Performance Evaluation of Makhamtao-Uthong Project with a Rapid Appraisal Procedure

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The Makhamtao-Uthong project performance appraisal: context

Thailand has invested in the past large amounts of capitals for the development of new water resources. There is now however very little scope for further expansion of water supplies. Increased competition from industrial and urban consumption and explosive growth of rice cultivation during the dry season over the last three decades raise a new challenge for the government of that country.

At the request of the Royal Irrigation Department of Thailand (RID), FAO has recently organized a training workshop on irrigation project modernization, in March 2000, with support from the World Bank Research Committee. This workshop was organized in the context of the preparation of the irrigation management modernization component of the Natural Resources Management Project, which Government of Thailand would submit to the World Bank for funding. Twenty-two staff and consultants were trained in modern irrigation and management concepts and developed a priority modernization plan, which will be used for the detailed preparation of the modernization component.

The two-week workshop included a three day course to present modern concepts in water control and management, a Rapid Appraisal Procedure (RAP) using a field questionnaire to compute internal and external performance indicators, a five-day field visit to assess the Makhamtao-Uthong project, a sub-project of the Chao Phraya project, and three day to evaluate the results of the field evaluation and formulate proposals for the modernization of management of that project. During the last day, the trainees developed their own conclusions and recommendations and presented them to RID Management and consultants in charge of preparation of the World Bank proposed project.

The training programme used extensively the tools and findings of a major and unique study funded by the World Bank Research Committee and implemented by IPTRID on the evaluation of the impact on performance of the introduction of modern water control and management concepts on 16 irrigation modernization projects including 6 rice irrigation schemes. This study has been published by FAO as Water Paper Series 19.

The RAP quickly (within a week) evaluates an irrigation project to assess what type of modernization is needed. External performance indicators are also quantified. These characterize the inputs and outputs of irrigation projects, including amounts of water, yield, and economics. A detailed questionnaire is developed to obtain information needed for external performance indicators and internal process indicators. A list of baseline project data (acreage, budgets, crops, climate, water availability) is requested from project authorities prior to the visit. Typical baseline data is either available or it isn't. If the data does not already exist, spending an additional 3 months on the site will not create the data. Baseline project data is needed to quantify external performance indicators. A 5-day visit is made to the project. Ideally, only 1 day is spent in the office to examine system maps and to review the baseline project data that has been prepared in advance. The majority of time is spent in the field with field engineers/operators, making observations and collecting the data needed for internal process indicators. Substantial lengths of the main canal, some secondary canals, tertiary canals, etc. are visited. Observations are made regarding the types of structures, general conditions, operator instructions, quality of flow and water level control, and other operational points. Impromptu conversations are held with farmers and operators. Short visits are made to any water user associations that may exist.

Internal indices provide ratings to hardware, management, and service throughout the whole system at all levels, an approach which has not been used in the past. The complete picture enables one to visualize where changes are needed, and what impact the changes would have at various levels. When the internal indicators are examined together and also combined with some of the external indicators, a clear image emerges about the design, operation, and management of an irrigation project.

The table below provides information on one of the internal process indicators, including weighting factors of the sub-indicators. The final weighted scores of the internal process indicators were always adjusted so that the maximum (best) indicator value is 10.0, and the lowest value is 0.0.

Sub-indicators for Indicator I-1 (Actual service to individual fields, based upon traditional field irrigation methods).

No.	Sub-Indicator	Ranking Criteria	Wt
I-1A	Measurement of volumes to field	4 - Excellent measurement and control devices properly operated and recorded. 3 - Reasonable meas. & control devices, average operation. 2 - Meas. of volumes and flows - useful but poor. 1 - Meas. of flows, reasonably well. 0 - No measurement of volumes or flows.	1
I-1B	Flexibility to field	4 - Unlimited freq., rate, duration, but arranged by farmer within a few days. 3 - Fixed freq., rate, or duration, but arranged. 2 - Dictated rotation, but matches approx. crop need. 1 - Rotation, but uncertain. 0 - No rules.	2
I-1C	Reliability to field (incl. weeks avail. vs. week needed)	4 - Water always arrives with freq., rate, and duration promised. Volume is known. 3 - A few days delay occasionally, but very reliable in rate and duration. Volume is known. 2 - Volume is unknown at field, but water arrives when about as needed and in the right amounts. 1 - Volume is unknown at field. Deliveries are fairly unreliable < 50% of the time. 0 - Unreliable freq., rate, duration, more than 50% of the time; volume is unknown.	4
I-1D	Apparent equity	4 - It appears that fields throughout the project and within tertiary units all receive the same type of water. 3 - Areas of the project receive the same amounts, but within an area it is somewhat inequitable. 2 - Areas of the project receive somewhat different amounts (unintentionally), but within an area it is equitable. 1 - It appears to be somewhat inequitable both between areas and within areas. 0 - Appears to be quite inequitable (differences more than 100%) throughout project.	4

The Makhamtao-Uthong canal system

The Royal Irrigation Department (RID) of Thailand selected the Makhamtao-Uthong (MU) canal system in the Chao Phraya basin for the field exercise included in the schedule of the training workshop. The Lower Chao Phraya Project, a nearly one million ha project, is served by 5 main canals diverting the Chao Phraya water from Chainat diversion dam. The Lower Chao Phraya Project is divided in 26 Operation and Maintenance Areas. The boundaries of O&M areas were defined for limiting the distances from area headquarters but are not based on hydraulic considerations. Each canal system is under the responsibility of several O&M areas. Each area is responsible for sections of several main canals. Consequently it is very difficult to get the basic data to calculate the external performance indicators of individual canal system. The Project is under the management of RID Region VII on the Right Bank and Region VIII on the left bank. The Northern part of the Lower Chao Phraya project is a typical conventional gravity gated system. The Southern part, south of Ayutthaya, is a typical delta irrigation system where the navigation channels play the role of irrigation, drainage, flood and pollution control canals.

Each dry season, the RID Office of Hydrology and Water Management allocates the volumes available from the two main storage reservoirs of the river basin for municipal and industrial supply, irrigation, navigation and pollution control and determines the areas of the Lower Chao Phraya that would be irrigated. RID records indicate that areas irrigated during the dry season exceeded planned areas by about 20 to 35 % during the years 1995 to 1998 (Table 1). In 1999, under the pressure of farmers' complaints, RID increased the volumes of water released from Bhumipol and Sirikit dams by about 15 to 20 % while water was available till the reservoirs were nearly drained. Exceptional rains in spring 1999 saved the dry season paddy crop.

Table 1: Planned and Actual volumes of water released from Bhumipol and Sirikit reservoirs (MCM) for dry season and planned and actual paddy areas (ha)

Year	**1995**	**1996**	**1997**	**1998**	**1999**
Water availability in both dams (MCM)	12733	14582	12107	6200	3879
Domestic water supply	1100	1800	1650	1600	650
Dry season crop: Phitsanulok	300	800	500	500	150
Dry season crop: Chao Phraya	3000	4150	3700	2900	1900
Navigation	300	400	300	300	0
Water supply Bangkok	700	750	750	750	650
Salinity control	600	600	500	450	350
Total planned (MCM)	6000	8500	7400	6500	3600
Total actual (MCM)	7216	9643	8556	6656	2575
Area planned (ha)	448,000	560,000	528,000	432,000	304,000
Area actual (ha)	512,000	669,000	649,600	606,000	538,000
Actual volume (m3/ha)	7366	8839	7954	7870	6743

Use of groundwater for irrigation has exploded during the last 5 years. It is reported that 28,000 tubewells are now in use in region VII. The MU canal is the most western system on the Right Bank of the river. The MU canal system consists of a 104 km long canal with a design capacity of 35 m3/s and twenty-four lateral canals serving about 44,500 ha on the left bank. Only the last 15 km of the main canal are concrete-lined. Lands on the Right Bank of the main canal are also irrigated by illegal pumping from the main canal and by drainage inlets. However no systematic monitoring of the illegally irrigated areas and volumes diverted has been made. The guess-estimates vary from to 2,800 to 8,000 ha. The MU canal system was designed for supplemental irrigation during the wet season (0.78 to 0.82 l/s/ha).

Responsibility for the management of the MU system is shared between three O&M area projects: Poniathep, Thabothe and Don Chedi. Don Chedi is only responsible for the last 47 km of the main canal and lateral canals serving 23,700 ha. RID Office of Hydrology and

Water Management prepare a seasonal delivery schedule in advance. The MU main canal diverts water from a branch of the Chao Phraya River about 15 km upstream of Chainat diversion dam. The design of the intake affects the delivery of water to the MU project area. The intake was designed for delivering the design capacity flow when the water level is at (or about) normal full level. A pumping station was constructed in 1998 to supply water when the level drops below that level. Upstream weekly variations of water level in Chainat reservoir, of about half meter, are due to the reduced power generation at Bhumipol and Sirikit plants and the reduced water released during weekends. The MU main canal is operated on rotational basis during the dry season: Water is delivered for 10 days to the lateral canals upstream of km 57 and for 12 days to the downstream lateral canals. A second 6-day upstream /downstream rotation was established between the lateral canals of Don Chedi. Finally water is delivered on rotation basis to the farm outlets.

The main canal is equipped with 6 gated cross-regulators, none of them with a weir section. All the gates are manually operated. The operation concept is based on delivering target flow downstream of each cross-regulator, particularly at the interface between O&M areas. The offtakes of lateral canals are either equipped of single gates or constant orifice gates (one of the gates frequently being not installed). All the field operators of cross regulators and lateral offtakes are supposed to and apply strictly the instructions given to them by the Operation chief of their O&M area. None of them is expected to take any initiative in adjusting the gates. A considerable volume of information is transmitted from the field to higher level for statistical purposes.

Flows in the main canal are calculated by the orifice formula with a low degree of confidence; and flows diverted to the lateral canals are determined by "experience". All the farmers interviewed during the field visit reported having an individual pumping equipment used to pump from any possible source of water: Main or lateral canals if gravity supply is insufficient, main and tertiary drains, borrow pits along the main canal, and groundwater. Farmers interviewed are hardly aware of RID plans to match the irrigated areas in the Chao Phraya basin with the water available in storage dams. All of them admit that they take risk, maximize pumping and eventually would request RID to increase water releases through political channels. Rice is the main crop during dry and wet season. Average annual cropping intensity is about 170-180 %. Sugarcane is cultivated in Don Chedi area and fishponds are also important. Average farm size is about 2.5 ha with a maximum of 15 ha. Average yields during the last five years in Don Chedi area were about 4.05 and 4.80 tons/ha. The volumes of water delivered at the head of Don Chedi area during the dry season 1996-98 range from 7900 to 8700 m3/ha. The Don Chedi O&M project has 155 employees of which 12 officers. (Administration section: 11; engineering section: 7; mechanical section:8; operation: 100+ of which water masters: 2; zonemen: 12; gate tenders: 38; canal tenders: 37). This staffing is rather high (150 ha per O&M staff). No water charges are collected from the farmers. However farmers spend between 10 to 35 US$/ha in pumping costs per dry season. The annual budget of Don Chedi area is about US$ 27.5/ha for O&M (excluding improvement works), of which about 66 % is for staff salaries (US$ 18.2/ha).

External performance and internal process indicators

Some external indicators required for giving a score to some internal sub-indicators have been estimated. The values of indicators of outputs/unit areas of the MU Project are in a good average, given the high cropping intensity and crop yields. Water indicators (relative water supply and relative irrigation supply) are certainly on the high side compared with other projects. The canal system is just able to pass the peak evapotranspiration requirements for a 100 % cropping intensity (cropping intensity is about 75% for the authorized irrigable area, but additional irrigated area on the right bank pushes the "legal" cropping intensity close to 100 %.). The volumes delivered to Don Chedi area (8,500 m3/ha) for the dry season are far below the volumes reported in other performance studies and even in feasibility studies. Obviously the main reason is the high level of recovery of drainage water within and on the

boundaries of the project, combined with the use of groundwater. The average values of internal indicators as rated by the trainees for the project were:

I -1	Actual service to individual fields, based on traditional on-farm irrigation methods	4.1
I- 2	Actual Service to avg. point of Effective Differentiation based on Traditional On-Farm Methods	2.6
I -4	Actual Service by main canal to its subcanals	3.7
I- 5	STATED service to fields.	3.4
I- 6	STATED service to avg. point of EFFECTIVE differentiation.	4.1
I- 8	Stated Service by main canals	6.9
I- 9	Evidence of Lack of Anarchy in Canal System u/s of ownership change	4.8
I- 10	Cross-Regulator Hardware (Main Canal)	2.3
I -11	Capacities (Main Canal)	5.7
I- 12	Turnouts (from Main Canals)	5.1
I- 13	Regulating Reservoirs	0
I- 14	Communications (Main Canal)	4.7
I -15	General Conditions (Main Canal)	7
I -16	Operation (Main Canal)	0.5
I -28	Number of Turnouts/(operator, gate oper., supervisor)	0.5
I -29	Feedback Information	0.5
I -30	Computers for billing/record management	2
I -31	Computers for Canal Control	0
I-32	Effectiveness of water supply releases from reservoir	3
I-33	Effectiveness of main system operation	5
I-34	How closely are instructions followed?	10

The analysis of the internal indicators and sub-indicators reveals that:

- The main canal provides a very poor and inequitable service to the secondary canals and sub-projects
- The reason lies not in poor maintenance nor in the cross-regulators but how they are operated
- Secondaries provide a very poor service to the points of effective differentiation (irrigation blocks
- Poor performance at the farm level is compensated by pumping and conjunctive use
- There is a water supply problem which cannot be solved overnight (linked to water level at the Chao Phraya dam on the Chao Phraya River)
- As instructions are followed, the solution lies in changing the instructions to gate operators. Some minor adaptation of cross-regulators would provide much more flexible and equitable distribution
- Communications and procedures can be drastically improved
- Staff density is very high and can be reduced
- There is no reliable measurement at any level

In addition:

- A transfer of the canal as it is presently operated would create problems of inequity between secondaries and sub-projects that cannot be solved by institutional measures alone.
- Rules established by WUAs equivalent to present rules would be subverted by farmers, as they are at present, for the same reasons.
- Shallow water tables are not available everywhere.
- The canals do not dominate some areas.
- Establishment of WUAs at the level of secondaries would allow controlling the problem of illegal turnouts and implementing a different operation strategy negotiated with the main canal ISP. Upstream and downstream areas have different cropping patterns that could be accommodated by a different service.

- Problems of inequity between upstream and downstream require a re-centralization of operational responsibilities for water dispatching in the main canal.

Priority Action Plan

The recommendations presented by the trainees during the closing session derived from the assessment of the external and internal indicators included:

Priority	Cost (Million Baht)	Action
1	0	Change instructions: water level control and empower operator to make adjustments
2	0	Establish a single operation unit for the main canal
3	5	Flow measurement at the head of the canal and each project
4	1.2	Flow measurement at the head of each secondary (flumes)
5	5	Long-crested weirs at cross regulators
6	0	Better transfer of data on turnouts
6	0.1	Walkie talkies for zonemen and gate operators
6	0.4/year	Improved mobility/transport
7	6	Motorize cross-regulator gates
8	0	Control or eliminate illegal turnouts

Longer-term measures identified were:

- Management of water recirculation within the project
- Management of conjunctive use
- Development of tertiary network
- Improve water supply to the main canal

Conclusions

The MU project is performing well in terms of productivity and water use despite the low capacity delivery of the canal system. Farmers have invested in individual farm pumps that have allowed secondary water sources to be tapped, the development of conjunctive use, increased reliability in water supply and to some extend in crop diversification and fishponds. The importance of individual pumping is overwhelming but has an economic impact on farmers' income. An evaluation limited to external indicators of the Makhamtao-Uthong system would have concluded that the project compares well with the best performing rice projects of the IPTRID study. Obvious recommendations would have been to establish water user associations and a system of water charges. The internal indicators provided the basis for a rational program of improvement that will enhance the operation, management and outputs of the project.

Benefits expected from a modernization program are expected to be a reduction in pumping costs and a reduction in O&M staff. Given the present efficiency of the project and of the Lower Chao Phraya Project it is doubtful that a modernization program could generate some water savings. However the improved reliability associated with a better discipline in water allocation should have a positive impact on crop productivity.

Proposed changes would enable a transfer of water management to users in good conditions of equity between different areas with the possibility to implement rules at the level of the secondaries, and to apply and enforce a water allocation and water charging system. Most of the actions identified are of the software type and require training only. The physical upgrading identified is minimal and costs less than the upgrading budgets currently spent on the system.

The RAP procedure, which has been defined in the course of the IPTRID study, is rapid and comprehensive enough to give good indications of the critical internal links of an irrigation

system. The complete picture provided by external and internal indicators enables one to visualize where changes are needed.

More generally, this training workshop has confirmed the efficacy of the modernization concept and tools such as the RAP for rapidly designing suitable irrigation modernization strategies. It is suggested that conducting a similar training programme for national officers and consulting firms including a RAP of selected representative schemes at early stages of project appraisal could lead to improvements in project scoping, design and strategy.

This is the approach followed with the World Bank in the context of the preparation of the Vietnam Water Resources Assistance Project: a first training workshop was conducted in March 2002 with the Rapid appraisal of the Cam Son- Cau Son irrigation system. Another workhsop is planned in May 2002 for the staff of the Dau Tieng irrigation scheme. Subsequently, during the implementation of an irrigation modernization programme, carrying out a Rapid appraisal of each scheme to be modernized by trained local staff and consultants could lead to similar improvements. Indeed, re-training of staff at all levels should be considered an essential component of an irrigation modernization programme.