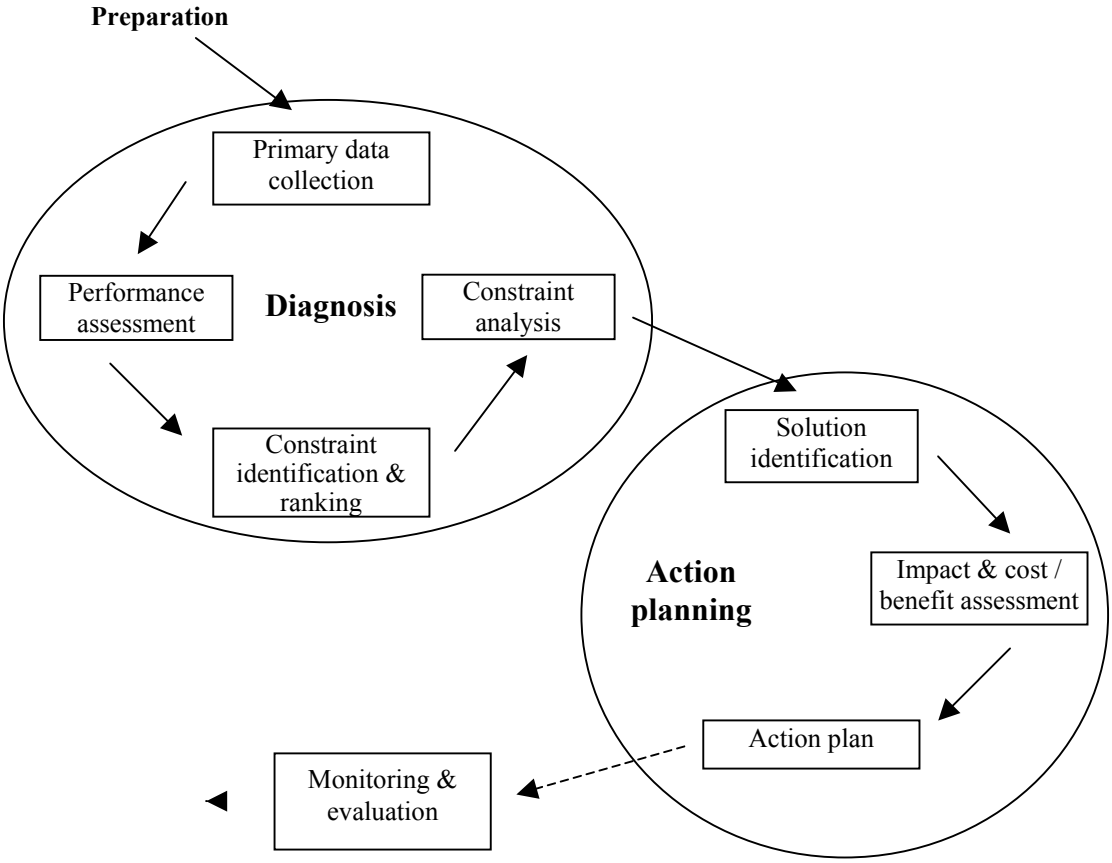

Figure 3: PRDA procedure

3. EXAMPLE OF PRDA APPLICATION IN MWEA IRRIGATION SCHEME, KENYA.

3.1. MWEA IRRIGATION SCHEME

The irrigation scheme is located at the foothills of Mount Kenya, about 100 Km to the Northeast of Nairobi. The irrigated area of 6,000 Ha supports a population of 4,000 farming households. Mwea is the largest centrally managed irrigation scheme in Kenya. It gets its water by gravity from two rivers originating from the watershed of Mt Kenya. Rice is grown for only one season per year. It uses the flooded paddy irrigation method.

The history of Mwea goes back to 1953 when it was developed under the British colonial government using captive Mau Mau (freedom fighters) labour. Soon after independence in 1963, the scheme was handed-over to the National Irrigation Board (NIB) a public irrigation agency. The NIB treated farmers as passive recipients of strict instructions regarding the management of the scheme and the role of farmers was limited to labour provision in paddy fields. There were quite a number of areas of conflict between NIB and farmers regarding cost of irrigation services (agricultural inputs and O & M fee) and absence of farmers' voice in the management of the scheme. These conflicts heightened in 1998 when farmers rebelled against NIB and their cooperative took over the management of the scheme in 1999. In the following years the scheme (and the cooperative) almost collapsed and in 2003, farmers and NIB reached an agreement. Under this agreement, a process of partial irrigation management transfer was initiated. It redefines the role of NIB to operation and maintenance of the major irrigation and drainage infrastructure and includes the formation of a Water Users Association. PRDA was conducted in 2004 to support the process of irrigation management transfer.

3.2. DIAGNOSIS

PRDA was carried out in Mwea in the fist quarter of 2004 by 2 NIB officers (irrigation engineers) a specialist of Farmers' organizations and an agro-economist from the ministry of agriculture. Inadequate water delivery at farm level was identified as the main constraint faced by farmers. As a consequence approximately half of the scheme stopped production and average paddy yield in cultivated area dropped from 5 to 3 tons / Ha. The diagnosis allowed making a comprehensive analysis of the causes of water shortage:

1- The flow of the two rivers supplying the scheme has been decreasing due to deforestation of the slopes of Mount Kenya (and perhaps climate change affecting East Africa). The intake work no longer makes it possible to supply the scheme during the peak irrigation periods. In addition irrigated area has been quickly increasing in the upper part of the watershed without real control by the Government authorities. Conflicts between Mwea farmers and water users upstream seemed inevitable if the Government pursues its "business as usual" policy or does not make investments aiming to increase the water resource.

2- High conveyance losses resulting of poor (quasi absence of maintenance); neither the cooperative or NIB was able to collect an O & M fee.

3- Absence of organized water distribution in the scheme

4- Poor on-farm water management: due to insecure water supply and absence of irrigation schedule, many farmers tended to irrigate their plots with as much water as possible when water was available and without considering actual crops water requirements to extent to which that approx 600 Ha were affected by water logging and salinity problems.

Such a diagnosis could have been made by a team of experts in a few days and without much consultation with farmers. Value added of PRDA was to favour information sharing, discussion, learning processes and collective awareness amongst farmers and between farmers and the evaluation team. Validation of the diagnosis by farmers was of crucial for the design and implementation of solutions.

3.3. ACTION PLANNING

Based on the diagnosis farmers and the evaluation team designed together an action to improve irrigation performance in Mwea irrigation scheme. Objective of the action plan was to improve and secure water availability within all plots by implementing the process of irrigation management transfer (IMT). Action plan for the IMT process included the following steps:

1- Formation of a Steering Committee for defining a strategy for IMT, the members were local government officials, NIB officers, elected farmers, representatives of the Ministry of Water and Irrigation and Ministry of Agriculture.

2- Organization of farmers meeting to discuss about issues and approve strategy for IMT.

3- Formation of the Water Users Associations (WUAs) and election of leaders by farmers: 62 WUAs at block level and an umbrella Association for the entire scheme.

4- Training of elected WUAs leaders.

5- Establishment of a water charging system for maintenance of main water infrastructure by NIB.

6- Development of WUA's By-Laws by all member farmers.

7- Starting of Operation of the WUAs.

8- Capacity Development of WUAs (offices, equipment, management tools, etc.)

9- Consultations between NIB and the WUA to find solutions to the water shortage problem.

3.4. RESULTS

Following IMT, The National Irrigation Board (NIB) has now been accepted to be a water service provider. It has improved the canal system through proper maintenance and collects the O & M fee. Farmers now maintain canals in the tertiary units.

Water shortage has also been alleviated through the implementation of a plan for staggered cropping: planting dates are now phased in fields / sections of the scheme. This planning is done by both the NIB and the WUAs.

New crops (soya, peas and maize) have been introduced by the Ministry of agriculture through demonstration plots belonging to voluntary farmers. They are planted immediately after rice is harvested. Thus the cropping intensity is increased.

Water shortage has also been alleviated through the construction of a water reservoir by NIB. This reservoir collects water from canals at night and during off-peak irrigation season. Stored water is then used for irrigation during peak water requirement periods. Construction of a second reservoir is planned.

Mwea umbrella Water Users Association has approached the local governmental authorities for the formation of a river-based Water Users Association to improve water management at the catchment level. As per today consultations of concerned players have been initiated.

Average paddy yields in the scheme are now 5.4 tons/Ha and almost all the command area was cultivated in 2006. The annual O & M fee for NIB service is 80 USD/Ha and represents 3% of the total value of production for the average yield; a level that seems quite acceptable to farmers since the recovery rate in 2006 was 95%.

3.5. LESSONS LEARNT

The case of Mwea irrigation scheme is now cited in Kenya as an example of successfull Irrigation Management Transfer, while a few years back the situation of the schemes seemed hopeless. However some conflicts remain between the NIB and the cooperative and between farmers and the cooperative. The main contribution of PRDA approach is very likely that it has helped a lot re-establishing a dialog and mutual trust between farmers and the NIB for redefining their respective tasks and responsibilities within the framework of Irrigation management transfer. Once again, information, discussion, learning processes and collective awareness are the key words for participatory irrigation management.

CONCLUSION

When compared to other participatory methodology, practitioners of PRDA in Sub-Saharan Africa have noted the high level of professionalism and special focus the method has on irrigation issues. The conceptual framework of the method is easy to understand. However, some practitioners found it difficult to understand the whole process. This may require the development of a training curriculum based on the manual and a greater attention to the educational background and experience of individuals when constituting PRDA teams.

Within an irrigation scheme, diverse strategies may develop, depending on each household's history, composition, objectives, and so on. When doing a PRDA, it is impossible to take account of each and every household's characteristics; however, it may be irrelevant to consider the scheme homogeneous. Hence we recommend adding

to PRDA approach making a typology of farmers that groups households with similar strategies and characteristics. Such a typology should be of a simple and practical nature and focus on landholding size, land tenure and production and marketing styles.

Institutional stability is strong factor of success of PRDA. In Ethiopia frequent institutional change and staff transfer in extension and other supporting services to irrigating farmers has hampered the process and caused losses of information.

PRDA takes root in the context of smallholder irrigation scheme in Africa. It relies on a number of background principles, orientations and concepts among which it seems important to highlight the following:

- Establishing multi-disciplinary partnerships, meaning that farmers' organizations, engineers, agronomists, extension agents, economists, decision and policy makers have been involved in the process.
- Acquiring a shared vision of irrigation management and of a long term sustainability of irrigation systems, including economic, social and technical perspectives.
- Promoting information, collective awareness and mutual learning processes amongst irrigation stakeholders.

In Kenya, the APPIA project and PRDA approach raised a strong and sustained interest of various stakeholders (farmers, engineers, economists and policy makers) and offered a unique opportunity to do fieldwork collectively and in a multi-disciplinary manner. Technicians and policy makers realized that there was no organization in country that can address all issues related to irrigation management. Hence the Ministry of Water and Irrigation decided the formation of a professional association to enhance networking amongst irrigation players, implement multi-disciplinary approaches and develop further Research & Development programs. In countries where they exist this could be one role of the National Irrigation & Drainage Committees.