PERFORMANCE OF IRRIGATION AND PARTICIPATORY IRRIGATION MANAGEMENT: LESSONS FROM FAO'S IRRIGATION MODERNIZATION PROGRAM IN ASIA

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ABSTRACT

Recent efforts to improve irrigation performance in Asia have to a large extent concentrated on governance and institutional issues through participatory irrigation management and irrigation management transfer. Beyond the objective of improving financing of operation and maintenance of the systems thanks to farmers' contribution, these reforms were also expected to improve the efficiency and productivity of the systems. Participatory irrigation management, together with demand management, is often the main measure recommended in integrated water resources management plans to improve productivity and efficiency of irrigation.

A recent series of appraisals of large and medium-scale irrigation systems by FAO in Asia with a Rapid Appraisal Procedure suggests that participatory irrigation management has largely failed to deliver on all these major objectives. Water users associations created are weak and have little influence on major management decisions and water delivery while chaos – the difference between actual and stated management and operation – is not reduced. On-going efforts in a number of countries are essentially based on the same models and are likely to produce the same outcomes. These disappointing results have led reform promoters to advocate deeper reform on the ground that these disappointing results were due to incomplete reform.

This paper argues that, unless significant results are achieved in improvement of service delivery to farmers and water users associations and reduction of chaos, institutional reform will continue to have disappointing outcomes. This will require addressing not only the deficiencies of the participatory irrigation management models presently adopted, but also addressing other factors of poor performance, related to system operation, management and design, as documented by the results of the appraisals of the systems.

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The paper concludes by recommendations on key features of future reform, based not only on a review of present problems and issues but also on a forward-looking perspective of the future evolution of the irrigation systems.

IRRIGATION MODERNIZATION AND PERFORMANCE ASSESSMENT

In recent years, the Food and Agriculture Organization of the United Nations (FAO) has been promoting the modernization of irrigation systems in Asia with a focus on service oriented management. FAO defines modernization of the irrigation systems (FAO 1997) as “a process of technical and managerial upgrading (as opposed to mere rehabilitation) of irrigation schemes with the objective to improve resource utilization (labor, water, economics, environmental) and water delivery service to farms”. This concept, centered on provision of water delivery service to farmers, has been the guiding principle for FAO’s activities in the region and for the selection and development of performance appraisal tools and methodologies, such as the Rapid Appraisal Procedure (FAO, 1999) and MASSCOTE (FAO, 2007, forthcoming).

Recent performance assessments and reviews have revealed that past reforms and investments in the irrigation sector, focusing either on institutions or on infrastructure, have largely failed to produce desired results of improved water delivery service to the farmers. Performance assessment of a large number of irrigation projects (FAO, 1999) which underwent some modernization indicated that the lack of knowledge of proper options was the single most reason for mitigated success of irrigation modernization projects and modest improvements in the water delivery service to farmers after the implementation of these projects. A review of irrigation evolution in South and South East Asia (Barker and Molle, 2005) has attributed disappointing performance of institutional reforms (Irrigation Management Transfer (IMT); Participatory Irrigation Management (PIM) to their failure to improve water delivery service to farmers: design and operation constraints that are not addressed by these reforms significantly contribute to these results. An appraisal of initial conditions and performance of the systems to be transferred was thus estimated to be instrumental to allow both a better design and strategic planning of physical, operation, managerial and institutional improvements, to achieve specific service objectives to be provided both by the irrigation service provider to water users associations (WUAs) and by WUAs to their members (Facon, 2005).

FAO has therefore been calling for a massive re-training of engineers and managers in irrigation agencies, consulting firms and Irrigation Service Providers in Asia (FAO, 2002), in order to introduce and provide knowledge and ways and means to design, manage and operate irrigation systems economically for improved performance and adequate service to farmers as they aspire to improved socio-economic well-being, evolve toward more commercial forms of agriculture and face the challenges of globalization on the one hand, and water resources management moves towards integrated water resources management in the river basins and competition for water from other sectors intensifies on the other hand. FAO has developed training materials and detailed curricula, as well as specific tools for the appraisal of irrigation systems for benchmarking and the development of appropriate modernization plans for irrigation systems. The first training workshop under the program was organized in Thailand in

2000 and, since then Vietnam, the Philippines, Nepal, Thailand, Indonesia, Malaysia, Turkmenistan, Pakistan, India and China have benefited from support of the Regional Training Program. More than 500 engineers and managers have now been trained with support from the Program.

THE RAPID APPRAISAL PROCEDURE, THE TRAINING PROGRAM AND BENCHMARKING

The Rapid Appraisal Procedure (RAP) was originally developed by the Irrigation Training and Research Centre of California Polytechnic University in 1996-97 as a diagnostic and evaluation tool for a research program financed by the World Bank on the evaluation of impact on performance of irrigation systems of the introduction of modern control and management practices in irrigation (FAO, 1999). The conceptual framework of the RAP for the analysis of the performance of irrigation systems is the following: irrigation systems operate under a set of physical and institutional constraints and with a certain resource base. The systems are analyzed as a series of management levels, each level providing water delivery service through the system's internal management and control processes 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, reliability) and accuracy of control and measurement, and depends on a number of factors related to hardware design and management. With the service quality delivered to the farm and under economic, agronomic constraints, system and farmers' management produces results (crops yields, irrigation intensity, water use efficiency), while symptoms of poor system performance and institutional constraints are manifested as social chaos (water thefts, vandalism), poor condition of infrastructure, poor cost recovery and weak water users associations.

In accordance with FAO's approach, trainees under the regional training program have been trained in modernization options, appraised their irrigation systems with the RAP and developed an irrigation modernization strategy for their system, with short, medium and long-term objectives and a phased action plan addressing both hardware and software improvements. Different aspects of management (incentives, training, budgetary resources and allocations, supervision, monitoring and evaluation, instructions to and initiative of staff, actual versus official practices, responsiveness of operation, gap between stated performance and actual performance, etc.) are rated. For Water Users Associations (WUAs), their overall strength is assessed based on the following criteria:

- Percentage of all project users who have a functional, formal unit that participates in water distribution;
- Actual ability of the strong Water User Associations to influence real-time water deliveries to WUA;
- Ability of the WUA to rely on effective outside help for enforcement of its rules;

- Legal basis for the WUAs;
- Financial strength of WUAs.

In addition, their in-kind and cash contributions to overall operation, maintenance, repairs and hardware improvements, is also assessed.

The details of performance indicators rating results and internal process indicators and sub-indicators, and values for the systems appraised under the training program, can be found in Appendixes 4 and 5 of this paper.

ACTUAL PERFORMANCE OF THE IRRIGATION SYSTEMS IN ASIA: SERVICE AND WATER USERS ASSOCIATIONS

All irrigation systems appraised at the occasion the regional training program were large-scale rice-based systems, with the exception, which will be the object of a specific paragraph. They were typically designed for supplementary irrigation of rice during the rainy season (with the exception of Turkmenistan, which is under an arid desert climate and the Jiamakou system in Shanxi Province, which irrigates orchards in a semi-arid climate). They are public managed in a supply-driven mode. Water users associations have been created in a number of countries but they do not play a meaningful role in the management of the systems. The systems are generally in a poor condition due to insufficient maintenance and provide poor service to farmers. Service provided by the main canals to the secondary canals and command areas is generally unreliable and inequitable, with the exception of Malaysia and Chinese systems. Water level control in the canals is poor and a main factor in poor service delivery. Some systems had not received support for many years while for others, substantial investment had recently been completed or was under way.

Design standards and operation have not changed in many countries for 20-30 years (Plusquellec, 2002). Specific flow-rates of the canals are calculated for supplemental irrigation, are therefore quite small, and decrease from the main canals to the lower level canals. This does not allow flexibility of operations and large variations in flow-rates. It is a particular constraint when farmers wish to synchronize their farming activities fro mechanization and thus need large amounts of water for land preparation at the same time, Cross-regulators are, with a few exceptions, manually operated underflow structures, in combination with underflow off-takes, and generally very sensitive to fluctuations in water supply. In the Philippines, duckbill weirs have been introduced for water level control. However, most of them have been vandalized as the systems have large variations in their water supply. During shortage periods, the upstream offtakes receive their allocation until available flows are depleted and downstream offtakes are shorted. In some cases, offtakes are of the overflow type (Rominj gates in Indonesia), which exacerbates fluctuations of flow-rates into the minor canals. Gates are rarely calibrated. The most common measurement method for flow-rates is the orifice formula through (non-calibrated) gates. Other measurement devices have been introduced (broad-crested weirs), but they are typically poorly designed (too broad) and inaccurate, or submerged. Recirculation of drainage is practiced in a large number of schemes, but none is equipped with buffer or regulating reservoirs.

Operation generally follows a seasonal schedule which is adjusted on average every week, usually following qualitative assessments of demand by managers or requests by farmers. Main structures are operated typically three times a day according to a set schedule, very often following instructions from a central office on gate positions. Although system managers often issue instructions on flow-rate targets at each off-take, these are rarely followed and most field operators adjust gates based on water levels in the canals. Farmers often operate the gates themselves and operators and managers have capitulated to this situation. A typical response to this lack of discipline is the "rotational supply": water levels are raised in canal reaches during "on rotation" periods and lowered during "off rotation" periods. Near-farm, and on-farm infrastructure is under-developed. The introduction of command area development on the structured design concept or proportional flow division as an alternative to previous fully-gated distribution network designs has not been successful. The systems are immediately subverted by the farmers.

Low-cost pumping technology and energy subsidies have allowed farmers to free themselves from the constraints of poor canal system performance or inadequate scheduling through groundwater pumping, illegal pumping from the canals, water scavenging or subversion of system policies and obtain more reliable or frequent supply, switch to other crops and more effective on-farm water management strategies and techniques. Conjunctive use is not managed by anyone but usually allows farmers to adopt highly productive farming systems.

General management policies are typical of public institutions in the region, with few effective systems for rewarding or sanctioning performance. Field-level operators are often very poorly paid and it is difficult for management and engineers to control how they actually operate the structures, which often differs form official rules and policies. How structures are actually managed is often directly responsible for instability of the system. In the Sunsari Morang (Nepal) system, main canal operators, when trying to provide a target flow-rate into a secondary canal, make an initial setting at the off-take of the secondary canal, then operate the cross-regulator of the main canal to lower or raise the water level in the main canal to adjust the flow-rate into the secondary canal. If they have raised the water level in the main canal too much, they then open a safety structure to divert the "excess" water supply into a drain. This example, while extreme, illustrates the important of all details of canal operation and of instructions to operators.

The administrative setup of the operating agency frequently hinders effective operation. In Thailand, the responsibility for operation of longs canal is divided into reaches under the control of different operation and maintenance projects which follow district boundaries. While water allocation is officially to each secondary canal, in practice there is a flow-rate target at the interface between each project. As a result, the projects focus their energy on disputes on flow-rates at these interfaces, operate the cross-regulators as flow control structures which creates water level fluctuations in the main canals, neglect flow-rate targets into the secondary canals, which thus fluctuate wildly, and no specific office is responsible in case of water deficit in the lower reaches of the main canals. While project managers already frequently integrate into their operation plans water supply to other users (municipalities, industrial customers), none of the projects appraised has specific environmental targets or goals.

Proposals and ideas of the training workshop trainees for improvement of their systems (and project proposals prepared by local consulting firms) - prior to the training - usually follow a standard menu of rehabilitation following prevailing standard designs, transfer of operation and maintenance costs to farmers, and substantial investments in rigid canal lining. The introduction of SCADA systems and information technology is frequently considered or already at an early stage of introduction. However, details of selection of sensors, of control logic, are frequently inadequate.

System managers rarely have in place effective monitoring and evaluation systems. When these are in place, they are rarely used for immediate feedback for operation. Flow-rates at spills and in drains are not monitored and managers do not have a proper water balance and estimation of the system's efficiency (with the exception of Malaysia thanks to IPTRID's national benchmarking program). There is however a gradual shift to performance-oriented management and the definition of performance indicators (Thailand). However, norms and budget allocations are often uniform nationally, not reflecting the constraints and potentials of projects, which may vary significantly across projects (Philippines). Some projects (Philippines) are piloting demand management with the introduction of volumetric water pricing. However, investment in the upgrading of the systems has not been geared towards improving control to customer water users associations, and proposed volumetric rates, based on current service fees, are not likely to yield expected water efficiency gains (de Fraiture and Perry, 2002, FAO 2004).

In summary, the level of chaos (difference between stated policies and actual policies) and of anarchy (subversion of policies) varies from system to system, but is generally high, particularly at the lower levels of management. Recent investments following standard standards or investment strategies (command area development) have poor results in terms of performance, control and service. While lack of discipline and institutional issues contribute greatly to this situation, many of the problems can be traced to:

- Problems in initial design;
- Exporting of design concepts outside of their area of validity;
- Difficulty to control and operate the systems;
- Layouts with confused hierarchies;
- Serious flaws in operation strategies;
- Inconsistencies between operating rules at various levels;
- Inconsistencies between operating rules and farmers' requirements;
- Changes in farmers' requirements not reflected by changes in system policies;
- Poor quality of water delivery service to farms;
- Lack of flexibility at all levels.

In this respect, irrigation planners, understood as central agency staff in planning and design branches, and irrigation managers, understood as system-level field staff in charge of system operation, are two different groups. The former are not necessarily aware of the specific difficulties which managers face every day. Planning and design procedures, as well as terms of reference for consulting firms which are frequently assigned the tasks of planning and designing system improvements, are typically not centered on the concerns of managers and farmers. Participatory design procedures are progressively being introduced, but they frequently focus on details such as layout of the canal networks or positions of the off-takes, rather than on more general (and more important) issues of service and performance objectives and design criteria.

A CHINESE EXCEPTION?

The RAP results of the Chinese projects (Zhanghe in Hubei and Jiamakou in Shanxi) stand in sharp contrast with projects in other countries. System efficiency, water productivity and service are very high compared with systems in Southeast Asia. While Zhanghe is essentially a rice-based system, it differs from other appraised system by its "Melon-on-the Vine" design, characterized by a large number of buffer reservoirs, at all levels, connected to the system. Jiamakou is a pumping scheme form the Yellow River in an arid province, has been converted rapidly from a wheat system to a commercial system dedicated to apple orchard, with a major challenge related to silt load in water supply. Both systems have benefited from modernization in recent years, and are currently not operated under upstream control. Cross-regulators are not used for maintaining constant water levels in canals. However, what distinguishes these systems from their counterparts is not so much technical features (infrastructure is not essentially better than the other projects') as management. The systems provide water delivery on an arranged volumetric basis to the heads of water user associations' canals, and charge water on a volumetric basis to farmers.

An additional feature of the Jiamakou management is the model of "business units" introduced for management: pumping, main canal water delivery and lower level distribution are organized into "business units" with performance targets which practically translate into financial incentives to staff. Before the RAP (May 2006), these financial incentives were related to efficiency of conveyance and distribution. As an outcome of the RAP, management objectives have been revised to include service standards, which have been translated into financial incentives.

For both projects, the authority of managers to effect and implement change seems to be much higher than in higher countries. This can be illustrated by the fact that, in Jiamakou, action was immediately taken: in the 4 months following the RAP, the Jiamakou manager organized additional training, working groups to analyzed RAP results and come up with recommendations, in the areas where service indicators had been shown to be lower than expected, has revised, as explained above, his management objectives and incentive systems, and implemented a program to improve water measurement devices at the head of field ditches, where water is measured for volumetric charging. Management objectives related to service improvement (improving lower level service in Zhanghe and improving field-level flexibility for Jiamakou) will imply using cross-regulators to maintain constant water levels, with the objectives of improving flow rate control at all levels of the systems. Technically and for management, the main issue for Zhanghe is to re-establish coordination among the multiple level reservoirs, which was disrupted by decentralization of water management, while for Zhanghe, the main issue is to utilize in-line storage to buffer the gaps between water supply by pump sets and demand, whose variations will increase with enhanced flexibility, as heavy silt loads do not allow for off-line buffer storage. For both systems, reducing service costs is a paramount objective. While Jiamakou sees financial incentives to staff as a key plank for improving performance, the one variable management cannot easily control is number of staff: the strategy is there to redeploy this staff over a larger service area in a future expansion phase.

WATER DELIVERY SERVICE AND WATER USERS ASSOCIATIONS

Actual water delivery service[1], which is evaluated based on flexibility, reliability, equity and measurement of volumes, in most irrigation systems is poor (17 systems below 2) to very poor (10 systems ranked below 1.5). Only 5 systems escapes from that bleak perspective: the 3 systems in Malaysia ranked medium (between 2 and 2.5). One system appraised in Vietnam and one in China achieved fairly good rates above 2.5.

The Institutional Reform in different countries is at different stages: WUA in some countries like Philippines and Cambodia at the time of evaluations were as old as 35, whereas in some other countries like Pakistan and China, they have been created only 2 to 3 years ago. In Vietnam and Cambodia, Water Users Associations or cooperatives are under the local governments. In Andhra Pradesh, they were officially defunct after 6 years of existence. A distinctive feature is that they employ irrigation teams (in Vietnam) or contractors (in Jiamakou, China, who also distribute water to the fields, collect water fees and receive a financial incentive based on fee collection) which distribute water to the field. In Thailand, the Philippines and Nepal, the WUAs are federated (with up to five levels in the case of Sunsari Morang, Nepal)

In general, water users associations in most of the irrigation systems are weak and have a little say in the way system is managed, even when they have been there for long time, for example in Philippines and Cambodia. The strength of WUA does not influence water delivery service to the farmers: no correlation could be found between the strength of WUAs and service to farmers ratings. The only exception to this is Jiamakou irrigation system in China which ranks high on water delivery service to the farm, water delivery service to WUAs, and strength of WUAs. This means that there are more important factors influencing the services to users, on top of it probably management at upper level. This translates into quality of water delivery service to the WUAs.

WUAs in almost all the irrigation systems have negligible budgets with most of its members contributing in kind. Irrigation service fee collection rate is often high (in the range of 70 to 100%) in the systems with strong water users association. However, even in those cases, overall financial requirements for system operation and maintenance are not covered, and the WUAs do not have the capacity to invest in system improvements. However, at the same time, in systems where pumping by farmers is ubiquitous (and paid by the farmers), corresponding expenditure can be very significant compared with

1- Ratings range from 0 (worse) to 4 (best) overall O&M spending on the surface system or much higher than surface delivery water fees.

While most of the WUAs have some kind of legal status, none of them apart from China and Vietnam can effectively rely on outside help for enforcement of their rules.

One of the limiting factors for some WUA in performing well is their small size and complicated hierarchical layers (sometimes as much as 5 layers of different Water users groups), which makes it difficult to raise enough funds or hire a technician for operation of the system under their control.. Farmers operate the gates without any knowledge of or consideration for hydraulic requirements and behavior of the system.

Some interesting and intriguing important conclusions of the study as shown in figure 3 are that:

- The performance in actual delivery service to users is independent of the strength of WUAs. This leads us to suggest that the real causes of the generally poor service in large irrigation systems are not addressed in most IMT-PIM reforms. FAO is convinced that too little attention has been paid to engineering, to strengthening the management set-up by ensuring professionalism at all levels of the management and these missing aspects should be the core of a badly needed "second breath" for IMT-PIM.

- The participation of Water Users Associations in management has not led in many cases to management objectives and policies that reflect the reality of water management in the systems: where farmers need to pump from canals or groundwater or recycle drainage water, these basic facts of the system are still ignored. Likewise, the actual cropping patterns, schedules and even crops in some cases, which are very different from what they were when the system was designed and built, are not reflected in official cropping patterns and scheduling.

- Responsiveness of management to service requirements and a basic agreement between managers and users on how water is managed in the system for what objective is still largely lacking. This includes taking into account the multiple uses and roles of water in the irrigation systems. In a sense, it seems that the reforms, which take a long time to deploy, seem to be geared to address to a large extent yesterday's problems (lack of funding for operation and maintenance and establishing basic equity, large fail to achieve those objectives and, if and when they eventually achieve then, they will be insufficient to meet the new requirements of farmers.

- A blueprint or standardized institutional reform package seems to have migrated from country to country, covering a large number of countries, particularly in Southeast Asia but also South Asia, with little adaptation to local circumstances and goals, and with essentially the same results. An interesting implication of the successive federation of WUAs from the bottom up is that the participation of farmers in important decisions takes place only once system-level federation and co-management are achieved (if that stage is ever reached). Participation, including for new projects, should start at the early stages so as to influence system objectives.

CHALLENGE AND RESPONSE OPTIONS

In spite of or indeed because of these problems and disappointing results, the need for institutional and management reform is more pressing than ever. At the First South East Asia Water Forum, convened by the Global Water Partnership Southeast Asia (Chiang Mai, 2003), the *water and food session* of the Forum addressed the three challenges cited in the Kyoto Ministerial Recommendation of the 3rd World Water Forum on Water and Food, i.e., food security and poverty alleviation, sustainable water use, and knowledge and partnerships. One of the conclusions of the Forum, endorsed in the Forum's declaration, was that '*Southeast Asian countries should collaborate to find ways to improve and transform large rice irrigation systems for participatory decentralized management, improvement of efficiency and service, multiple use, financial sustainability through payment of service and IWRM'*.

This statement acknowledges the need for a transformation of the irrigation systems and participatory decentralized management in the context of achieving specific performance objectives in a broader context of water sector reform for integrated water resources management. Transformation is seen as a response to transformations in the agricultural sector and the broader socio-economic environment. In view of the conclusions drawn from the assessment of present performance of the systems and IMT/PIM, ways to improve and transform the systems should be designed taking into account the diversity of the systems and of their socio-economic contexts, probable and desirable evolution scenarios: IMT/PIM should not be considered in isolation as in the past but be an integral component of a broader transformation or modernization of the sector, be designed to achieve specific performance and service objectives and respond to farmers' needs not only now but also in the future.

With this in mind, FAO, with the support the Evaluation Study of Paddy Irrigation under Monsoon Regime (ESPIM) Project Financed by the Government of Japan and the Vietnam Institute for Water Resources Research, Ministry of Agriculture and Rural Development, Vietnam, convened a Regional Workshop on the Future Of Large Rice-Based Irrigation Systems in Southeast Asia in Ho Chi Minh City in October 2005 to identify strategies, opportunities and interventions for the sustainable management of large rice-based irrigation systems in Southeast Asia (SEA) over the coming decades in the context of improved management of water resources, and to promote collaboration in the region. The workshop intended to address three critical questions that would determine the character that large rice-based irrigation systems evolve over the next 20-25 years, namely:

- **How would agriculture and rice production evolve in SE Asia?** How would agriculture evolve to provide viable employment for the expected reductions in the agricultural labor force, in light of current population projections and predicted demographic changes; changing nutritional and dietary expectations; changing irrigated and rain-fed agricultural areas and yields; and increasing competition from the Urban, Industrial and Environmental water sectors? What changes would be required in agricultural water services to support the projected evolution of the sector?

- **What changes would required in irrigation service provision by the large rice-based irrigation systems?** What institutional, managerial as well as technological changes would be required for the large-scale irrigation systems to be able to provide the new range of services required by users and perform their new functions?

- **How would on-going and expected reforms and investment programs measure up against the projected needs of the region?** How should public sector irrigation agencies develop to support new agricultural demands; what might be the role of the private sector in future development? How could participatory management become effective? Could institutions recently or in the process of being created evolve towards becoming managers of multiple use systems if needed? Were there alternate approaches to irrigation and agricultural water management reforms that may be more effective and responsive to the sector's requirements? Were present models for management of large rice-based irrigation systems able to evolve towards future requirements? Were investments programs on large rice-based irrigation systems of the current generation responding adequately to the future challenges? Did current models for river basin management represent an optimal context for an evolution of the large rice-based irrigation systems towards sustainable management?

The workshop gathered fifty experts and representatives from: national irrigation agencies and institutions, river basin and water resources management agencies and national water apex bodies, agriculture ministries and environmental agencies as well as academic and nongovernmental organizations from countries in the region: Vietnam, Malaysia, Thailand, Philippines, Laos, Cambodia, Indonesia, Myanmar and China; regional bodies and institutions such as the Mekong River Commission, the Asian Institute of Technology (AIT); international organizations such as the Food and Agriculture Organization of the United Nations (FAO), the International Water Management Institute (IWMI), and the International Rice Research Institute (IRRI); the donor community, with the World Bank and the Asian Development Bank; internationally recognized centers of excellence such as the California Polytechnic State University; international initiatives such as the Comprehensive Assessment of Water Management for Agriculture; environmental INGOs such as the International Union for the Conservation of Nature and Wetlands International and the World Wildlife Fund.

The workshop reviewed trends and challenges related to water resources management, socio-economic development, trade, agriculture and rice production and the environment, the present performance of large-scale rice-based irrigation systems in Southeast Asia, national current and planned strategies, programs and goals for large rice-based irrigation systems, the rate of adoption and effectiveness of previous recommendations, and identified the main drivers of change. The workshop then outlined main scenarios for the future evolution of large rice-based irrigation systems, based on a typology of their characteristics and socio-economic environments, identified the implications of these scenario in terms of service and performance objectives, design, management, operation, institutions, financing, environment and biodiversity, and multiple use, re-appraised present policies, strategies, programs and intervention models, and made recommendations for new strategies and directions and concrete action. The typology adapted for the large rice-based systems, the drivers which influence their future and the evolution scenarios that were derived for the different classes of systems are presented in Appendixes 1, 2 and 3.

Having agreed on the evolution scenarios, the workshop split into 4 thematic working groups, to work on the specific implications of the drivers, strategies and policies, and evolution scenarios in four different domains and derive recommendations, considering also a review of previous recommendations, their effectiveness and implementation: Financing and multiple roles; Design and operation; Management and institutions; New irrigation systems.

The workshop followed an iterative process whereby the thematic groups reported and were able to comment on the work of the other groups, in order to ensure consistency and cross-fertilization of recommendations in all 4 domains. The final recommendations were finally presented and amended in plenary and adopted by the whole workshop. The recommendations are presented below.

FINANCING AND MULTIPLE ROLES

1. Modernization should aim to secure reliable, equitable and predictable water supply and be responsive to individual needs of farmers where possible. Trust farmers to respond to such a water supply, e.g., through conjunctive water use.

2. Water-delivery systems need to be flexible (technically, institutionally) to deliver water to multiple uses (agriculture, environment, city, industry, energy generation), from entire river basins down to (within) large irrigation systems.

3. Financing (capital and O&M) of irrigation systems needs to progressively move from subsidies to market-based incentives, and public-private cost-sharing mechanisms, as economies evolve (Early -> Transition -> Post-agriculture).

4. "Early economies" should anticipate for, "transition economies" should plan for, and "post-agriculture economies" should harmonize (social, cultural, institutional, and policy) water management for different ecosystem services within irrigation area and catchment.

MANAGEMENT AND INSTITUTIONS

1. SEA governments should invest in professionalization of irrigation management through the establishment of continuous in-service training focused on operational management:

   a- Training of today’s graduates who are tomorrow’s managers b- Training at all professional levels within irrigation systems across all relevant disciplines.

c- Overseas secondment of irrigation managers within the region and in higher-income countries.

d- Practical trainings for farmer organisations/WUAs/Federations.

2. The irrigation sector in SEA should operationalise and mandate a suite of assessment and performance measures to continually upgrade and compare the effectiveness of service provision and the management of negative externalities, such as environmental impacts:

a- RAP

b- Benchmarking

c- Introduction of service related performance for irrigation service provider staff.

d- Public accountability – balance sheets

e- Improve and sustain monitoring, data collection and processing and management for improved service provision.

3. Existing PIM approaches in the regions should be diagnosed, and successful approaches and their contexts identified and replicated. A key focus of initiatives to implement participatory management and management transfer should be on:

a. Minimizing the transaction costs relative to actual benefits of participation

b. Incentivizing participation and compliance of the irrigation service providers:

c. Self-financing arrangements

d. Functional water user associations and federations, with clear rights responsibilities and programs of action in both management and local investment.

e. To be effective, the service delivery of WUAs and Federations must be improved and support is required to realize this.

4. Propagandize! Take these messages to the governments.

DESIGN AND OPERATION

1. A greater awareness of the operational deficiencies of large rice based irrigation systems exists since the last FAO consultation; given the present lack of expertise and magnitude of the problem, there is a need to develop excellent "Water Control

Engineering" programs in universities and engineering schools. Related to this is the establishment of national/regional Centers of Excellence for irrigation modernization.

2. Regional training programs on Modernization and the Rapid Appraisal Process (RAP) specialized for different levels of the organization: senior managers, operations staff, designers/engineers. RAPs should be carried out before any new investment is put in place for a comprehensive diagnosis of the system, developing proper water management strategies, and benchmarking of existing and desired performance.

3. Revise national design standards and operation manuals to take advantage of new knowledge in the irrigation sector and state-of-the-art technologies.

4. Replicable pilot projects to demonstrate modern technologies; learn from practical experience for a relative small cost.

5. Consider use of new donor lending instruments – e.g., adjustable program loan (APL) (longer time periods are needed to design and implement modernization programs; typical 5 year loans are too short).

NEW LARGE-SCALE IRRIGATION PROJECTS

1. Comprehensive options and feasibility assessment. Before committing to new, large-scale irrigation developments a comprehensive assessment should be made of the land and water existing use values and development options in that place. If a new, large-scale irrigation development is proposed, it should be examined by a wide-ranging analysis which is ecologically, physically, politically, socially and culturally "logical". These different logics should all be used to guide analysis and debate when examining the feasibility of a project. This should take place before progressing into the formal, legal, often rigid and relatively narrow "impact assessment" process.

2. Vision of future changes. If a new, large-scale irrigation development is proposed, the design must recognize and be flexible enough to take account of the inevitability of future demand changes. As economies improve and alter, land/water use and cropping systems will change. Therefore the function/service of the irrigation will change. From the initial stage of the development of an irrigation project, it is important to visualise the trajectory of how these changes might occur (eg. from rice-focused production to more diversified enterprises).

3. Governance, water rights and responsibilities. Large-scale irrigation projects, as with any others, should be planned, built and operated within a governance regime that embodies social justice ethics, is transparent, and participatory. Participation in irrigation governance should not be restricted to technical experts and bureaucrats, but should be open to representatives of affected communities and interest groups. The water rights and responsibilities of all stakeholders should be openly negotiated and established, with equity and sustainability being primary considerations. Management arrangements for a new project should include, from

the beginning, credible representatives of different stakeholder groups.

4. Local capacity development. If a new, large-scale irrigation development is proposed, it is essential to increase efforts to boost the capacity of local stakeholders playing many different roles. For example, local decision makers need to be aware of the different options and feasibilities. Public authorities need to be skilled in designing terms of reference and oversighting contracts. Local consulting firms and engineers are required to construct and then be locally available to support ongoing operation, maintenance and adjustment. User groups need to be aided to improve water use efficiency. Local civil society organizations and universities should be able to play roles in governance (eg. monitoring compliance with negotiated protocols) and problem-solving. Supporting the development of this capacity needs to be factored into any new project.

5. Finance. In addition to the overall economic assessment, it is critical that an adequate financial strategy is put in place. The finance for complete construction must be ensured. Beyond construction, there must be a plausible strategy to ensure the availability of funds to meet full operation and maintenance costs, drawn from all project beneficiaries.

6. Monitoring impact on ecosystem and livelihoods. Irrigation projects do more than supply water. They become part of the ecosystem and may have major impacts, for example on groundwater hydrology. The year-round effect of a project on the hydrology and wider environment have to be assessed. As does the impact, whether positive or negative, on the livelihood of all affected peoples.

CONCLUSION

The findings and recommendations of the workshop have highlighted a number of key issues:

- Although a greater awareness exists of the present deficiencies of the irrigation systems, knowledge does exist, efforts to develop tools have been substantial and effective, and efforts t develop capacities have been effective where implemented, very little successful modernization has taken place in Southeast Asia.

- In the present context and under future perspectives, modernization of the irrigation systems and their management to increase their flexibility and insert them in river basin management, taking into account multiple functions of agricultural water management, is more required than ever. A fast pace of change is the one certainty, the other certainty being that unless management adapts, the discrepancy between stated an actual policies will widen.

- Compared with 10 years ago, new layers of complexity have been added to our understanding of irrigation, from multiple use and social complexity, to multiple use, multiple ecosystem and livelihood functions, and agro-socio-economico-ecologic complexity

- To respond to this complexity, management needs to be professionalized and present institutional reform models need to be evaluated and overhauled to respond to new demands and characteristics of farmers. Capacity building of managers and of intermediate service providers will need to be substantially boosted. Simplicity of operation and proper information will be required. The need to strengthen capacities also applies, critically, to consulting firms, and to the various components of civil society.

- Evolution scenarios, objectives and strategic responses will vary greatly according to the types and socio-economic environment of the systems. Non-rice drivers will play an important role in their evolution.

- Compared with recommendations made 10 years ago (FAO, 1997), new recommendations can be characterized as: moving away from generation of both positive and negative externalities by accident and from development of autonomous farmers' responses by neglect, to explicit management of multiple roles on the one hand, and to explicit recognition of farmers' service and other objectives, of their contributions to overall efficiency and productivity for instance by pumping, and of the costs thus incurred to them, and search for the most practical, economical options on where, how and at which levels (main system, intermediate distribution, farmers, conjunctive use, etc.) to locate improvements for service delivery.

- The main focus will remain the improvement of performance of existing assets. New systems may be still developed in predominantly agrarian economies, in ecosystems with comparative advantages, but their planning and appraisal process should be reformed to adhere to improved water governance.

Focusing on IMT and PIM, the key recommendations of the workshop, respond to the issues and problems identified through a review of the present performance of the existing systems, and to the future challenges that they will be facing. FAO, for this reason, fully endorses these recommendations for consideration in future IMT/PIM programs, not only in Southeast Asia, but also in other sub-regions, and stresses a the same time that they should not be considered in isolation, but as a part of a broader sectoral reform or modernization that encompasses institutions, management as well as infrastructure.

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APPENDIX 1

Typology of the large rice-based systems in Southeast Asia (from the Regional Workshop on the future of Large Rice-Based Irrigation systems in Southeast Asia, Ho Chi Minh City, 2005)

Table: Technical criteria

	Technical criteria	Main characteristics (and examples)
1	Reservoir-backed, gravity fed irrigation systems	Water is stored in large reservoirs, distributed via a canal networks to the fields mainly by gravity (Zhanghe system, Dau Tieng, UPRIIS)
2	Off-river diversion irrigation systems	Water level in the rivers is raised by dam so that water can be distributed via a canal networks to the fields (SCRIS, Philippines)
3	Off-river pump irrigation systems	Water is pumped into a canal networks, to be distributed to the fields (Northern part of Vietnam)
4	Integrated water management systems in the deltas	Low lying deltas, Consisting of a series of multifunctional canal networks (water supply, drainage, transport..) and water management structure (salinity control) and an mosaic small irrigation systems (tidal or pump)
5	Conjunctive groundwater-surface water system	Both gravity fed surface irrigation + groundwater pumping
Additional criteria	Urban-rural irrigation systems	Near or including cities or industrialized centers, steep competition for water and labor (Cu Chi, Zhanghe, Mangat)

Table: Socio-economic context[1] found to be most operational for the objectives of the workshop were found to be the following. Major implications in terms of goals and strategies were identified for each class.

National and Sub-national stage	Economic and Agriculture Situation	Strategy and policy
Focus is outside agriculture Post-agriculture/advanced	highly diversified agriculture Resources competition high environmental concern diets shifting need to conserve certain level of food production capacity on the way to diversification	Reduction/decommissioning of rice irrigation areas Specialization improve water productivity protect environment and water quality government investment for modernization
Agricultural export main focus Intermediate/transition	quick demographic transition further improvement of food security need to stabilize rice production rice exporting for FC earning+C6 rely on rice production	Stabilization and modest development of rice irrigation areas development of small systems increase the financial self-sufficiency further water resources development
Agriculture main focus Low developed/early economy	urgent need for food security possess comparative advantage Little alternatives	further rice irrigation expansion strong government financial support external assistance

1- Classes refer to national context or sub-national context as appropriate (agricultural export may thus be outside of the system area to another province).

APPENDIX 2: Major drivers affecting irrigation water management for larg rce-based systems in Southeast Asia[1]

Common drivers
o Food Security: National-Regional-Household. o Poverty alleviation/regional development. o Increasing concern for environmental protection and ecosystem management. o Issues of energy and other chemical inputs o Climate change (coastal impact- risk for rainfed agriculture).
Nation specific
o Development stage that set the exporting/importing strategy. o National Budget Support/Constraints – O&M cost reduction (may be a constraint) o Institutional reforms: Regional Autonomy – decentralization o Agriculture and water management policy o Migration rural/agri-urban population balance.
Other Drivers for Change
o Equity of distribution including gender concerns o Multiple purpose nature of service from reservoirs o Markets diversification and integration (need for crop diversity) o Pressure on Water resource: Scarcity, Water quality and competing uses of water o Reclaiming land.
Management related objectives/drivers
o Cost-effectiveness of O&M and management o More responsive, transparent and participative management o More flexible water delivery systems o Accounting for multiple uses of water o Water on Demand (removing technical constraints) o Technology: availability of low cost pumps
Accompanying supports (enabling conditions) /drivers:
o Strategies of the World Bank and Asian Development Bank for management/rehabilitation projects o Capacity building in water infrastructure management and service oriented management, in modernization development.

EVOLUTION SCENARII AND STRATEGIC RESPONSES

Considering the effect of different drivers, strategies and policies for all 5 types of systems in the three contexts/stages, the workshop developed likely evolution scenario. The following table is a synthesis of the outputs of the different working groups.

1- Source: Regional Workshop on the future of Large Rice-Based Irrigation systems in Southeast Asia, Ho Chi Minh City, 2005

APPENDIX 3: Evolution scenario and strategic response for large rice-based irrigation systems in Southeast Asia[1]

National and Sub-national stage	Economic and Agriculture Situation	Strategy and policy	Type 1: Reservoir gravity	Type 2: Off-river gravity	Type 3: Off-river pump	Type 4: Conjunctive	Type 5: Integrated management deltas
Focus is outside agri. Post-agriculture	highly diversified agriculture Resources competition high environmental concern diets shifting need to conserve certain level of food production capacity link between water and multifunctionality	Reduction/decomissioning of rice irrigation areas Specialisation improve water productivity protect environment and water quality government investment for modernization	0	-	+	+	-
			Optimizing multiple use economically justified; limited number of sites available for new systems	**Reduce. Merge or neglect due to low reliability Convert to type 3 or 4 Convert to different crops/land use**	**Increasing energy costs Crop diversification Rice phases out economically justified; limited number of sites available for new systems**	**Highly flexible Farmers decide Market rules (export possibilities) (manymers use pumps)**	**urnanizationOptimizing multiple use (environment, drainage isuues, per-urban agriculture, urbanization) ; more crop diversification**
Agri Export main focus Intermediate	on the way to diversification quick demographic transition further improvement of food security need rice exporting for FC earning+C6 to stabilize rice production	stabilization and modest development of rice irrigation areas development of small systems increase the financial self-sufficiency	**not economically justified by agriculture alone but may expand;**	**0**	**0/-**	+	**Expand short term then decline due to urbanization, sea level rise, salinity?**
			Anticipate on multiple uses	**Improve, modernize (endless) Inherent limitations of supply**	**Likely reduction due to energy costs (for paddy)**	**Highly flexible Farmers decide Market rules (export possibilities) (several farmers use pumps)**	**Optimize multiple use Expensive drainage (environment, drainage isuues, peri-urban agriculture, urbanization)**
Agriculture main focus Low developed	rely on rice production urgent need for food security possess comparative advantage Little alternatives link between water, ecosystems, and livelihoods	further water resources development further rice irrigation expansion strong government financial support external assistance	0	+	+	+	**Expand short term then decline due to urbanization, sea level rise, salinity?**
			Too expensive for rice but plan for future or multi-purpose structure	**low costs Comparative advantage (compared with either options)**	**Affordable investment Subsidized O&M**	**Highly flexible Farmers decide Market rules (export possibilities) (some rich farmers use pumps)**	**Developing paddy systems Not yet urbanization**

1- Source: Regional Workshop on the future of Large Rice-Based Irrigation Systems in Southeast Asia, Ho Chi Minh City, 2005