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Building Blocks and Strategies for Agriculture Water Management Policy

Lessons from Modernization Programmes in Asia

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Building Blocks and Strategies for Agriculture Water Management Policy

Lessons from Modernization Programmes in Asia

by

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for the

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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This presentation belongs to a set of modules which are part of the EASYPol Resource package: **FAO Policy Learning Programme – Specific policy issues – Natural resource management - Water**

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Table of acronyms

CA	Command Area
CDE	Capacity Development Engineering
IPTRID	International Programme for Technology and Research in Irrigation and Drainage
MASSCOTE	Mapping System and Services for Canal Operation Technique
M&E	Monitoring and Evaluation
O&M	Operation and Maintenance
RAP	Rapid Appraisal Procedure
SOM	Service Oriented Management
WUA	Water User Association

1. SUMMARY

In many instances the management of irrigation systems is notoriously performing at lower level than what was expected. At the same time irrigation management is increasingly complex: more diversified service to users (including other than crops) – raising competition for water – and the need to be more cost effective are the main drivers of the complexity.

Modern and highly performing management requires not only applying adapted techniques but also a conducive institutional and political environment for which capacity building programs are required.

One of the challenge is to balance flexibility to adjust for project specificities and high consistency at national level. Another challenge is to ensure that policy decisions are enough practical and can be implemented or followed by local operators. At all levels the capacity of the actors need to be increased.

A consistent approach mixing project and state level is thus required to develop management modernization strategies and programs. FAO-NRLW has developed approaches combining field project assessment and modernization planning (RAP-MASSCOTE) with the establishment of a typology of irrigation systems allowing then to upscale the issues and solutions at national level for better policy decisions.

2. INTRODUCTION

For many reasons modernization is a widely needed investment to improve water use efficiency, give good service to farmers and other uses, reduce the cost and the burden for the state budget, and improve the environment, but this is a costly and lengthy intervention. For a country with 1 million ha of irrigated land, at an average cost range between US$ 500 and US$1000 /ha and this would mean an investment of say between 500 million and 1 billion. This would be a significant investment for many developing countries and this means that there is an acute need to be effective in this investment in terms of technical, institutional and financial terms.

Objectives

By the end of this module, users should know how to illustrate the practical implementation of an agricultural water management policy and to use two contrasting examples from South Asia.

Target audience

Policy decision makers, Water and irrigation engineers, Consultants involved in assisting government developing policies.

Required background

Basic knowledge of irrigation management on large systems.

Readers can follow links included in the text to other EASYPol modules or references[1]. See also the list of EASYPol links included at the end of this module[2].

3. National strategy for improvements and investments

As a first step, the national capacity to invest and manage effectively would need to be mobilised and enhanced in order to reduce as much as possible the reliance on otherwise expensive external expertise.

A national modernization strategy requires several fundamental, or essential elements:

- A vision of the natural resource management
- A vision of the macro-economic context in agriculture and water sectors
- A set of objectives assigned to irrigated agriculture and irrigation management
- Clear identification of requirements for (needs) and means (local and national) that has to be mobilized to raise the know how and the capacity
- Monitoring and evaluation of the performance

The definition of national strategy is then required with the following key objectives:

- Build the internal expertise
- Capitalise the knowledge
- Raise the technological and managerial capacity for modern management
- Mobilise the national training capacity
- Mobilise and raise the research capacity to investigate and M&E technical options
- Mobilise the policy and financial resources
- Coordinate the M&E of the programme
- Ensure unrestrained circulation of knowledge and information

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[1] EASYPol hyperlinks are shown in blue, as follows:
a) training paths are shown in **underlined bold font**
b) other EASYPol modules or complementary EASYPol materials are in ***bold underlined italics***;
c) links to the glossary are in **bold**; and
d) external links are in *italics*.

[2] This module is part of the EASYPol Resource Package: **FAO Policy Learning Programme – Specific policy issues – Natural resource management - Water**

- Favour the exposure and good communication with the outside world.

THE BUILDING BLOCKS	THE BUILDING PROCESS
TYPOLOGY RAP MASSCOTE CAPACITY BUILDING	**TOP DOWN** Policy is discussed and set at national level: the KEY DETAIL is How to make it work in? e.g. NEPAL **BOTTOM UP** local management issues and opportunities induce POLICY issues and changes e.g. Karnataka INDIA

The main issues in agriculture water management	REASONS	The main challenges
LOW PERFORMANCE in Irrigation management	• Lack of focus on the details • Lack of engineering in the reforms • Lack of managerial capacity [local level] • Lack of transparency in the process • Lack of consistent policy approach.	Increasing diversity Increasing complexity

4. BLOCK 1 - TYPOLOGY OF IRRIGATION SYSTEMS

4.1. National vs local strategy

On the one hand modernization programmes should be site specific and decisions must be made by the users themselves – Subsidiary principle- at the local level, but on the other hand, there is a common basis of knowledge on modernization approaches that should be capitalised at the appropriate level and tapped when needed. Modernization is a lengthy and costly process and it would be a waste of time and money not to capitalise and share the capacity at national or state level or even sometimes at regional levels. Experiences, both good and bad, need to be called upon to enrich the knowledge database about how to improve performance of canal system management.

It is quite often the case that the national or state level is able to carry out such capitalisation of know-how and knowledge.

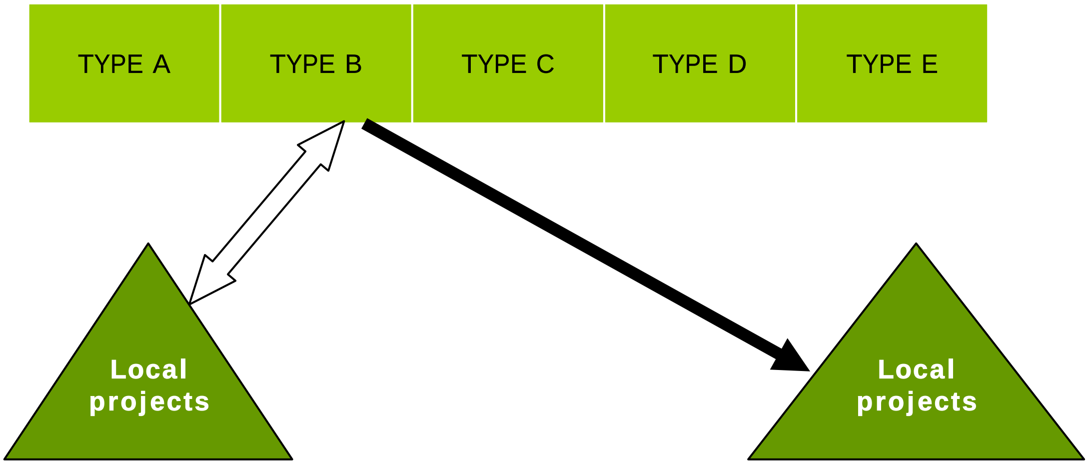
One way to combine site specificity and the need to generate some useful knowledge is to rely on a consistent typology of irrigation systems where main features, main drivers of changes are identified. Such a typology allows for the progressive aggregation and incorporation of the results from local experiences into a reliable modernization strategy adapted to a limited number of system types at the national level. This typology of systems is then used to define possible options for each type of system which still needs to be fine tuned at the local level. This is the way to use the positive outcomes from one project to other places presenting similar features.

A strategy of Modernization should aim at building the knowledge base of pilot projects in a typology oriented frame and should aim at developing a consistent set of interventions that are the basis for successes in modernization programmes.

4.2. Typology for irrigation systems to tackle the diversity

Typology is an instrument for building knowledge and defining best interventions.

Figure 1: Typology of irrigation systems



There are numerous ways of building a typology of irrigation systems, it really depends on the point of view and/or the perspectives one wants.

For instance in a recent workshop on Large Rice Based Irrigation System in South East Asia (FAO 2005), the discussion about the future of rice based systems were organized using two types of typology: the primary one distinguishes the macro-economic context in which the system works, with 3 main classes and the secondary one was more a hydrology oriented typology.

Context:

- **Agriculture Focus :** Early developing, rice dominant system
- **Transition:** Commercial agriculture, export & rice diversification
- **Post Agriculture**: Rice intensification and multi-purpose system

Hydrology:

Type 1: Reservoir-backed, gravity fed irrigation systems

Type 2: Off-river diversion irrigation systems

Type 3: Off-river pump irrigation systems

Type 4: Conjunctive groundwater-surface water system

Type 5: Integrated water management systems in the deltas

Additional criteria: Urban-rural irrigation systems

This typology proved to be very useful in the discussion avoiding both generalities and being trapped by the details. For each context and types a scenario of evolution was discussed with a common understanding throughout the entire SEA region. This is how typically a typology can be useful to allow cross-sharing ideas and outcomes.

As far as Canal Operation is concerned, the range of features and drivers are more restricted than looking at the entire picture. In the following sections we propose a typology based on drivers/criteria for canal operation.

4.2.1. A typology for canal operation

A typology should assist irrigation system managers to analyze the complex domain of irrigation system operations by defining a set of pertinent criteria for the analysis of canal operations and to develop a class structure for each criteria. The matrix of criteria and sub-divisions can be used for applications at different levels of irrigation infrastructure, for example in the:

- evaluation of system properties of importance in canal operation to assist irrigation managers' decision making [local management].
- partition of systems into subsystems with homogeneous operational characteristics [local management].
- comparison of the difficulties of operation between irrigation systems to enable improved allocation of resources [national/regional level].
- comparison of irrigation system performance in relation to the physical, agricultural and institutional context [policy makers, research and development institutes].

4.2.2. Defining the main domains and the criteria

Bearing in mind the rationale of the Canal Operation we consider:

- the Constraints which affect the variability of inputs to the system and hence modify the status of the system are well-thought out.
- the characteristics of the Structures involved in the process. The characteristics of canal reaches and regulating structures determine how the system will react to perturbations of the input and how perturbations caused by the operation of the "machine" will propagate through the system.
- the quality of the irrigation service on the system, which enables the manager to determine what level of performance, should be achieved.
- Finally, the COP demand or **Means** or resources (inputs and efforts) required to achieve the required level of performance given the internal and external constraints.

There is no generic typology that can be defined and applicable in each country or each sub regions within countries. We have provided here below a list of criteria to be considered, prioritized according to the context and used in the design of the typology. For many criteria the situation is quite homogeneous within a region or a country and therefore they are no longer used in the typology to differentiate irrigation systems.

The canal operation typology suggested here is developed with four domains of analysis.

The first domain considers the technological aspects of the irrigation system, seeking to differentiate the control process; the degree of operation; and characteristics of the 'process' machines the canal reaches and the structures. This domain is referred to as *"**Systems and Structures**"*.

The second domain focuses on the interface at the boundaries of the considered system, with particular regard to the characteristics of water flows at the boundaries. The system network being considered joins with a number of other networks including irrigation, drainage, return-flows, runoff, natural streams and rivers. This domain is therefore referred to as "***Networks***".

The third, "***Water management***" considers the opportunities and constraints presented by the hydrological context of the system considered, with a particular focus on the constraints imposed on canal operations by the relative availability and quality of water resources.

The fourth domain is the **"Service**" provided to users of the system. This includes service to farmers and to other uses of water. The quality of the delivery to the user will, to a large extent, affect the potential of the user to make effective use of the irrigation delivery and therefore the perceived value of the water.

4.3. Towards practical typology

The matrix of criteria, resulting from the four domains above, includes a total of 21 criteria proposed for consideration when re-engineering the process of irrigation system operations. Although the partitioning of each criterion has been kept minimal to avoid too great a number of classes, it is clear that a strict application of the typology, as defined, leads to the identification of huge numbers of potential types of system, which is of no practical value. However the practical significance of each criterion has to be considered with reference to the context of each application. Although we strongly promote the need to fully consider the heterogeneity of irrigation systems it is, however, necessary to recognize that many of the criteria systems may be considered to be homogeneous. Furthermore, some criteria may be totally irrelevant in a particular context. Therefore, to be useful for a specific application a typology should result in a very limited number of types of irrigation systems. An effective typology of irrigation systems should be of less than 10 classes.

4.4. An example of typology of irrigation systems in Sri Lanka

In Sri Lanka a typology approach has been carried out for canal operation of the sixty-four major/medium irrigation systems operated by the irrigation department. This application has shown that in this context the irrigation systems are homogeneous for the large majority of the documented criteria: 18 out of the 21 criteria are not bringing any partition. Only three criteria were sufficient to enable a clear distinction of the operational characteristics of the studied systems, namely: Storage, Type of supply and Layout of lateral flows. The latter criterion is further subdivided into two sub-criteria: Return Flow (yes/no) and Runoff (yes/no) linked mainly to the type of canal (Single/Double Bank canals).

However, it must be pointed out that if sub-systems had been studied, rather than entire schemes, greater variability of some criteria would have been identified, for example recycling facilities and double bank canals appear as more variable and therefore more significant at sub-system level than at system level.

With a total of four criteria and sub-criteria selected at system level, and two classes each, 16 theoretical system types can be defined. However no instances of five of the defined types were found in the survey of systems in Sri Lanka. Furthermore, after elimination of classes with few instances, all sixty-four systems where classified into four main types. These types appeared to be quite different with respect to the probability of perturbations occurring, the likely behaviour in response to perturbations, and finally the difficulty in operating the distribution systems. They are:

- **Reservoir and localized storage system:** the main source of supply is a reservoir; it has a localized storage (intermediate reservoirs), single bank canals, without return flow entering the system.
- **Reservoir without localized storage system:** the main source of supply is a reservoir; no localized storage (intermediate reservoir), with single bank canals, and without any return flow entering the system.
- **Diversion river system:** main source of supply is from a diversion (river), it has single bank canals, with or without localized storage and return flows.
- **Return Flow system:** This type groups irrigation systems with return flows coming back into the system, having single bank main canals, fed by a reservoir or a diversion and with or without localized storage.

The first type is the least complex system for operation. The occurrence of perturbation on discharge is low as this type of system is fed by a reservoir, and has little or no lateral inflows. The opportunities for operation are good as on-line storage increases the efficiency and the reliability of operation (minimize fluctuations and water losses). On the other hand, systems with a river diversion supply, with lateral inflows from return flow and surface runoff, and with no on-line storage capacity are much more complex to operate. Perturbation occurrence and magnitude are high, and the canal has little flexibility to cope with these.

5. BLOCK 2 - THE RAPID APPRAISAL PROCEDURE (RAP) FOR DIAGNOSING IRRIGATION MANAGEMENT

A sound diagnosis of the current performance situation is often the most important phase in the modernization process. It gives a good indication of the constraints and problem areas in the system. Although system performance could be assessed in different ways, FAO recommends using the RAP, which was developed by FAO and the Irrigation Training and Research Centre (ITRC) of California Polytechnic State University to enable managers to proceed with the initial stage of modernization together with user group leaders.

RAP is a systematic set of procedures for diagnosing the bottlenecks and the performance and service levels within an irrigation system. It provides qualified personnel with a clear picture of where conditions must be improved and assists in prioritizing the steps for improvement. Furthermore, it also provides initial indicators that can be used as benchmarks in order to compare improvements in performance once modernization plans are implemented. Annex 3 provides detailed information on RAP and how to conduct it.

5.1. Basic elements of diagnosis and evaluation

The diagnosis or appraisal of project performance provides the fundamental basis for designing modernization strategies and plans. Thus, if it is not done properly, the whole modernization process will probably be flawed and fail to yield the intended results. Appraisal of irrigation system performance should help in the identification of short-, medium- and long-term actions needed to improve its performance. An appraisal or evaluation must be:

- **systematic**: conducted using clear, step-by-step procedures, well planned, and precise;
- **objective**: if done by different professionals, the results should not differ;
- **timely** and **cost-effective** (not taking too much time, and not too expensive);
- **based on minimum data** required for a thorough evaluation.

It should cover:

- all aspects that could influence actual water delivery service, including the physical infrastructure, water management practices, roles and responsibilities governing WUA[3]s, budgets, and maintenance;
- all levels of the system.

A proper diagnosis or appraisal process should be based on a combination of:

- field inspections, to evaluate the physical system and operations;

[3] Water User Association

- interviews with the operators, managers and users, for evaluating management aspects;
- data analysis, to evaluate a water balance, service indicators and physical characteristics.

A systematic evaluation of the current situation should be able to provide answers to the following questions:

- What level of water delivery service does the system currently provide?
- What hardware (infrastructure) and software (operational procedures, institutional setup, etc.) features affect this level of service?
- What are the specific weaknesses in system operation, management, resources, and infrastructure/hardware?
- What simple improvements in various components could make a significant difference in service delivery to users?
- What long-term actions could be taken to improve water delivery service significantly?

Conventionally, appraisals of irrigation systems often look at the big or overall picture and consider the inputs (water, labour, overall cost, etc.) and outputs (yield, cost recovery, etc.) of a system. While the overall picture is important, it does not provide any insight into what parts or components of a system should be improved or changed in order to improve the service in a cost-effective manner. Therefore, a sound diagnosis should provide insights into the internal processes as well as outputs. In other words, it should integrate internal and external indicators.

5.1.1. Internal indicators

The internal indicators assess quantitatively the internal processes (the inputs [resources used] and the outputs [services to downstream users]) of an irrigation project. Internal indicators are related to operational procedures, the management and institutional setup, hardware of the system, water delivery service, etc. These indicators are necessary in order to have a comprehensive understanding of the processes that influence water delivery service and the overall performance of a system. Thus, they provide insight into what could or should be done in order to improve water delivery service and overall performance (the external indicators).

5.1.2. External indicators

The external indicators compare the inputs and outputs of an irrigation system in order to describe overall performance. These indicators are expressions of various forms of efficiency, e.g. water-use efficiency, crop yield, and budget. They do not provide any detail on what internal processes lead to these outputs and what should be done in order to improve performance. However, they could be used for comparing the performance of different irrigation projects both nationally and internationally. Once these external indicators have been computed, they are used as a benchmark to monitor the impacts of modernization on improvements in overall performance.

Box 1: Examples of internal and external indicators

Internal indicator	External indicator
Flow rate capacities	Command area efficiency
Reliability	Field irrigation efficiency
Flexibility	Production per unit of land (US$/ha)
Equity	Production per unit of water (US$/$m^3$)

5.2. Evaluating irrigation projects – methods, tools and procedures

An irrigation project can be appraised in many different ways incorporating all or some of the elements described above. The methodologies commonly used by researchers and evaluators of the system make use of checklists, detailed data collection and analyses, participatory rural appraisal (PRA) techniques, and detailed surveys. However, the use of these tools depends on the perspective with which diagnostic analysis is performed. For example, researchers often opt for data collection and detailed analysis, which requires time and other resources. PRA is often used to incorporate local knowledge and perspective on the irrigation system performance into the diagnosis.

Traditionally, diagnostic procedures focused on only one or two of the components, e.g. equity in water delivery or institutional reforms, and only covered part of the system, e.g. one lateral. These limited-purpose diagnostic studies have usually been based on the collection of substantial field data and, thus, are time-consuming and expensive. Field data collection is feasible for long-term research projects. However, for project appraisals and diagnosis for modernization improvements, it is often necessary to evaluate the situation rapidly with whatever data are available. The lesson learned is that where data are not readily available at a project, it is usually not realistic to expect project staff to gather them.

5.3. The FAO approach to irrigation system appraisal

Experience has shown[4] that a rapid and focused examination of irrigation projects can give a reasonably accurate and pragmatic description of the current status of an irrigation system, and of the processes and hardware/infrastructure that in turn result in the present condition. It is on this basis, that FAO, together with the ITRC and the World Bank, developed a methodology/tool called the RAP with well-defined procedures for the rapid assessment of the performance of irrigation schemes.

The RAP allows for the identification of major actions that can be taken quickly in order to improve water delivery service (especially where the diagnosis is made in cooperation with the local irrigation authorities). It also helps in identifying long-term actions and the steps to be implemented in a modernization plan.

[4] FAO, 1999.

Although irrigation systems can be evaluated and appraised using any or combinations of the above-mentioned methods, FAO recommends using the RAP because of its rapid nature, systematic procedures, and comprehensive approach, as it covers all the different components (physical, management and institutional) of an irrigation system. The following sections describe the concept of the RAP.

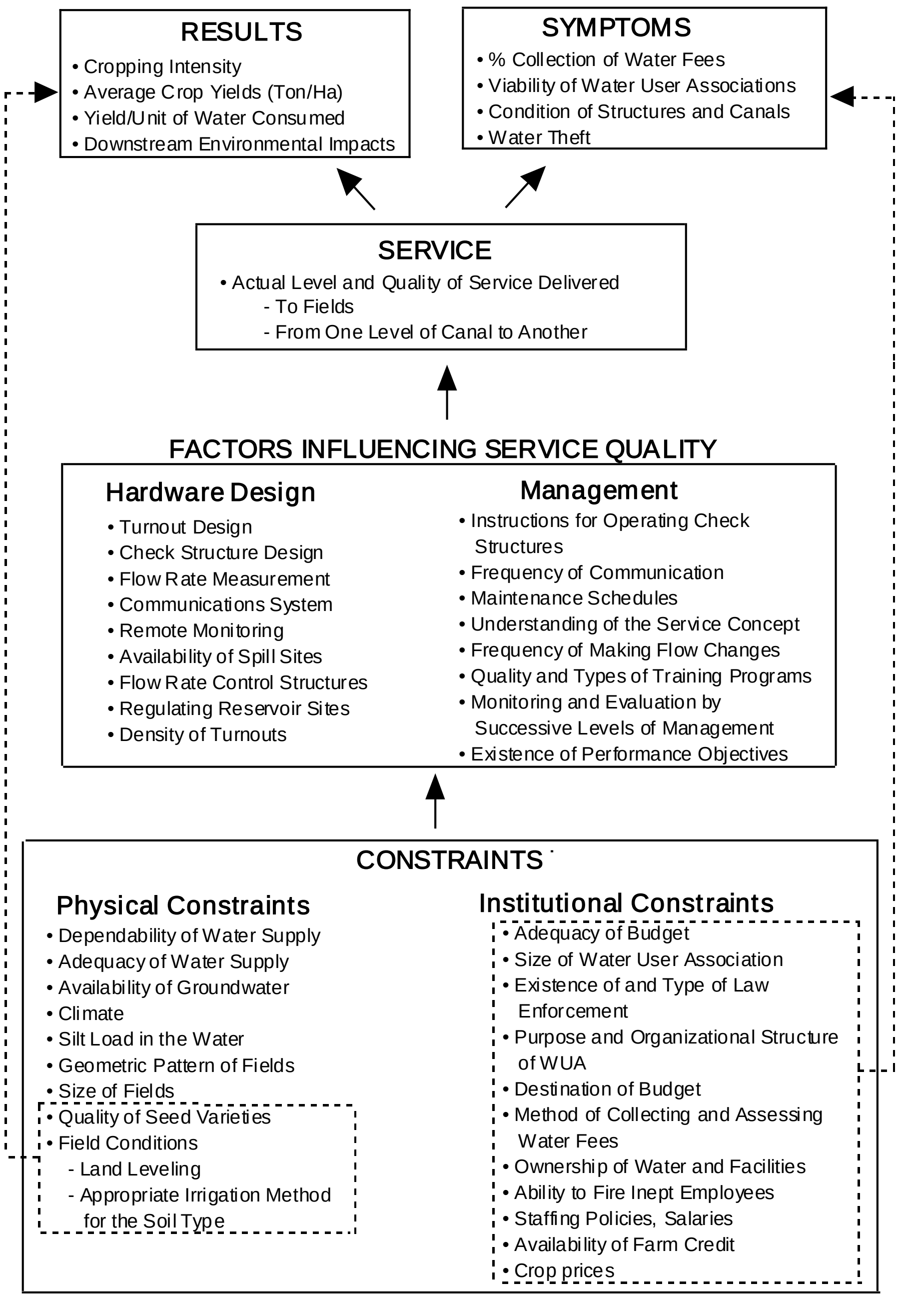
5.3.1. The Rapid Appraisal Procedure (RAP)

The RAP was developed originally by the ITRC in the mid-1990s for a research programme financed by the World Bank on the evaluation of the impact on performance of the introduction of modern control and management practices in irrigation[5]. Since its introduction, the RAP has been used successfully by FAO, the World Bank and other irrigation professionals for appraising projects in Asia, Latin America, and North Africa.

The conceptual framework of the RAP (Figure 2) for the analysis of the performance of irrigation systems is based on the understanding that irrigation systems operate under a set of physical and institutional constraints and with a certain resource base. Systems are analysed as a series of management levels, each level providing water delivery service through the internal management and control processes of the system to the next lower level, from the bulk water supply to the main canals down to the individual farm or field. The service quality delivered at the interface between the management levels can be appraised in terms of its components (equity, flexibility and reliability) and accuracy of control and measurement, and it depends on a number of factors related to hardware design and management. With a certain level of service provided to the farm, and under economic and agronomic constraints, farm management can achieve certain results (crop yields, irrigation intensity, water-use efficiency, etc.).

[5] FAO, 1999

Figure 2: Conceptual framework for the Rapid Appraisal Procedure



Symptoms of poor system performance and institutional constraints are manifested as social chaos (water thefts, and vandalism), poor maintenance of infrastructure, inadequate cost recovery and weak WUAs.

The basic aims of the RAP are:

- assess the current performance and provide key indicators;
- analyse the O&M procedures;
- identify the bottlenecks and constraints in the system;
- identify options for improvements in performance.

The RAP can generally be completed within two weeks or less of fieldwork and desk work if some data are made available in advance by the system managers. A set of Excel spreadsheets in a workbook is developed in order to conduct the RAP (Annex 3). These spreadsheets provide the evaluators with a range of questions related to the physical, management and water systems of an irrigation project that the evaluator has to answer. Based on the data and information input, a set of internal and external indicators is computed automatically.

The RAP has also been used as a foundation for benchmarking. The International Programme for Technology and Research in Irrigation and Drainage (IPTRID) defines benchmarking as a systematic process to achieve continued improvement in the irrigation sector through comparisons with relevant and achievable internal or external goals, norms and standards[6]. The overall aim of benchmarking is to improve the performance within an irrigation scheme by measuring it against desired targets and own mission and objectives. The benchmarking process should be a continuous series of measurement, analysis and changes to improve the performance of the schemes. Thus, the RAP becomes a tool for regular M&E of an irrigation project.

5.3.2. Appraising the physical infrastructure

The physical infrastructure or hardware (reservoirs, canals, diversion and distribution structures, etc.) of an irrigation system is the major physical asset of an irrigation authority or water service provider. Keeping the infrastructure/hardware in reasonable shape and operating it properly is the only way to achieve water delivery targets, provided that the delivery targets are set realistically (based on the available water resources and the capacity of the system). The main items to examine while appraising the physical characteristics of a system are:

- assets: conveyance, diversion, control and other structures per kilometre;
- capacities: canals and other structures;
- maintenance levels;
- ease of operation of control structures;
- accuracy of water measurement structures;

[6] IPTRID, 2001.

- drainage infrastructure;
- communications infrastructure.

5.3.3. Appraising project management

The management arrangements, procedures, incentives, etc. of any irrigation system play a vital role in how it is operated. The ways in which decisions are made, communicated and implemented influence not only the way the system is managed but also the perceptions of users about how the performance of the system meets their needs.

Often, operations, and thus water delivery service, could be improved significantly without much monetary investment by improving operational procedures, including for example the way control structures are manipulated. However, this often requires capacity development and appropriate targeted training of the office personnel and operators.

In order to identify improvements in the management of a project, it is necessary to appraise the following items (as a minimum):

- **operation**:
  - water allocation and distribution rules,
  - rules and procedures for operation,
  - stated vs actual policies and procedures,
  - the way structures are manipulated and operated – how changes are managed,
  - communication,
  - skills and resources of the staff at all levels;
- **budget**:
  - how realistic the budget is for the system operation to achieve set targets,
  - cost recovery – whether the system is able to pay for itself and invest in improvements as needed;
- **institutional**:
  - user satisfaction,
  - user involvement in decision-making – WUA.

5.3.4. Appraising water management

Water delivery service

Irrigation systems are composed of hydraulic layers, where each layer or level provides service to the next, lower level (water supply→ main → secondary → tertiary → user). Therefore, it is necessary to evaluate water delivery service at all levels.

At each level in general and for water users in particular, it is very important to receive the required volume of water at the right time, thus adequacy, reliability and timeliness are crucial. However equity of water deliveries is also a critical target for managers.

Therefore, adequacy. reliability and equity indicators are often used for assessing water delivery service. Other important indicators, particularly for modernization, are flexibility (frequency, rate and duration) and measurement of volumes. Farmers can strategize and plan their cultivation and irrigation activities better where they can choose or at least predict the frequency, rate and duration of water delivery. Thus, the RAP computes the following indicators to assess water delivery service at each level of an irrigation system:

- reliability,
- equity,
- flexibility,
- measurement of volumes.

As mentioned above, irrigation systems are often under increasing pressure to provide water for uses other than irrigation. In such cases, it is also necessary to evaluate the level of service required for these other uses.

Water balance

A water balance provides an accounting of all the inflows and outflows within a defined boundary, as well as information about different water efficiencies (e.g. conveyance efficiency and application efficiency). Thus, it provides a good assessment of existing constraints and opportunities for improvement. It helps set the stage to determine the level of water delivery service to be achieved and to design appropriate allocation strategies. The RAP includes a water balance at the system/project level for the rapid assessment of the external indicators and identification of the potential for water conservation. However, for regular monitoring and water management decision-making, a more detailed water balance is required.

6. BLOCK 3 - MASSCOTE

6.1. A methodology for developing a modernization plan for irrigation management

The MASSCOTE methodology has been recently developed by FAO to assist technical experts, irrigation managers and, more broadly, irrigation professionals in embarking upon the difficult road of modernization or re-engineering of irrigation management of medium to large irrigation canal systems.

Although the majority of the irrigation experts, policy makers, donor agencies and practitioners recognise a dire need to bring about drastic changes in irrigation management, unfortunately, few know how to put this into practice. In the past, despite of considerable efforts and resource allocation a large number of modernization projects have failed miserably and irrigation institutional reforms have not yielded expected results because of lack of attention to the details. A recent FAO survey on more than 30 irrigation systems in Asia shows that inadequate attention to canal operation is a major reason for disappointing results and underperformance of the many irrigation systems.

With increasing water scarcity and growing competition for available water resources from different sectors, agriculture is expected to do "more with less" water as well as finances, thus freeing up resources (water, money) for other uses. However the irrigation engineers are still trained in the same old fashioned manner that only prepares them to design and construct the canals and not to manage irrigation systems. There are very few training centres and universities (mostly in the western developed countries) which provide training in service oriented irrigation management and modern canal operation techniques. Usually, irrigation professionals are expected to learn by themselves in the field how to deal with performance improvement, multiple uses of water, environmental needs, low farm gate prices, conjunctive use, etc.. Mostly they are left with limited capacity and resources to deal with the increasing complexity of management.

Irrigation modernization is neither magic, nor rocket science. Modern irrigation management basically refers to responding to the current users' needs with the best use of the available resources and technologies. As they say "The devil is in the details" but the paradox is that chasing the devil is not attractive to many. The more water is debated globally the less actual managers are provided with practical solutions and tools that could assist them in addressing complex situations and requirements.

The MASSCOTE approach is a modest attempt to break this paradox and to help managers seriously tackle modern needs issues and challenges. The entry point is canal operation but the scope is modernization and the goal is to promote Service Oriented Management.

The methodology capitalises on many modernization programmes in which FAO has been involved in recent years, in particular through associated training (RAP and MASSCOTE trainings). During the last decade, FAO has trained more than 500 engineers in Asia. Therefore it is fair to say that the approach presented here has largely been developed in close collaboration with irrigation managers in the field, who are envisaged to be the main users of this product.

MASSCOTE seeks to stimulate the critical sense of engineers in diagnosing, evaluating obstacles, constraints and opportunities and developing a consistent modernization strategy. The methodology is specifically developed step-wise to convert the complexity into simple and straightforward elements which facilitate the shift towards more effective water management and improved water delivery service.

The goal of MASSCOTE is to generate a solution for irrigation management and operation that works better and that serves the users better.

Canal operation is at the heart of the MASSCOTE approach for two main reasons:

- In the diagnosis phase: The critical examination of the canal state and the way it is operated yields significant physical evidence on the grounds of what is really happening in terms of management organization and service to users.
- In the development of the modernization plan, canal operation is critical as the intervention aims to achieve the agreed upon and/or upgraded service. Many

irrigation reforms have shown how important canal operation is the hard way, by neglecting it in the design.

Users are central to this SOM-based approach. The way in which the various steps of MASSCOTE are developed aims to generate solutions for service and operations on which the users will have to decide.

Therefore, it is fair to say that canal operation is the focus of MASSCOTE, while its overall goal is modernization of management and the users as central actors.

It is always risky to bring forward a definition as there is then the possibility of not capturing all aspects of the problem, of being misunderstood, or of becoming rapidly obsolete or irrelevant in some context. Nonetheless, this paper proposes the following definition: Modern irrigation management is an SOM with a cost-effective institutional and technical setup to govern the scheme and operate the system for producing the agreed-upon services.

Canal operation is a complex set of tasks involving many critical activities that have to be done in a consistent and timely manner for good irrigation management. Among the numerous aspects of management, the following need to be considered:

- service to users;
- cost and resources dedicated for O&M;
- performance monitoring and evaluation (M&E);
- constraints on the timing and amount of water resources;
- physical constraints and opportunities relating to topography, geography, climate, etc.

There is no single answer as to how to integrate all the elements into an effective and sustainable framework for improving canal operation. However, the new MASSCOTE approach has been developed on the basis of extensive experience with irrigation modernization programmes in Asia between 1998 and 2006.

MASSCOTE aims to organize the development of modernization programmes through a step-by-step methodology:

- mapping various system characteristics;
- delimiting institutionally and spatially manageable subunits;
- defining the strategy for service and operation for each unit.

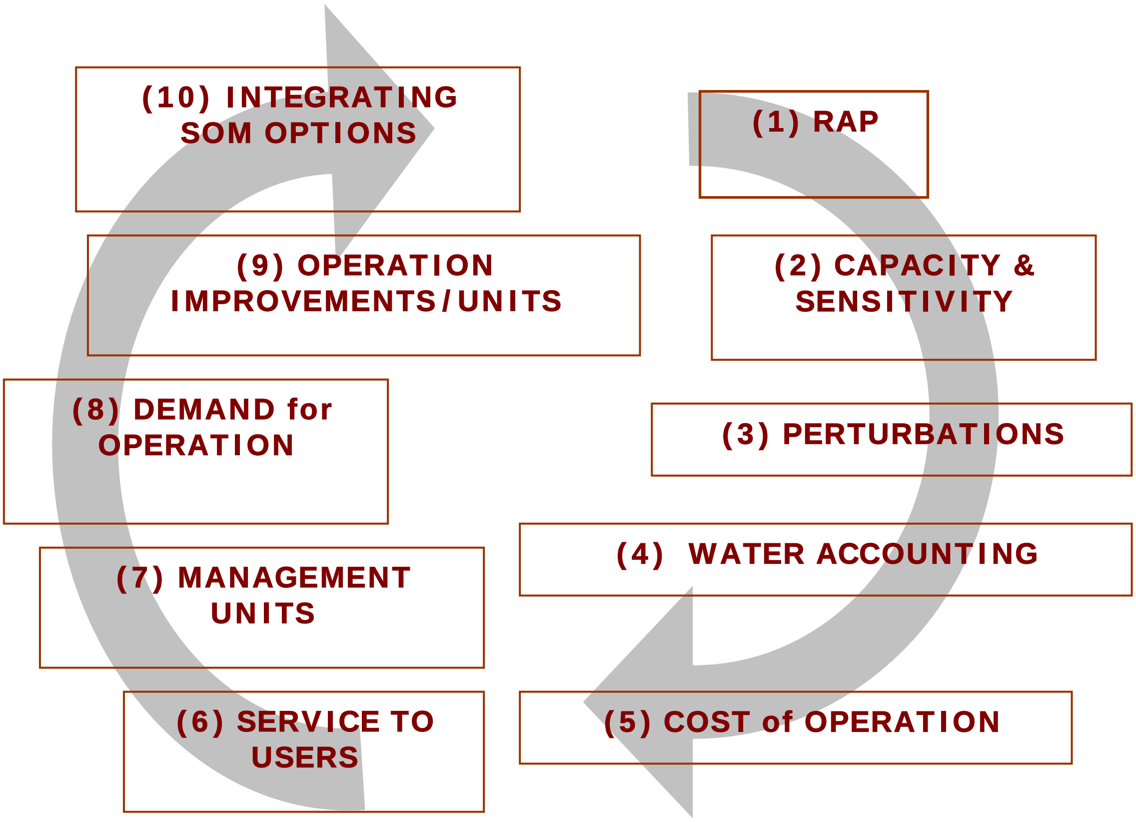
6.2. A step-by-step framework

The first steps outlined in Table 1 and Figure 3 are to be conducted for the entire CA. The goal is to identify uniform managerial units for which specific options for canal operation can be designed and implemented.

Table 1: The MASSCOTE framework

Mapping	Phase A – baseline information
1. The performance (RAP)	Initial rapid system diagnosis and performance assessment through the RAP. The primary objective of the RAP is to allow qualified personnel to determine systematically and quickly key indicators of the system in order to identify and prioritize modernization improvements. The second objective is to start mobilizing the energy of the actors (managers and users) for modernization. The third objective is to generate a baseline assessment, against which progress can be measured.
2. The capacity & sensitivity of the system	The assessment of the physical capacity of irrigation structures to perform their function of conveyance, control, measurement, etc. The assessment of the sensitivity of irrigation structures (off takes and cross-regulators), identification of singular points. Mapping the sensitivity of the system.
3. The perturbations	Perturbations analysis: causes, magnitudes, frequency and options for coping.
4. The networks & water balances	This step consists in assessing the hierarchical structure and the main features of the irrigation and drainage networks, on the basis of which water balances at the system and subsystem levels can be determined. Surface water and groundwater mapping of the opportunities and constraints.
5. The cost of O&M	Mapping the costs associated with current operational techniques and resulting services, disaggregating the different cost elements; cost analysis of options for various levels of services with current techniques and with improved techniques.
Mapping	Phase B – Vision of SOM & modernization of canal operation
6. The service to users	Mapping and economic analysis of the potential range of services to be provided to users. Mapping a vision of the irrigation scheme.
7. The management units	The irrigation system and the service area should be divided into subunits (subsystems and/or unit areas for service) that are uniform and/or separate from one another with well-defined boundaries.
8. The demand for operation	Assessing the resources, opportunities and demand for improved canal operation. A spatial analysis of the entire service area, with preliminary identification of subsystem units (management, service, O&M, etc.).
9. The options for canal operation improvements / units	Identifying improvement options (service and economic feasibility) for each management unit for: (i) water management, (ii) water control, and (iii) canal operation.
10. The integration of SOM options	Integration of the preferred options at the system level, and functional cohesiveness check. Consolidation and design of an overall information management system to support operation.
11. A consolidated vision & a plan for modernization and M&E	Consolidating the vision for the Irrigation scheme. Finalizing a modernization strategy and progressive capacity development. Selecting/choosing/deciding/phasing the options for improvements. A plan for M&E of the project inputs and outcomes.

Figure 3: The steps in the MASSCOTE approach



7. BLOCK 4 - CAPACITY DEVELOPMENT

7.1. The NRLW conceptual approach to capacity development

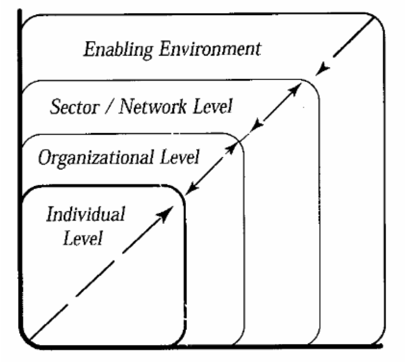
In a recent international workshop on capacity building FAO (Kay & Renault, 2003) suggested the use of the generic framework proposed by Bolger (2000) describing in terms of different levels of capacity, namely individuals, organizations and societies but he emphasizes the links between them. For example, the performance of a water user association is shaped as much by society (laws, regulations) as it is by individuals (skills, leadership, relationships).

Four levels of capacity emerge from this approach. Each represents a level that can be examined and analysed and as well as a possible entry point for support from a donor or technical cooperation. Interpreting these levels in terms of irrigated agriculture:

- **Individual level**. This is the most 'concrete' and familiar part of capacity development and would include the education and training of the various stakeholders, farmers, local professionals, engineers and other disciplines involved in irrigation.
- **Organizational level**. This refers to groups of people such as water user organizations, research groups, government extension agencies, private companies that share common objectives such as improved livelihoods at a farming level or improved water management or increased agricultural productivity at a national level. Institutions are the rules and agreements, formal and informal, and shared values that bind organizations. So the capacity of an organization is embedded in the ability of its individuals to work together within established rules and values.
- **Sector/Network level**. The sector level emphasises the point that irrigation is part of the larger picture of integrated water resource management and reflects the increasing awareness of the need for policies that integrate and cover all aspects of the water sector and not just irrigation, water supplies and the environment in isolation. The addition of networking at this level is less important for irrigation as this can take place at all the levels.
- **Enabling environment**. This represents the broad national and international context within which irrigated agriculture can develop and this has considerable influence over what happens at the lower levels. It is concerned with policy at the highest levels in government and the ability of people at the lower levels to influence it. It is also about the socio-economic conditions that enable or discourage irrigation development and the legal framework that provides farmers with security of tenure for land and water and the power to seek legal redress when contracts are broken.

The above generic framework provides a useful start point for mapping the territory of capacity development in irrigated agriculture. However, it needs to be enriched with specific aspects of social science, the practical activities of a well-functioning irrigation sector and the activities that develop capacity. There are many irrigation related issues to consider. The question is what to include and what to leave out. Adding too many can lead to confusion and paralysis whereas adding too few can lead to an over simplification that does not bring out the main issues.

Figure 4: A conceptual framework for capacity development (Bolger 2000)



A compromise is proposed here by introducing a second dimension based on the familiar activities of planning, design, construction, operation and maintenance. In addition to these, research, education and training and networking have been added as important capacity development activities in their own right. Research here refers to the capacity to develop new knowledge in a specialist institute or university, and education and training refers to the capacity to disseminate knowledge in colleges, universities etc. Networking refers to the various formal and informal networks that are instrumental in disseminating knowledge and innovation. The historical development of agriculture in many countries has shown that the capacity of farmers' unions and cooperatives to communicate with each other and with their members has been an important tool for boosting agricultural progress. Similarly, engineers and agriculturalists have benefited from the networking capabilities of their professional organizations.

To demonstrate the move away from the traditional top-down approach to development, two important guiding principles have been added to the framework, namely, subsidiarity (decision-making at the lowest possible administrative level) and participation.

An appropriate label for this approach is **Capacity Development Engineering (CDE) –** the capacity to handle effectively capacity building programmes.

Figure 5: A framework for capacity development engineering in irrigated agriculture

Capacity levels	Water sector activities				Capacity development activities			Methods
	Planning	Design	Construct.	O&M	Research	Ed & Tr	Network	Needs Action Impacts
IV Enabling env								
III Sector								
II Organization					←			
I Individual								
	Capacity Development Engineering (CDE) - Guiding principles: subsidiarity and participation							

Each box in the framework represents an activity in the water sector that requires trained individuals working in organizations and within an enabling environment. If constraints are identified for a particular activity then the need can be assessed, actions taken and impacts measured. But as Bolger points out in relation to the generic framework, the levels (or boxes in this case) are not simple watertight compartments but are very much linked together is a variety of ways that depend on local circumstances. The simplicity of the framework should also not mask the complexity of the issues to be dealt with.

7.2. A methodology to craft a CD programme

FAO in 2003 and IPTRID in 2004 and 2005 organized international workshops with ICID on capacity building with the objectives of designing practical approaches for management capacity of irrigation and drainage systems. The following sections are extracted from Hundtermark and Sato (2005).

7.2.1. Planning framework

The design of a strategy and its formulation is a long process which involves a phased and multi-faceted approach. It implies that organizations involved realign their goals and policies, revise expected results, and adjust strategies and action programmes, as the Strategic Plan is implemented.

Strategic planning usually does not lead to a rigid plan but aims to create the conditions for a continuing flexible response. A strategy can be defined as a long-term plan of action which is designed to achieve a particular goal. It also involves the definition of objectives and resources allocation which are required in order to implement plan. A widely applied approach in strategic planning is to examine the strengths, weaknesses, opportunities and threats of the organization or system where a Capacity Development process is going to be developed.

7.2.2. Strategic planning

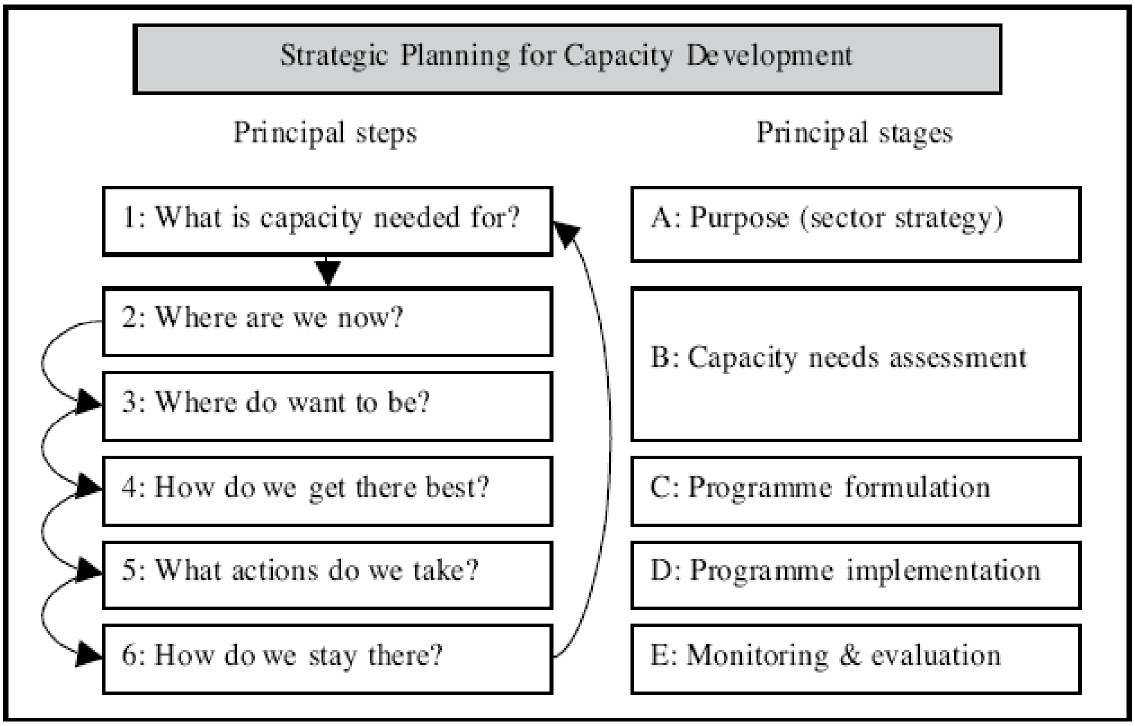
This is the beginning of a strategy development process for capacity development that includes:

- Diagnosis: identification of the gaps
- Definition of the goals
- Means
- Monitoring of performance

For the development of a capacity development strategy, Kay et al. (2004) distinguished a five-phased approach which is presented as non-linear; its phases are interlinked and overlapped, and they form a continuing cycle of development and change according to the prevailing circumstances. In each step a fundamental but simple question is asked: ***Where are we now?*** Defining the present capacity within the system: ***Where do we want to go?*** Looking ahead to the future desired state, the vision of what capacity is required in the future in order to do the job: ***How do we get there best?*** Comparing the present situation and future desired state; identifying the capacity gaps and strategies and actions designed to fill these gaps and achieve the desired goals: What are the priorities? ***What actions do we take?*** Fulfilling the strategies and undertaking the planned capacity development activities in order to meet the defined objectives: ***How do we stay there?*** Monitoring and evaluation to feed back experiences into the planning phase.

The analytical process embraces a series of steps which set the foundation for the formulation of a comprehensive capacity development strategy.

Figure 6: Principal steps for the development of a capacity development strategy



Means
Research
Education & Training
Networks

Networks
Networks can have a positive influence at all the levels of the framework by providing a means of communication for individuals and organizations. The rapid and huge developments in information management provides an enormous opportunity to disseminate and share information but at the same time there is always the threat that a digital gap will benefit the better of at the expense of the poor and disadvantaged.

The network function of capacity development is two-dimensional (Figure below). The vertical dimension integrates the levels mentioned in the framework such as the network of people and institutions belonging to a specific project, ranging from farmers to external donors, via local governmental officers and/or training institutes. This line of capacity development is traditionally the one which was acted during the top-down approach of projects, and which remains active today although with a much more participatory approach and more balance in the decision making among the different actors.

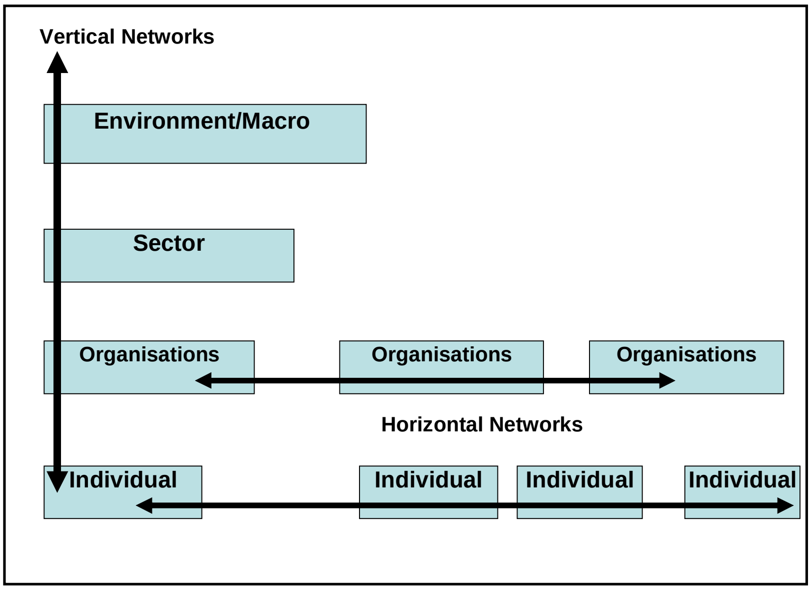
The horizontal dimension refers to the networks linking actors or organizations of the same nature and level. There is strong evidence that this networking aspect has been previously neglected by those responsible for development. Social science in agriculture has shown that the adoption of new techniques and the diffusion of progress is often more the result of discussion and comparison among peers than the result of knowledge brought in by other actors.

Linking or twinning a newly created WUA with an existing one from the same country or from another one is a typical horizontal network. The president of the new WUA is more likely to understand and trust the president of the more experienced on than some external consultant. In the same way he is also more likely to adopt a management change suggested by a peer.

The support from aid agencies for this type of networking is growing although it is still on a very small scale. But the impact usually goes beyond those immediately involved via other networks. There are many examples of this kind of cooperation in the Mediterranean region. This networking is also called the professional cooperation. FAO, for instance, has developed many field programmes based on technical expertise from the 'south', known as 'south – south' cooperation.

Mixed networks connect actors with similar levels of decision-making but from different fields

Figure 7: Horizontal and vertical networks



8. CONCLUSIONS

Three important features are worth to be reminded:

Ideally a double sweep approach between the project and the national state level should be practiced, with a consistent fine tuning between policy development and project level considerations. This is the best way to promote conducive and effective policies that actors will contribute to implement and will benefit from.

A very critical foundation for policy development in water management is to carry out first with the local actors reliable assessments of performance and issues in the existing systems.

The ownership of policy changes and thus the effectiveness of the recommended changes, is critical. Policy changes that are not practical or understandable are likely to fail. The ownership of changes by the actors requires participatory approach and capacity development for the practitioners.

9. Readers' Notes

9.1. Time requirements

Time required to deliver this module is estimated at about 2 hours.

9.2. EASYPol links

This module belongs to a set of modules which are part of the EASYPol Resource Package: **FAO Policy Learning Programme – Specific policy issues – Natural resource management - Water**