Thousand Years of Hydraulic Civilization
Some Sociotechnical Aspects of Water Management

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Abstract

Sri Lanka had efficient hydraulic civilization for a period of thousand years from 200 BC till 1200 AD. Out of its 103 drainage basins, those underneath in the dry zone were successfully irrigated through system of tanks and diversion canals. Sociotechnical aspects of water management seem efficient and well performed in the construction and maintenance of these tank and canal systems. It is believed that the king and the regional chieftains perform very strong tight management. In addition strategic use of both top-down and bottom-up initiatives as well as private partnerships with their own tanks and maintenance systems were supported for the efficient maintenance and management. Though there are a number of contradictory points affecting the different ethnic and religious groups, the Dublin principles have been used at various decision-making stages by the present governments. However, the current political, economic and technical performances are not geared enough for such efficient water management. The religious, ethical and moral aspects interwove with the ancient civilization, were the basis for maintenance and management of the hydraulic systems and subsequent upheaval in the society. Therefore, we argued that for successful water resources development programs need community engagement, sound technology and timely resources.

Introduction

This paper aims to bring up some sociotechnical aspects of water management in Sri Lanka. It discusses several sections dealing with the establishment of hypotheses, general outline of water resources in Sri Lanka, some aspects of water management in the global context and sociotechnical aspects of water management in ancient and present periods in Sri Lanka. Then wind up with a discussion on future management of water resources. Sri Lanka is well known for its hydraulic civilization from the beginning of the 3rd century BC (Geiger - Mahavamsa, 1958). A period of more than thousand years of mostly uninterrupted sustainable water management was portrayed in the dry zone of Sri Lanka. This was largely obliterated by a number of invasions by South Indian races (Geiger–Chulavamsa, 1929; Basnayake, 1995) and later from the Portuguese, Dutch and English (Silva, 1998). There was some interest among the British administration towards renovating the tank and canal system as witnessed by the scholarly records on the Rajarata tank system (Brohier, 1935). The mechanism behind the Rajarata tank system has been later identified as evolved from a system of cascade tanks (Madduma Bandara, 1985). The script as recorded in the Chulavamsa (Geiger, 1929) stated a specific hydraulic principle. King Parakramabahu the great had stated “not even a little water that comes form the rain must flow into the ocean without being made useful to man” (Geiger – Chulavamsa, 1929; Nicholas, 1955). This has been used by many engineers and could use even in the future as a key principle for the sustainability of the dry zone hydraulic regime.

Hypotheses

The following statement regarding the present system of tanks and related hydraulic systems and it's effectiveness in the ancient period have been proposed as a hypothesis to be tested.

- Due to social aspects the technical performance of the current water management is much lower than ancient times.

Judging by the current water management and related irrigation efficiency and based on ancient chronicles, we believe that the overall performance of the ancient periods (200 BC – 1100 AD) could be relatively higher (Geiger – Chulavamsa, 1929; Nicholas, 1955). However, a mechanism is needed to examine and prove this in terms of agronomic and technical basis. Some believe that this has resulted due to a very strong tight management practice, which wound around the single political entity (King) or a number of regional chieftains. A tight top-down strategy (disciplined and responsible) or a strategic use of both top-down and bottom-up initiatives may improve such efficiency. It may start as a strong directives form the king while officials supported to him had participated in making his directions materialized. Parallel

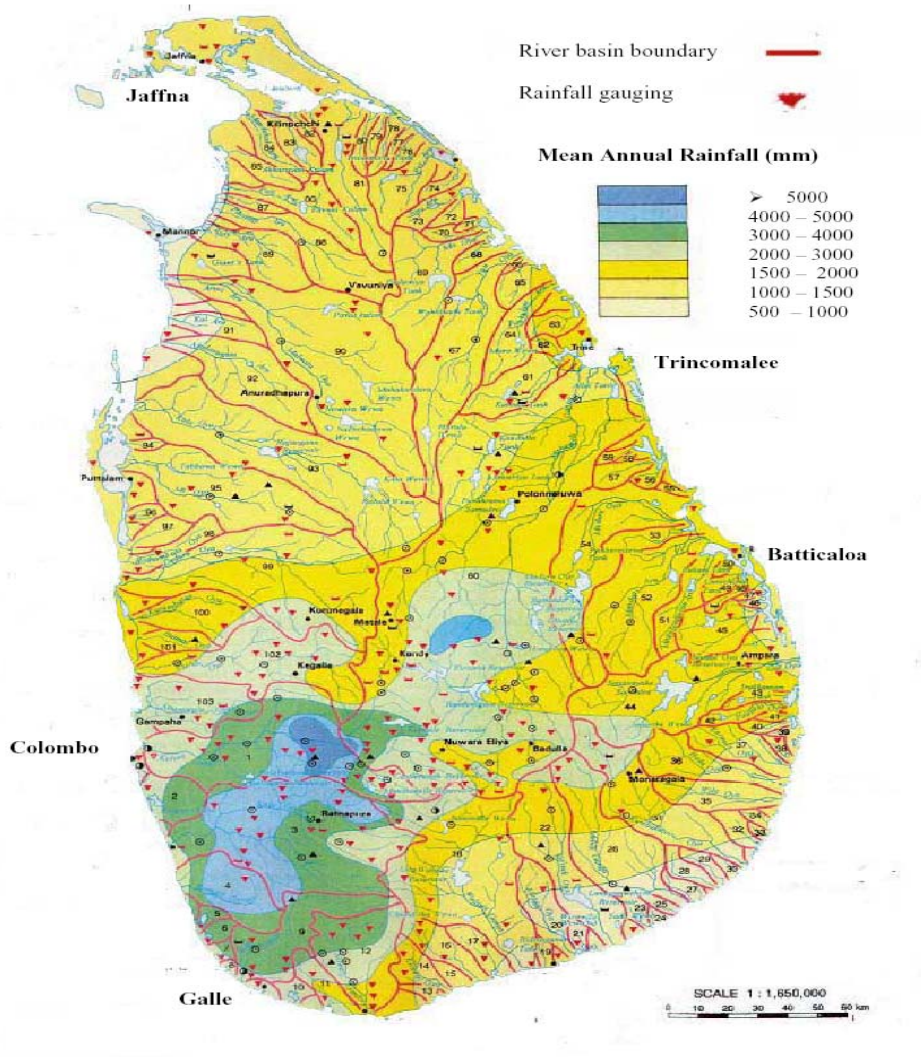

Fig. 1. Surface water resources in Sri Lanka (Somasekeram et al., 1997)

to this the farmers themselves may have organized in some form within the hamlets to absorb the routine as directed by the hierarchy. However, it can be argued that private partnerships having their own tanks and maintenance systems were also supported for the efficient maintenance and management system. Therefore, we believe that this efficiency may have resulted from collective "top-down" mandate and "bottom-up" initiatives.

Moreover, strong indications are present to show that the hydraulic regime in the dry zone must have been technically planned with a time tested remodeling activities for a period of more than thousand years. In this sense the water system evolved rather than being put in as an externally-conceived, untested complete system. The "technical planning" likely originated as minor irrigation activities started besides water bodies in the lower part of basins. Subsequent regulation of such water bodies took place by adding cascaded tank systems towards the upper parts of the basin. A more detailed description on these follows in a separate publication. The implementation of such activities must be maintained and managed by different levels of the society. Some chronicles indicate that they have adapted a willing to pay (WTP) or willing to work (WTW) criteria, which were strongly maneuvered by the society (Geiger-Mahavamsa, 1958; Liyanagamage and Gunawardhena, 1961).

Water Resources in Sri Lanka

Surface water resources in Sri Lanka, given in Fig.1, is highly influenced by the regional climatic pattern and island's topography characterized by the central highlands and surrounding lowlands extending to coast. The rainfall, which is the only form of precipitation, can be considered under four distinct periods as a) First inter-monsoon period from March to April, b) South-West monsoon period from May to September, c) Second inter-monsoon period from October to November and d) North-East monsoon from December to February.

Although, Sri Lanka receives an annual rainfall of about 1800 mm, there is a significant spatial and temporal variation in the rainfall (Fig. 1). North-West and South-East parts of the island receive annual rainfall of 900mm with 70% of that is received during October to February of the year. On the other hand, some parts of the hill-country receives an annual rainfall of about 5000mm. Sri Lanka being a tropical country with different land use comprising of agriculture 27%, forest 30%, homesteads and services 16%. The potential evapotranspiration has been found to be in the range of 1500 – 1700 mm per annum (Kayane 1983).

Sri Lanka has 103 distinct river basins ranging from 10 - 10450 km^2 in size (Fig. 1). Most of the large basins are of broad leaf–like shape and originate from the central hill and extend to coastal plain area. Presently the island enjoyed an inland water storage capacity of 6 km^3 as fresh water reservoirs to regulate seasonal runoff (Amerasinghe et al., 1999, Weerakoon et al., 2001). The contribution from nearly 18000 small irrigation reservoirs scattered in the dry regions of the island receiving less than 1500 mm of rainfall is estimated to be about 0.5 km^3 (Weerakoon and Hearth, 2002). Though no detailed water balance study covering the entire island has been carried out, annual run-off generation in the island is estimated to be about 5 million ha m with a runoff ratio of 0.4. It is also estimated that 65% of the runoff escapes into the sea as stream runoff. Requirement for evapotranspiration and replenishment of ground water are estimated to be 40% and 20% of the runoff respectively (Manchanayake and Madduma Bandara, 1999). Some of these values are arbitrary and spatial and temporal variations could be high. Significant amount of groundwater escape through subsurface geological formations and structurally weak zones are also expected (Jayasena et al., 1986; Jayasena, 1989; 1993; 1995).

Water management in global context

Water scarcity in the world has been forecasted by many scientific studies. Based on a recent study (Wallace, 2000), Sri Lanka will face water scarcity in the next 50 years. It is interesting to note that most of these countries (Fig. 2), which show, water scarcity in the present were once among the most powerful countries in the world with specific hydraulic systems. Probably that power and wealth accumulated within these countries drew people from many different areas causing destabilization of governing systems and subsequent un-sustainability and disorganization. These alien communities could not understand the driving force of such individual hydraulic systems as one could witness in African continent with good examples form Egypt, Middle East and East Asian regions. This may cause problems in the decision making process while depriving of precious water resources needed for sustainability. The core problems of such global changes have been indicated below which might consider under anthropogenic and ecological basis.

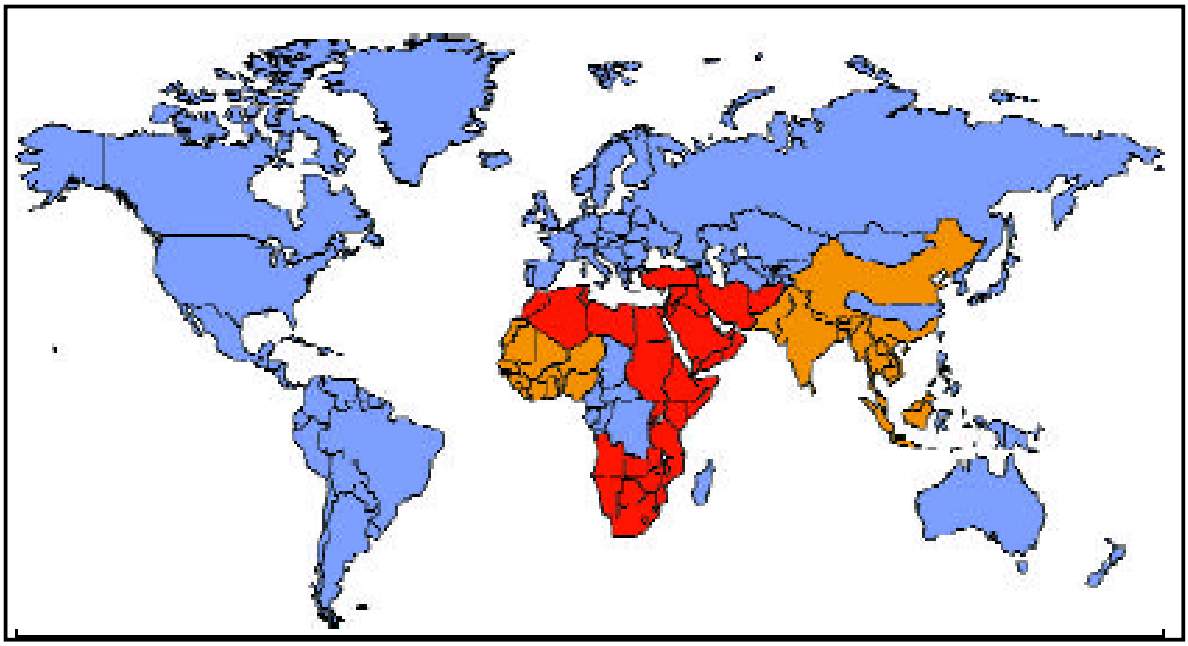

Fig. 2. Estimated global water scarcity in 2050 (after Wallace, 2000).
Red - < 1000 m^3 / person / year,
Orange - 1000 and 2000 m^3/ person / year
Blue - > 2000 m^3 / person / year

Anthroposphere:
- Population growth and migration,
- Threats to health,
- Threats to food security,
- Widening disparities in development worldwide,
- Spreading of non-sustainable lifestyles;

Ecosphere:
- Climate change,
- Loss of biodiversity,
- Soil degradation,
- Scarcity and pollution of freshwater resources,
- Pollution of the world's oceans,
- Human-induced natural disasters.

The globally accepted criteria for water resources assessment and development have been summarized by the UN resolution passed in 1992 at Dublin, UK has been a key practice for current water resources management. Though there are a number of contradictory points affecting the different ethnic and religious groups, these criteria in principle have been used at various decision-making stages. The 1992 Dublin Principles are itemized below

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment;
- Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels;
- Women play a central part in the provision, management, and safeguarding of water;
- Water has an economic value in all its competing uses, and should be recognized as an economic good.

These principles provided tight and clear phrases to establish the importance and significance of water resources. They stress the significance of human participation for sustainable water resource development, since it is a finite but very specific economically valuable resource. Some people think that some of these principles could precipitate wars between countries, but Wolf (1995, 1997) argues the opposite, that water stress has not historically lead to war, and further favors negotiation, presenting the possibility that these processes may provided the basis for broader international solutions.

The context of water resources plans must be addressed and the following terms have been discussed in the literature as central aspects of the socio-technical context to be considered. We may condense these issues to the following indices and definitions with their relations in the making of decisions on present programs.

- Stress: The demand for water exceeds the available amount during a certain period
- Strain: The ratio of Shortage/Availability; the shortage measured as the difference between requirement and availability (Haddadin, 2002)
- Demand versus Supply: Economic analyses, discount rates and risks of projects
- Poverty Indexes: depends on Resources, Access, Capacity Use, Environmental Impact
- Water Poverty: The ratio of the amount of available renewable water to the amount required to cover food production and the household uses, of one person in one year under the prevailing climate conditions (Salameh, 2000). On the basis of several criticisms (Sullivan, 2002) on such aggregate index, Feitelson and Chenoweth (2002) suggested a different definition. It is a situation where a nation or region can not afford the cost of sustainable clean water to all people at all times

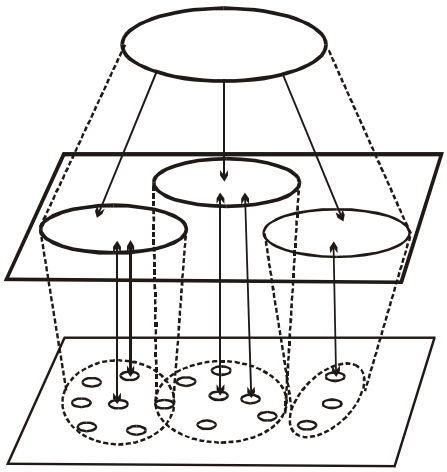

Fig. 3. The figure showing Macro, Meso and micro level actors interacting each other in the water Resource Development programs (Modified after Kemp et al, 2001)

- Pareto efficiency: Economic index guiding personnel gains
- Complexity of integrating diverse “Actor” perspectives and involvement (Fig. 3)
- Management objectives and plans
- Political decision-making structure

The technical setup of the Hydraulic system

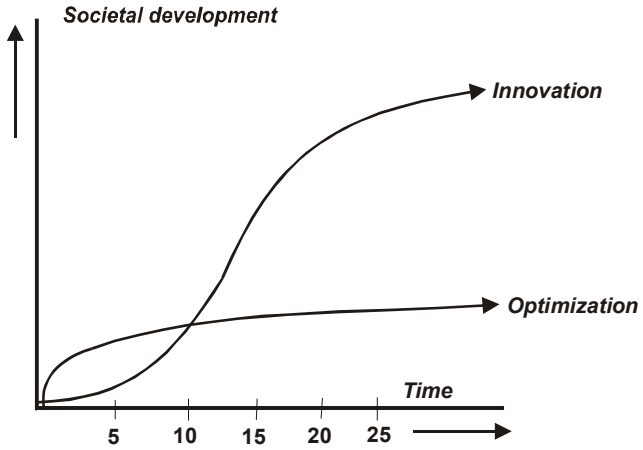

Fig. 4. The figure showing system optimization vs. system innovation in Water Resources development in the dry zone of Sri Lanka (Modified after Kemp and Rotmans , 2001)

It is clear that depression storages have provided a starting point for water management in newly civilized agriculture-dependent societies in ancient Sri Lanka. Those who visited from North India brought this new culture with the seeds of this technology, which they may have used at the beginning. As the figure 4 shows, the planning of building reservoirs initiated at a crude level however, innovations speeded it with the societal input. By virtue of the evolutionary development of the technology and infrastructure adapted as and when changes were necessary. In our case the cascade system of tanks evolved in parallel to the societal development as shown in the “Innovation” curve (Fig. 4). If we just consider the optimization, the development of the society may locate at a lower level. If we follow a pathway of innovation, we must employ proper maintenance and restore law and order in order to govern the system. Many developed nations have undergone such changes and good examples could be drawn form countries in Asia.

Figure 5 shows how normal, forested and regulated catchments would behave. The ancients had identified the easiness of regulating flow by cascaded tank system. The longevity of the flow could be maintained and which was a key to sustainability in the dry zone. The cascade system has been tested and even modeled (Jayatilake et al., 2002). It proves that it is even working under the present system and could be creating a sustainable system for the people.

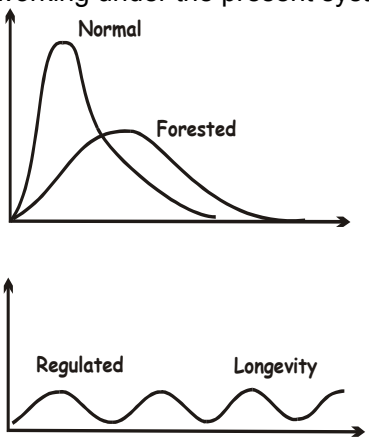

Fig. 5. Hydrographs showing normal, forested and regulated watersheds

The characteristics and trends of the present era in USA (Vonnahme, 1998)

"top down " mandates	→	"bottom up" initiatives
Command and control regulatory emphasis	→	Partnership oriented voluntary compliance emphasis
Federal funding driving program	→	Creative financing
Balancing economic and environmental issues	→	Integrating economic and environmental issues
Federal agency leadership oversight	→	Federal/state partnership
Acknowledgement of socio economic consideration and differing value systems in planning and management	→	Inclusion of socio economic considerations and differing value systems in planning and management
Single media emphasis	→	Multimedia ecosystem approach
Geopolitical boundaries as the basis for planning and management	→	Hydrologic boundaries as the basis for planning and management
Environmental ethics	→	Sustainability ethics

USA provide specific interests on a number of issues (Vonnahme, 1998). Based on written records, we believe that the ancient hydraulic civilization must have been undergone similar activities but the effects were oscillating between the extreme ends depending on the situation. Though we have had a tight top down approach in administering hydraulic systems in our country, effective solutions for water related issues and problems might have obtained through moderate approach. The person in charge or the peasants themselves have been using the irrigation waters with due responsibility that only at several occasions the code of ethics were breached by the people. However, the system had been undermined and become ineffective following a series of rulers disinterested in water resources activities, as occurred after 13th century (Geiger – Chulavamsa, 1929). Haphazard management was the central problem encountered by the British in early 19th century when they attempted to revive the tank-based irrigation system in Rajarata after some 500 years of neglect. These may provide how effective was the public participation component during the Parakramabahu period (Nicholas, 1955; Basnayake, 1995). The effectiveness of original hydraulic system was evident even with many breached tanks and diversion schemes within the hydraulic regime in the dry zone of Sri Lanka as seen in the early 19th century.

Sociotechnical Issues: Ancient

Selected pivotal issues related to ancient and modern period have been listed below to highlight key aspects of this evolution. Our aim is to focus upon several key issues within the hydraulic system in terms of its total environmental basis. This is a qualitative discussion that calls for renewed in-depth consideration in subsequent publications

1. Water management – The plans for such activities may have initially started by a proper technical process but maintenance of the system through social systems with some form of a public participation.

2. Lower population – Many have argued that there was lower population in the ancient period while some believe that the area between Polonnaruwa and Anuradhapura may have been heavily populated during Polonnaruwa period. Considering current conditions, it

is clear that with proper irrigation facilities and management, we could feed the present population as evidenced by recent bumper harvest (Daily News, 2003).

3. The historic technical solution was cascaded tanks for flood irrigation (rice) complemented by run-of-the-river diversion of major rivers to supplement dry zone irrigation.

Many of these cascade tank systems show linear basins as depicted in the above diagram (Fig. 6). The Drainage basin "A" usually shows a more subdued hydrograph while the "B" the leaf shape one shows a prominent peak. Dhanapala and Jayasena (1998) attempted to model several basins in the central highlands using maps and empirical formula. They found the same effect where subdued peaks were noted when the length of the basin is longer. Ancient hydraulic engineers may have understood this and used as to control the flow and regulate the system. This was effective in water conservation and sustainability of the people living within the system. The water usage was distributed along the paddy lands located in the fracture zones so that the subsurface water movement was effective in maintaining high water table (Jayasena et al., 1986; Jayasena, 1989, 1993, 1995). Figure 7 show how this may have happened during the flood irrigation and harvesting period. Since only one time that they have been using the flooding mainly during rainy periods, the availability of water for subsequent period is high and storage within the tanks replenishes the subsequent requirements. In addition it must be quickly flushed off after short period of rainfall during monsoon periods causing proper flushing and removing of salts. However, at present salt accumulation in the flow regime has been identified by many studies (Jayasena, 1989; Jayasena and Dissanayake, 1995; Jayasena et al., 2000).

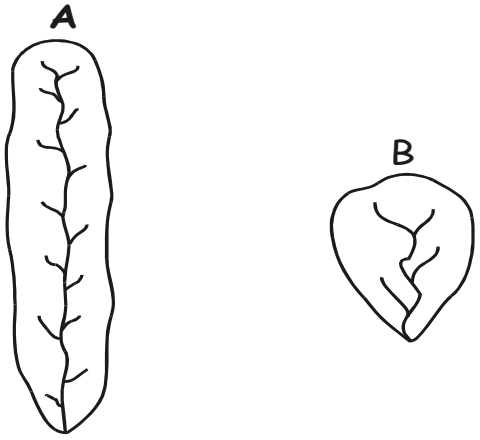

Fig 6. The linear and the leaf shape drainage basins

4. "Bethma": Irrigation according to supply, social objects; succeeded in increased food quantity and reliability

5. Traditional individual storehouses and large granary at "Vel Vidane" (Authority of irrigation and tanks in the village) provided increased reliability of food supply.

6. Was control wielded by a single political entity (King) in a tight top down strategy (disciplined and responsible) or both top down and bottom up initiative and community participation? In all likelihood some form of private partnerships was present at time when selected individuals had their own tanks and maintenance responsibilities. This issue requires additional investigation to truly understand the modes by which innovation and change entered the water management culture.

7. It is known that wind flow adjacent to major tanks was used for smelting iron (?) as documented at Naula, Samanalawewa, Tissawewa and other locations in Sri Lanka (Geiger – Mahavamsa, 1958; Basnayake, 1995). Was this industry a factor in tank design, or an opportunistic association? This is a question to be answered in a later publication.

8. "Tawalla" the upper periphery of the tank is the region where water was passing through a wetland. Since clay and sand were deposited in this region, it has been used in the dry periods to extract clay for the potter. This was recorded in Mahavamsa as shown by Tissawewa in Anuradhapura. How did these tanks contribute to this locally important industry? This is a question to be addressed in a future publication. Wetlands are effective in

maintaining appropriate BOD, N and P of the flowing waters. Especially NO_x contribution by cattle along the periphery could be removed in this method. The plants in these areas have been used for making mats and other household items for the benefit of the village peasant families.

9. Long duration paddy (Ma Wee) and variety of subsistence grains suitable for climatic situations and water availability was available. As seen in the figure 7, the soil is moistened for a longer period when compares with the short duration paddy. The water table is at a higher level that even a short period rainfall may initiate recharging on site. This could decrease the surface discharge; however since the current system with lower water table could take more time to recharge causing quick out flow of rainfall from the system.

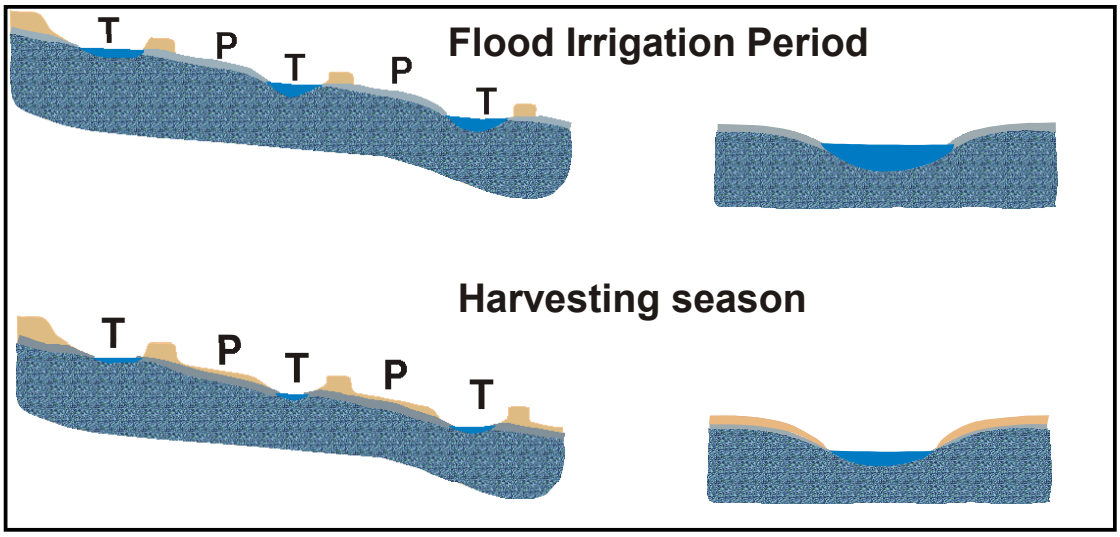

Fig. 7. Water table variation during flood irrigation and harvesting periods. T and P denotes a tank and a paddy field respectively

10. Variety of biological preservation techniques for food and grains.

11. Application of organic fertilizer- Organic farming

12. Traditional methods of controlling insects so that the biota preserved. Fish, worms and crabs in the paddy fields provide very well ventilated and porous upper soil and good quality water. This may hinder the outbreak of mosquito menace.

13. Closed but well integrated society. Many religious rituals – Individual is responsible for his doing –Integrity within the society

14. No public water supply schemes except for major monasteries and core of the kingdom – Water Conservation.

Sociotechnical Issues: Current

1. Systems of cascade tanks remain. Major constructions were added through government based implementing machinery - Dependence.

2. Increased water logging and salinization in the un-drained areas resulted from additional irrigation – Loss of irrigable lands

3. Short term paddy (3 - 4 month variety) with two seasons per year – excessive evaporation compared with a single season; more chemical fertilizers needed which resulted economic hardships and loss of interest among the farmers (Simple calculation of cost - benefit) - Dependence.

4. Large government storehouses (for paddy) out side the system. People do have mistrust with government officials due to ignorance and corruption - Farmer is not benefiting.

5. Chemical preservation techniques for food and grains – Dependence

6. Party politics (1-6 years). Political/Social system has more diffusive objectives. Members of the Parliament (MP) were appointed based on a chit system, which was wholly on personnel relations, and later reinvented a system based on district majority, which also created a severe competition among the prospective candidates. Both these systems created inefficiencies. The MP's were not responsible for the respective electorates and the people that created a self-serving political system. The political integrity was lost – Ineffective and Expensive.

7. Chemical preservation techniques for food and grains – Dependence

8. Application of chemical fertilizer, herbicides and fungicides created a mass destruction of the biological system and additional burden to the already deprived farmer– Dependence

9. Project funding responds to political power not citizens needs. No buy in (small segments get the benefits). International influence through donor agencies and later through NGO's create skepticism among the people - No partnership

10. Breakdown in Social cohesion. Very open system with diluted values within the society. No one is responsible except the weak government machinery – Moral values go down.

11. Still very few and unreliable water supplies for major cities. Hamlets and villages are depending on ephemeral wells, springs, streams, tanks and canals. Major concern

12. More mechanized farming system has been introduced. Traditional socially driven collective farming system was disrupted – Dependence

Discussion

The forgoing subtopics have revealed the significance of unique hydraulic civilization, which had been efficiently executed in a period from 200 BC – 1200 AD. Out of 103 drainage basins, the basins underneath the dry zone were successfully irrigated through system of tanks and diversion canals. Several sociotechnical aspects related to present and ancient hydraulic regime in Sri Lanka have been discussed. Mahavamsa (Geiger, 1958) indicated that religious, ethical and moral aspects interwove with the ancient hydraulic civilization. This was the base for maintenance and management of the hydraulic systems that caused subsequent upheaval in the society. Keep this in mind; we could argue that for successful projects need community engagement, sound technology and timely resources. In the present, usually resources are coming through out side as donor driven support. It is our belief that this should directly go to the relevant project, however, what we observe is a politically driven interest disorganizing such activities (Fig. 8). The necessities of the community could not be met by pure politically driven and manipulating activities. Due to some of these activities, the people's interests on proper governance have been challenged.

It can be seen that the key for successful water resources development and sustainability of such systems was public participation and/or community engagement. Maintenance of irrigation programs consequently provides efficient outcome and sustainability of the hydraulic system. At present we as engineers should concern on how we should do this and what step do we have to take in future to correct this?

It is necessary to develop an effective hierarchy with respected representatives from the local community. We believe the monks and priests, school principals, noble men and women within village level must encourage participating in such activities for the benefit of the society. We should initially provide them with family based or sector based responsibilities and encourage their authoritative participation for water supply and maintenance programs.

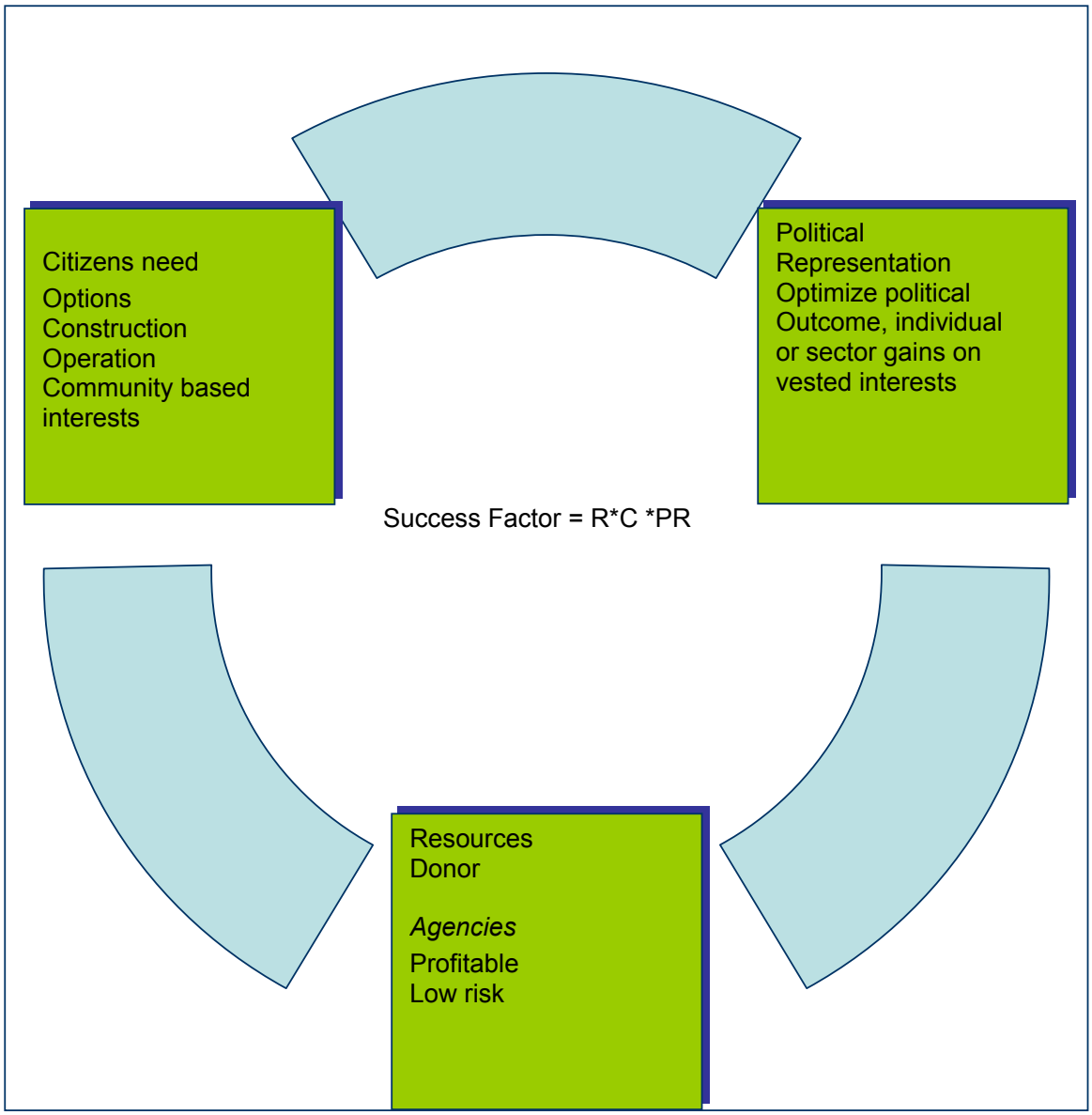

Fig 8. The interrelationships of Resources, Citizen and Politician in the Present water resources development

Let them build up mutually dependable local industries parallel with the above activities. We must minimize direct input of government machinery except for high tech advises and monetary supports. The committees comprised with such bodies must maintain strict measures and they must be responsible to maintain the longevity of the water supply and irrigation systems. Any mismanagement is to be taken in to a higher body and immediately solved with the participation of the community. We expect that the monks or priests could do a better judgment on such extreme cases while these committees could handle routine water related activities.

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References

Amarasinghe U A, L. Mutuwatte and R. Sakthivadivel, 1999. Water scarcity variations within a country: A case study of Sri Lanka, Report 32, International Water Management Institute, Colombo, Sri Lanka. pp.32.

Brohier, R.L., 1934. Ancient Irrigation Works in Ceylon, Government Press, Colombo, 64p.

Dhanapala, T.R.W.S. and Jayasena, H.A.H. 1998. Hydrologic model for selected sub-catchments in the Mahaweli basin of Sri Lanka. National Conference on Status and Future Direction of Water Research in Sri Lanka. International Water Management Institute, Colombo, Sri Lanka. 17 pp.

Feitelson, E and Chenoweth, J., 2002. Water Poverty: Towards a meaningful indicator. Water Policy 4: 263-281.

Geiger, W.C., 1958. The Mahavamsa - The Great Chronicle of Sri Lanka– Translated from original versions written by Ven. Mahanama Thera, Pali Text Society, London.

Geiger, W.C., 1929. The Chulavamsa – Translated from original versions written by Mahathera Dhammakitti and Tibbotuwegama Sumangala Thero, Pali Text Society, London.

Haddadin, M, 2002. Water issues in the Middle East challenges and opportunities, Water Policy, 4: 205-222.

Jayasena, H.A.H., 1989. Hydrogeology of basement complexes - A case study from the Kurunegala District of Sri Lanka. M.S. Thesis. Colorado State University, Fort Collins, CO 80525, U.S.A. 121pp.

Jayasena, H.A.H., 1993. Geological and structural significance in variation of groundwater quality in hard crystalline rocks of Sri Lanka. In Hydrogeology of Fractured rocks (Eds. Sheila and David Banks), Memoirs of XXIVth IAH Congress Oslo, Norway. Section C8: 450-471.

Jayasena, H.A.H., 1995. An analysis of fluid flow through fractured rocks. In K. Dahanayake (Editor), Handbook on Geology and Mineral Resources of Sri Lanka, Second South Asia Geological Congress Souvenir Publication, Colombo, Sri Lanka. pp 87-90.

Jayasena, H.A.H., Balasooriya, N.W.B., Suhail, M.N.M. and Rajapakse, R.R.G.R., 2000. Seasonal effects on water quality variation in a crystalline terrain- A case study from the VRR sanctuary in Sri Lanka. Journal of the Geological Society of Sri Lanka., 9: 38-53.

Jayasena, H.A.H. and Dissanayake, C.B., 1995. Analysis of hydrochemistry in the ground water flow system of a crystalline terrain. In Memoirs of XXVIth IAH Congress - Edmonton, Canada. Top in the session on Tropical Hydrochemistry. pp12

Jayasena, H.A.H., Singh, B.K. and Dissanayake, C.B., 1986. Groundwater occurrences in the hard rock terrain of Sri Lanka - A Case Study. AQUA., 4: 214-219.

Jayatilaka C.J. Sakthivadivel R. Shinogi Y. Makin I.W. Witharana P. “A simple water balance approach for determining water availability in an irrigation tank cascade system” International Water Management Institute (IWMI) P.O. Box 2075, Colombo, Sri Lanka

Kayane, I and Nakagawa, S.,1983, Evaporation and water balance in Sri Lanka, Climatological Notes, No.33, Tsukuba, Japan. pp 85

Kemp, R. and Rotmans, J., 2001. The management of the co evolution of technical, Environmental and Social Systems. Proc. Int. Conf. on “Towards Environmental Innovation System”. Garmisch-Partenkirchen, Netherlands. 1-22pp.

Kumarasinghe, U, 2003 Aug 10, Bumper Yala harvest projected, Daily News, Colombo, Sri Lanka.

Liyanagamage, A and Gunewardhena, R., 1961. Anuradhapura Period, Kelaniya

Madduma Bandara, C.M. 1985. Catchment ecosystem and village tank cascade in the dry zone of Sri Lanka: A time-tested system of land and water resources management. In strategies for river basin management: Environmental integration of land and water in a river basin, ed J. Lundqvist, U. Lohm and M. Falkenmark, 99-113. Dordrecht: D. Reidel Publishing Company.

Manchanayake, P and Madduma Bandara, 1999. Water Resources of Sri Lanka, National Science Foundation, Colombo, pp.112.

Nicholas, C.W., 1960, A short account of the History of irrigation works up to the 11th century. History of the Ceylon, Jour. of Royal Asiatic Society, New Ser., VII (1960), 43-69.

Nicholas, C.W., 1954. The irrigation works of king Parakramabahu I”, The Ceylon Historical Jour., IV: 52-68.

Parker H. “Ancient Ceylon” Asian Educational services New Delhi, 1981

Salameh, E., 2000. Refining the water poverty index, Water International, 25(3): 469-473.

Silva, C.R. de, 1990. Sri Lanka a History. Vikas Publishing house limited, New Delhi. 316 pp

Somasekaram, T., Perera, L.A.G. Perera, M.P. de Silva M.B.G., Karunanayake. M.M and Epitawatta, D.S. eds. (1982) The National Atlas of Sri Lanka: Survey Department of Sri Lanka.

Sullivan, C. 2000. The development of water Poverty index: a feasibility study. Department for International development, Center for ecology and Hydrology.

Vonnahme, D.R., 1998. The emerging state role in planning and management, In Coordination: Water Resources and Environment ed by William Whipple, Jr., American Society of Civil Engineers, 1801, Alexander Bell Drive, Reston, Virginia 20191-4400, USA. 23-28.

Weerakoon, S.B., Herath, S. and Tamai, T., 2001. River basin based paddy extent estimation considering the irrigation systems in Sri Lanka, Int. Symp. LUCC contribution to Asian Environmental Problems, Tokyo.

Whipple, W, 1998. Guiding Principles for Coordination, In Coordination: Water resources and Environment ed by William Whipple, Jr., American Society of Civil Engineers, 1801, Alexander Bell Drive, Reston, Virginia 20191-4400, USA. 3-8.

Wolf, A.T. 1995. Hydropolitics along the Jordan River: Scarce Water and its Impact on the Arab-Israeli Conflict. United Nations University Press, Tokyo, Japan.

Wolf, A. T. 1997. “’Water wars’ and water reality: Conflict and cooperation along international waterways.” NATO Advanced Research Workshop on Environmental Change, Adaptation, and Human Security. Budapest, Hungary. 9-12 October.

Paradigmatic Change in the Indonesian Irrigation Development in Disarray [1]

Mochammad Maksum [2]

Introduction

It is indeed very worthwhile in discussing recent dynamics of the irrigation development in Indonesia by relating this subject with the political turmoil precipitated by the Indonesian economic crisis, following the depreciation of the Thai baht in 1997, which has resulted in a unique crisis in Indonesia. The uniqueness of the crisis can be seen in the multidimensional nature and the extent of the crisis. The latter has placed Indonesia in a serious political instability, and made the country's currency comparatively the most affected by the Asian crisis with the longest impact.

Months before the Asian crisis came, the Indonesian macro economy was disturbed by serious natural calamities in the forms of extensive forest fire destructing large forest area and very long drought destroying agricultural production. Before the country fully recovered from that natural crisis, Indonesia joined several Asian countries entered into the Asian financial crisis by the end of 1997. While the republic is still in the middle of facing the economic crisis, escalating public distrust to the state suddenly forced this Republic enter into its nationwide political crisis. Soeharto, who had governed Indonesia for more than three decades, was forced by the students to step down as the president of the country, two months after receiving the mandate of the People's Assembly[3].

The economic development model having no strong economic foundation adopted by the authoritarian government of Indonesia was blamed by many as the primary cause of economic crisis. Consequently, reformation movement following the economic crisis had to be politically anticipated by the *newly established* democratic government under Habibie, Wahid and Megawati as the third, the forth and the fifth Presidents of Indonesia, respectively, to review overall national development policies and conduct necessary policy reformation at all levels. Democratic movement started to significantly characterize the country's legislation and policy system.

The country's water resources development affairs were not an exemption. Irrigation development as its significant part experienced the most remarkable shift in political paradigm from being a strongly supporting factor of the rice-biased agricultural development for the sake of food self-sufficiency. Radical reformation of the national irrigation policy that has been well drafted and socialized strongly indicates the need for having more comprehensive and socially-sensitive development policies, otherwise agricultural sector would be dampened back more deeply into its sectoral and structural marginalization in the context of national development by disseminating more rural poverty in the *next possible crisis*.

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[1] Presented at the International Workshop on: Water and Politics. Conducted by the World Water Council (WWC) in Marseille, French, February 26-27, 2004.

[2] Director and Agricultural Economist, Center for Rural and Regional Development Studies, Gadjah Mada University, Yogyakarta-Indonesia.

[3] Mochammad Maksum. 2001. Economic Crisis and Its Human-Social Cost in Indonesia. Paper presented at a conference on: Civil Society Response to the Asian Crisis in Three Countries: Indonesia, Korea and Thailand. Seoul, Korea, April 20-21, 2001. Cited in Maksum, M. and Sigit Supadmo Arif. 2001. Sectoral and Structural Poverty Syndrome in Irrigated Agriculture in Indonesia. Submitted in the Country Workshop on Pro-Poor Intervention Strategies in Irrigated Agriculture in Indonesia. Yogyakarta. May 23, 2001.

Structural Marginalization of Irrigated Agriculture

The political-economic crisis experienced by Indonesia meant many things for irrigated agricultural sector. It is now nationally accepted that agricultural sector of Indonesia has been impoverished within the country's economic development model characterized, among others, by: (i) the adoption of the top-down and authoritarian development model; (ii) foreign capital and foreign input based development; (iii) import-based industry biased development; and (iv) rice biased development in agriculture[4].

Such development model enabled the country successfully improve the living standard of the country but with a very limited attention to the need of attaining the *growth-equity-sustainability*[5] objectives of the country's development. The first three characteristics have been able to provide an average annual growth rate of about seven percent for the 1980-90s to the country's economy by abnormally concentrating on high-technology intensive industry (HTI), capital intensive industry (CII), and skilled-labor intensive industry (SLI). Abnormal biased in these industries has resulted in favorable economic growth at the expense of other industries, namely, natural resource intensive industry (NRI) and unskilled-labor intensive industry (ULI), the two industrial sectors shouldering the economy of the citizen majority.

Such political-economic bias to HTI, CII and SLI, which penalized NRI and ULI, could be observed in many cases. Industry-biased credit distribution, industrial development and local currency protection, among others, had made robust growth in the three industries but at the same time negatively made NRI and ULI to be extremely high cost, inefficient and less competitive industries. Trough this mechanism, the Indonesian agricultural sector has been structurally marginalized for the last decades[6]. Rural poverty incidence dominated by rural areas could be partly attributed to this policy bias.

Natural consequence of that political choice, extremely rice-biased and industry-biased development policy had made agricultural sector marginalized for the sake of rice production *at all cost*. Nation-wide agriculture development in the country before entering into its reformation era were completely designed and dedicated for delivering production-oriented rice development. Consequently, overall irrigation development systems were politically very rice-biasedly developed.

It was very clear that in terms of rice, agricultural and irrigation development was very successful in delivering the country's self-sufficiency in rice, which was significantly attained in 1984. However, this rice success was not very well accompanied by proportional improvement in the people's welfare in agricultural and rural areas.

Among other impacts easily observable at the ground were: (i) farm production approach has left the farmers remain poor; (ii) input dependent of rice farming made rice sustainability questionable; (iii) rice biased agricultural policy left almost no incentive to other agricultural commodities; (iv) non-rice economic development, including R&D, was very minimal; (v) crops diversification was discouraged; (vi) more MNCs dependent of non-rice production system; and (vii) food security profile tends to depend on a single staple food, which is rice, instead of diversified staple foods as previously practiced by Indonesians. In turns, due to

[4] Read Jung, Ku-Hyun; A. Poungsomlee; M.Maksum; and TK Park. 2003. Civil Society Response to the Asian Crisis: Indonesia, Korea and Thailand. Published by the East and West Studies, Yonsei University, South Korea in cooperation with the Asia Pacific Philanthropy Consortium (APPC).

[5] The critical triangle as cited by Mochammad Maksum. 1997. The Critical Triangle of Agricultural Development. In Maksum, M. et al. (eds.) 1997. People Based Sustainable Agricultural Development for a Global World. P3PK-UGM.

[6] Read Maksum, M and Sigit Supadmo A. 2001. Sectoral and Structural Poverty Syndrome in Irrigated Agriculture in Indonesia. –ibid-.

sectoral maldevelopment, agricultural sector in general, including forestry and fishery, hardly gain any global trade advantage during the crisis[7].

In criticizing this agricultural and irrigation development paradox, a national workshop on structural poverty in irrigated agriculture conducted in the Center for Rural and Regional Studies, Gadjah Mada University, 1999[8], concluded that the majority of poverty incidence in irrigated area in Indonesia was very much influenced by structural problems. Therefore, it must be considered as structural poverty[9] by any development intervention. Otherwise, any political and economic interventions formulated would never be very sensitive to poverty alleviation need.

The introductory part of this paper clearly mentioned that irrigation development policy was not exempted from the spirit of democratic and reformation movement. Though it will not solely guarantee the success of irrigation development in the country, people may hope that irrigation policy reform might serve as the basis to better develop the country's irrigated agriculture with a more democratic and humanistic consideration. It is very relevant, therefore, to review a short historical perspective of the Irrigation Management Policy Reform (IMPR).

Political History of IMPR

The downfall of the New Order Government in the second quarter of 1998 and the issuance of the Decision of the People's Assembly (TAP MPR) in 1998 on reform and community participation in development forced the government initiating the formulation of policy reform for irrigation development. Recommendations gathered from series of seminar conducted since 1990 were considered as very valuable reference in the preparation of the Irrigation Management Policy Reform (IMPR). Based on the TAP MPR and for neutrality reason, senior personnel from prominent universities (Universities of Gadjah Mada, Padjadjaran and Andalas) were recruited in the third quarter of 1998 to draft the original concept of IMPR[10].

In maintaining the neutrality and the acceptability of the concept at the community level, IMPR draft was being intensively socialized and consulted by the government through intensive public consultation. For the sake of objectivity and the transparency in public consultation, prominent NGOs (LP3ES and SKEPHI) were recruited to conduct such public consultation during the months of December 1998 - February 1999. Based on that public consultation and necessary revision, it could be concluded that the revised version of draft was then declared as IMPR concept publicly acceptable to reflect the need of farmers in irrigated agriculture development.

On April 13, 1999, Abdurrahman Wahid as the President of the Republic at that time declared IMPR concept in a national workshop of vice governors of the country. This Presidential declaration (*Maklumat Presiden*) was formalized by the issuance of Presidential Instruction (*Instruksi Presiden*) No. 3 1999 on IMPR composing of 5 principal policies: (i) redefinition of tasks and responsibilities of irrigation management institutions; (ii) empowerment of farmers via Water User Associations; (iii) transfer of irrigation management to Water User

[7] Export development of agricultural sector showed minimum growth in 1997 and 1998, while some industries in this sector showed even negative growth. When local currency depreciated, this negative or minimum growth of domestic based sector should have not been the case if sectoral development is normal.

[8] That workshop was conducted by the Center for Rural and Regional Development Studies (CRRDS) of Gadjah Mada University in cooperation with KIKIS, Percik and AUS-Aid. December, 1999.

[9] Several basic problems connected with structural poverty in irrigated agriculture recommended by the KIKIS workshop was summarized in Maksum, M and Sigit Supadmo Arif. 2001. Sectoral and Structural Poverty in Irrigated Agriculture in Indonesia. –ibid- please read Appendix 1.

[10] Maksum, Mochammad; et. al. 2003. Study on the Impact of Irrigation Management Policy Reform (IMPR) Implementation in Indonesia. A Final Report of the NGO-University Consortium for Water Resource Management Reform.

Associations; (iv) financial reform in irrigation management; and (v) sustainability of irrigation systems.

Box 1: Principal Components of IMPR

- redefinition of tasks and responsibilities
- empowerment Water User Associations (WUAs)
- irrigation management transfer to WUAs
- financial reform in irrigation management
- sustainability of irrigation systems

Based upon political commitment on IMPR as stipulated by the Inpres No. 3/1999, the Government of Indonesia (GOI) started to conceptualize the implementation plan of IMPR in 1999 through the establishment of Working Committee (*Kelompok Kerja, POKJA*) whose members composed of representatives of the government, NGOs and universities. Based on several experimentation and initial implementation of IMPR since 1999, that Working Committee on Irrigation was very successful in drafting the irrigation development management guidelines, which was finally strengthened through the issuance of the Government Regulation (*Peraturan Pemerintah*) No.: 77/2001 on Irrigation. Without nullifying the need to support its effectiveness, this Government Regulation has been able to highlight several paradigmatic change in irrigation development management.

The elements of paradigmatic changes marked by this regulation are, among others, the following shifts in irrigation development: (i) from rice-based to welfare-based and sustainability; (ii) from centralized to decentralized; (iii) from the top-down to bottom-up development process; (iv) from the state monopoly to participative development; and (v) from the authoritarian government to good governance accommodating participation of other stakeholders and adopting the principles of good governance.

At the ground level, such a Government Regulation has been intensively adopted as a duly official basis for the nationwide irrigation management. Starting from all provinces in Java, IMPR implementation started to be in effective use also for selected provinces outside Java, while some others has been also made ready for IMPR implementation. The achievement of IMPR implementation were very remarkable though it is still being constrained by the fact that adopting such a very extreme paradigmatic shift was proven to be requiring consistent political will to support. Box 2 clearly indicates several structural constraints of IMPR implementation.

Box 2 Among Structural Constraints are:

It must be kept in mind that IMPR has been newly issued and implemented. The shift in irrigation model from being very centralistic to the decentralized and participative one still requires necessary strengthening efforts;
Repositioning irrigation stakeholders related to the task redefinition seems to be a serious bureaucratic problem requiring time and transition adjustment.
Irrigated agriculture in Indonesia has been rice-biasedly developed. There are too many constraints must be faced in bringing the shift from the rice-based towards welfare-based agriculture in favor of the farmers.
Sectoral-based development model has been implemented for decades by the country has marginalized agricultural sector by positioning this sector as producer of cheap commodities. To support the decentralized, participative and people-based development, inter-sectoral synergy is indefinitely postponable.
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IMPR Implementation: Lessons Learned

Lessons learned presented in this chapter are completely derived from the implementation evaluation conducted in several evaluation studies[11] primarily aimed at assessing the extent to which the effectiveness of IMPR implementation and at the same time identifying relevant problems at the ground constraining the IMPR implementation in attaining its objectives. This chapter is presented as partial citation of the findings and lessons learned relevant to be raised connected with the political issues concerned as the central theme of this WWC workshop.

Box 3 Relevant Questions

What and to what extent is the impact has been accrued from IMPR Implementation during the early years after IMPR issuance?
At what level is the readiness of the Government and other stakeholders concerned in supporting IMPR Implementation?
What intervention strategies could be recommended for the IMPR Implementation to be more effective?

As far as the first questions is concerned, it is in fact very promising in the sense that IMPR implementation has provided positive impacts in terms of agricultural, economic, physical, environmental and socio-political impacts. Without nullifying the need to have continuous improvement and empowerment during the earlier years of IMPR implementation, overall

[11] Among others are: (i) CRRDS. 2003. Pro-Poor Intervention Strategies in Irrigated Agriculture in Indonesia. A Final Report prepared by the Center for Rural and Regional Development Studies (CRRDS), Gadjah Mada University in cooperation with the International Water Management Institute (IWMI); and (ii) Maksum, M. et.al. 2003. Study on the Impact of the IMPR Implementation in indonesia. –ibid-

impacts guarantee that IMPR has been well functioning as appropriate movement towards better irrigation sustainability.

Qualitative responses raised by sample farmers significantly reported that agricultural impacts were presented, among others, by better cropping intensity, higher acreage of cropping area, higher land productivity, more acceptable harvest certainty, flexible cropping selection, and higher rural food security. However, as far as economic impact is concerned, significant improvement has not been presented very clearly due to the fact that agricultural improvement was not simultaneously accompanied by the improvement in market and economic infrastructure development in favor of farmers.

Sectoral model of the country's development does not provide conducive market condition for agricultural development. Market and pricing policy, trade, monetary and fiscal policies are still being set in a conventional way to provide cheap commodities for the people in large, with minimum consideration of the importance of promoting the welfare of the farmers, the majority group of the country's citizen. This sectoral development model constituted as the primary constraint of IMPR implementation in addition to many other constraining factors including rice-biased culture, limited availability of non-rice technology, extension and subsidy, and rice-based irrigation system development adopted for the last few decades.

IMPR implementation has been able to successfully revitalize and empower the capacity of water user associations (WUAs), in any aspect, in irrigation development affairs. The improvement of these social capitals[12] strongly indicates the most remarkable socio-political impacts of IMPR, considering the fact that stimulating social change process of the farmers from being net beneficiaries of irrigation development towards participative farmers is not an easy task. It is expected that such social capital strengthening efforts must be intensified to guarantee better prospect of irrigation system sustainability.

Direct impact of the improvement of social capital performance in the forms of better environmental awareness, participation, and togetherness, has been actualized in better self-reliance of the people in minor physical and environmental maintenance of the irrigation system. Physical works of the irrigation system has been better performed by WUAs than that being performed by engineering contractors. The stealing of irrigation equipments and the emergence of social conflicts in irrigation among the farmers have been significantly minimized through better communication developed through WUAs.

Although the socio-political impacts of IMPR implementation has been very significant, the readiness of the farmers need to be continuously advocated knowing the fact that the farmers used to be positioned as net beneficiaries of irrigation for decades without being invited to participate in the previous development models. The limited readiness of bureaucratic personnel and other stakeholders concerned was strongly considered as one among the most constraining factors. Shifting from the previous irrigation development model with the State as the only development monopolist requires serious effort for a good governance promoting balanced participation among stakeholders.

To conclude, the weaknesses found out during the earlier period of IMPR implementation still characterized overall constraints that could be summarized, among others, in the followings: (i) limited support of macro level policy; (ii) human resources constraints; (iii) socio-cultural diversity; (iv) limited availability of data and information; (v) weaknesses in management function particularly connected with the coordination of institutions concerned; and (vi) limited financial availability13.

[12] Social capital has been also well working in protecting the dam safety. See a case shown in Appendix 2

13 For further discussion of this, read Arif, Sigit Supadmo. 2000.New Paradigm in Irrigation Development and its Possible Implementation. Presented in PPKP Training. Yogyakarta, 12-14 June, 2000.

Above all, it is ultimately necessary for IMPR implementation to have stronger political will of the Government in seriously promoting the decentralized, participative, bottom-up, and people-based irrigation management policy as has been demonstrated by IMPR. Moreover, such a political will is needed to strengthen development values have been adopted and operationalized as the rule of conduct and the rule in use by the farmers at grass root level. Political protection of farmers' welfare and development values they have adopted from any possible violation must be places as a primary duty of the State.

Irrigation Policy in Disarray

Paradigmatic changes has been mandated IMPR as well as IMPR implementation evaluation proven the fact that IMPR has been very successful in revitalizing local capacity to better manage irrigation system management. However, the evaluation finding found out very clearly that the most constraining factor was structural bottlenecks reflected in many aspects including: poor inter-sectoral synergy and coordination, poor readiness of bureaucratic people to adopt IMPR implementation, as well as limited political will and consistency of the Government to protect IMPR and its development values, the values adopted based on decentralized governance system as has been stipulated by the Law Number 22/1999 on Regional Autonomy.

Moreover, recent development shows an extremely contradictory phenomenon. The Government, who initiated the formulation of IMPR concept and is supposed to be the primary supporter of IMPR, clearly demonstrated its inconsistency and serious ambiguity against IMPR. The same Government who proposed the stronger formalization of IMPR, is currently observed as has been very enthusiastic in fighting against IMPR. IMPR moratorium has been primary campaign issue raised by bureaucratic elites in irrigation.

More than that, the draft law on water resources (RUU-SDA), which has been formally approved by the Parliament (DPR) as a law still contain the most controversial issues on irrigation, covering the issues of people participation, people right in irrigation management, decentralized irrigation, and the issue of privatization. The law has been criticized by many as a very political laden legislative product nullifying the important of public participation and criticism, and disregarding development values has been promoted by IMPR and has been adopted by the farmers as their rule in use. The Law has also been blamed as very poorly processed without being accompanied by intensive public consultations and nullifying the criticism raised during public consultations.

The implication at the grass root level would be very clear. The Formal issuance of the Law on Water Resources would seriously threaten the development values have been adopted. In addition to that, the limitation of public participation and farmers' right in irrigation management as being promoted by IMPR, might reshuffle the right in irrigation management has been turned over to the farmers in favor of government monopoly, at least for the larger, secondary and primary schemes.

The issuance of that Law has also reflected serious political ambiguity and inconsistency of the Government in irrigation management policy. It has been seriously criticized as very potential in disseminating public distrust of the farmers against the ruling Government. It must be kept in mind that escalating public distrust to the Government might be reflected in unexpected political movement especially facing the 2004 election.

This Republic has been in trouble since the financial crisis in 1997. It has been criticized as the failure of the Government in adopting development model. Many more structural problems have been created by the Government penalizing farmers in rural areas. The Law

on Water Resources could be listed as structural problem marginalizing farmers and discouraging the farmers to participate in development and revitalize their social capital.

Concluding Remarks

Former irrigation development has been totally developed to support rice-self sufficiency without proportional consideration to the farmers. It has been significantly reoriented towards welfare-based irrigation development through the issuance of IMPR following the political reform experienced by the country since 1998. It is the real answer to political needs of the farmers assessable at the grass root level requiring the decentralized, participatory, bottom-up, and people-based irrigation development.

However, the most recent development of irrigation policy adopted by the Government seems to be significantly insensitive in accommodating such development values have been adopted by the farmers as the new rule in use in irrigation development. It is very clear that such recent policy formalized through the approval of the Law on Water Resource seems to be politically against the values promoted by IMPR.

We may conclude that Irrigation management policy in Indonesia is in a very serious disarray due to political inconsistency and ambiguity. Such disarray is very political in nature. Irrigated agriculture is again being marginalized. It is very unfortunate if such a political inconsistency would be followed by the escalation of public distrust, which could be reflected in any possible political movement of the people at the grass root level.

Appendix 1: Basic problems connected with structural poverty in irrigated agriculture

No	Basic Problems	Observed Problems
1	Power Relation	Top-down development Low bargaining power in input and output market Input dependent farming Low profitability Unclear right on production input (water)
2	Institutional Infrastructure	Government oriented rural institutions Village Unit Cooperative (KUDs) functioning more in favor of input companies and local capitalist Low credit availability, Bank Plecit is more favorable Farmer union is wrong representation of the farmers Low agriculture and irrigation research
3	Constraining Policies	Industrial biased economic policy Rice-biased agricultural development Pricing policy in favor of urban community Capitalist oriented export policy Diversification technology availability Production based agriculture and irrigation
4	Environment	water availability, certainty, reliability Higher input dependent of agricultural land High land conversion Lower carrying capacity Higher population pressure and rural dependency of the economy
5	Cultural Constraints	Apathy of the farmers majority More fragmented land Women's role is limited Subsistent oriented farming

Dam Safety Protection Through Community Participation: the Case of Sermo Dam, Yogyakarta, Indonesia[14]

The Sermo Dam is the only dam in Yogyakarta Special Province. Its effective operation is started in 1997 to satisfy a multipurpose function for an expected life expectancy of 50 years, a technical life initially set. However, after a few years of operation its life expectancy was found out to be much shorter that that being targeted. At that point in time, the remaining lifetime was estimated to be 35 year only, instead of 45 years according to its design plan. The dam lost ten years of life expectancy for nothing.

Serious decrease in life expectancy could be fully attributed to extremely high erosion rate of its catchments area strongly characterized by extremely high land slide potential. Limited upstream conservation management and limited size of green-belt area controllable by the dam management, could hardly contribute meaningful protection capacity to the dam.

Knowing the fact that the government capacity in dam protection is very limited, the Center for Rural and Regional Development Studies, Gadjah Mada University promoted what the Center calls as the dam safety community in a specific perspective, primarily due to the life expectancy dependency on them.

Populated nature of upstream area is a serious problem. This problem has been intensified by the fact that they are dominated by those below poverty line and characterized by malaria disease. Though expecting their participation in protecting the dam safety is clearly impossible when they hardly get any benefit from the dam, the Center still believed that there is no other way to protect but promoting the upstream community participation in it. Such participation could only be mobilized through an integrated upstream community empowerment promoting the dam safety community.

An integrated modeling has been taking effect in the field since 2002 supported by a simultaneous movement of the district government. Malaria eradication, people-based green-belt management, adoption of highly commercial crops for green-belt and upstream area, community forest development, animal husbandry development, and the issuance of regional regulation in quartz quarry, are among integrated programs have been taking place.

Although the dam safety impact is still in waiting, intermediate impact indicators, covering economic, social, institutional and environmental impacts, have been very promising and remarkable to consider. It is expected that, in turns, the dam life expectancy could be lengthened appropriately in satisfying the originally set technical lifetime.

[14] An Abstract cited from CRRDS. 2003. Dam Safety Modelling: the Case of Sermo Dam, Yogyakarta, Indonesia. Final Report of the Center for Rural and Regional Development Studies Gadjah Mada University (CRRDS-GMU) in cooperation with the Ministry of Infrastructure and Regional Settlement, the Republic of Indonesia.

Unbundling 'Lack of Access' to Water in Rural India

By: Nayanika Mathur, The Energy and Resources Institute (TERI), India

A defining feature of rural India has remained its limited access to information and basic services – energy, water, sanitation, health and education – despite the relative growth in economic terms and the investments in public services. There has been a dawning realisation of the neglect suffered by rural India due to this lack of access. Access to services and resources can be studied in a variety of ways. The way one defines it has critical implication for policy. This particular paper demarcates and studies 4 predominant ways in which 'access' to water in rural India has been studied - access in terms of conditions of 'scarcity'; lack of access as being symptomatic of poverty; access as a redistribution issue; and most recently, access in terms of capabilities.

Access to Water in Rural India

Although India is endowed with sufficient water[1], there are significant variations in the spatial and temporal availability of this resource[2]. Consequently, at any given time, there are areas of both water excess and water stress in the country. There are significant variations in water availability even within a river basin. For instance, the availability of water within the Ganga basin varies from 740 cubic metres in the Yamuna to 3,379 cubic metres in the Gandhak.

Indicators of water stress and scarcity are used to reflect the overall water availability in a country or region. When the annual per capita water availability of renewable fresh water in a country or region falls below 1700 cubic metres, it is considered to be a situation of water stress. When the availability falls below 1000 cubic metres, it is known to be a situation of water scarcity. When the per capita water availability falls below 500 cubic metres, it is said to be a situation of absolute scarcity[3]. The annual per capita availability of renewable freshwater in the country has fallen from around 5,277 cubic metres in 1955 to 2,464 cubic metres in 1990. Given the projected increase in population by the year 2025, the per capita availability is likely to drop to below 1,000 cubic metres. The present per capita water availability in India comes to be around 1250 cubic metres, which puts India in the category of "Water stressed" countries. By the year 2050 this is projected to be around 750 cubic metres. Even if the total available water is taken into account the per capita water availability is estimated to be around 1400 by the year 2050. The country will thus still be water stressed.

At present, agriculture is the single largest user of water, accounting for about 85% of the total water demand in the country. In the coming years, there will be an increase in the demand for water from among all the competing sectors. Studies done by the IWMI (International Water Management Institute) have shown that much of western and peninsular India will suffer from acute scarcity in the coming 25 years.[4] Agriculture will progressively lose its share of irrigation water to industry and municipal uses.

Providing water for domestic consumption in rural India is mired with complications. Rural water schemes have remained an extremely complex issue for Indian planners since Independence. Despite massive resource allocation during the last nine Five-Year Plans, there were as many as 61,747 problem villages in the country towards the end of 1997.

[1] With an average annual rainfall of 1,170 mm, India is one of the wettest countries in the world

[2] At one extreme are areas like Cherrapunji, in the north-east, which is drenched each year with 11,000 mm of rainfall, and at the other extreme are places like Jaisalmer, in the west, which receives barely 200 mm of rain. Nearly three-quarters of the rain pours down in less than 120 days, from June to September.

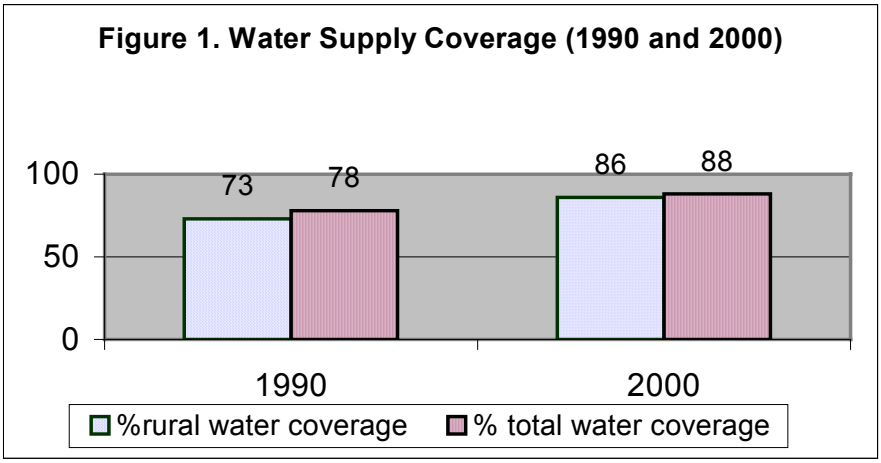
[3] Engelman, R and Roy, P (1993).Sustaining water: population and the future of renewable water supplies. Washington, D.C: Population and Environment Programme, Population Action International. 56 pp

[4] http://www.1worldcommunication.org/indianfoundation.htm

Interestingly, the country started out with a figure of 150,000 problem villages in 1972; this rose dramatically to 231,000 in 1980. According to the latest statistics, about 15,000 habitations in the country were reported to be without any source of potable water; some 200,000 villages were partially covered by drinking water schemes; and 217,000 villages reported problems with the quality of water.

It is difficult to estimate the proportion of population that has access to clean drinking water. At the time of the First Five-Year Plan, 6% of the rural population and some 48% of the urban population had access to safe drinking water. There has been a phenomenal increase in coverage, and by 1994-95, as much as 82% of the rural population was covered[5]. As per the latest figures, approximately 90 percent of rural habitations have been fully covered with drinking water facilities and 20 percent of rural habitations have been covered by sanitation facilities[6]. The WHO's Global Water Supply and Sanitation Assessment 2000 Report showed an increase in rural water supply coverage from 73% in 1990 to 86% in 2000 (Figure 1).

Figure 1. Water Supply Coverage (1990 and 2000)



Source: Global Water Supply and Sanitation Assessment Report 2000. World Health Organisation.

There exists, as is evident from the various figures above, a discrepancy between estimates arrived upon by different sources on the water and sanitation coverage in rural India. This discrepancy can be ascribed to difficulty in data gathering in rural India as well as different methodologies adopted by different agencies. The broad consensus, which does emerge in all discussions on rural water supply in India, is that while access to drinking water in India has increased over the past decade, the tremendous adverse impact of unsafe water on health continues. The World Bank estimates 21% of communicable diseases in India are water related. Of these diseases, diarrhoea alone killed over 700,000 Indians in 1999 (estimated) – over 1,600 deaths each day[7].

Unbundling `Lack of Access'

Broadly, four different approaches to the study of access or the lack thereof to water can be distinguished[8]. The four approaches shall be studied with particular reference to access to water for domestic consumption in rural India. It is to be noted that though we are specifically

[5] www.infochange.com accessed on 30/10/03
[6] Ministry of Rural Development, India. 2003. Annual Report – 2002-03.
[7] http://www.who.int/multimedia/indiawhosuccessfull/sanitation/photo_underpage.html accessed on 11/12/03
[8] This typology has been drawn from P.B. Anand, 2001, *Water Scarcity in Chennai, India – Institutions, Entitlements and Aspects of Inequality in Access*. Discussion Paper No. 2001/140. United Nations University, WIDER.

studying the domestic sector, the issue of access spawns it to include agriculture and industry as well.

Lack of Access due to 'Scarcity'

The predominant approach to lack of access revolves around issues of **'scarcity'.** In this case, the problem is interpreted as one of there not being enough of the resource in aggregate terms (e.g. water scarcity in the case of arid regions such as Rajasthan) or in per capita terms (e.g. water measured in cubic metres per capita, CPMC, falls below the required level). Reports such as: 'the next world war may be over water'; 'about 40 countries will not have adequate water supplies in the near future'; 'the drought affected area in Africa is spreading at a rate of 2.3 million sq. miles a year' are now commonplace. The aspect of scarcity and the drastic need to conserve water is not disputed in this paper. Rather, the aim is to move beyond gratuitous comments on water scarcity and understand the politics of accessing this scarce resource by a traditionally fragmented and weak section of Indian society – its over 700 million strong rural populace.

Lack of access in this approach is a result of providence (in terms of water as a natural resource) and population. The social and political construction of scarcity on the basis of the prevailing power relations is completely obscured in this approach. Lyla Mehta[9] in her study of the famously 'water scarce' Kutch region in the state of Gujarat argues that access to and control over water is usually linked to prevailing social and power relations, which influence how it is used or abused. She argues that water scarcity can be constructed differently by different political and social actors, often to meet political ends. Through a detailed empirical and multi-sited examination of both actual practices and discourses around scarcity in the Kutch region of western India, she argues that scarcity is both 'real' and 'constructed'. The 'real' aspects of water scarcity relate to dwindling groundwater aquifers, increased salinity and so on, while the 'constructed' aspects refer to the state discourses which portray scarcity as natural (rather than human induced) and chronic (rather than cyclical). These external essentialised notions of scarcity generated by state discourses and state programmes are more often than not quite different from local people's knowledge systems and livelihood strategies that allow them to adapt to the unpredictability and temporary scarcity of water.

Lack of Access symptomatic of Poverty

In yet another approach, lack of access is seen as being a symptom of poverty. Not having adequate water or sanitation is thus, seen as a characteristic of lower levels of development and deprivation. For e.g. the World Bank reports negative relationships between per capita GDP and percentage of population not having access to water supply and sewerage[10]. In this approach, there is an in built assumption that economic development will, in due course, lead to improvements in water supply and other such basic services. As already stated earlier, it has now been comprehensively proven that there is no direct co-relation between economic development and social development in terms of provisions of access to basic services to **all** sections of society[11].

For instance, the Panos Environment briefing12 studying access to water directly exhibits this approach, by comparing water consumption between an average British citizen and "many

[9] Lyla Mehta, 2003, 'Contexts and Constructions of Water Scarcity', *The Economic and Political Weekly*, November 29, 2003.
[10] World Development Report 1992: Development and the Environment, Oxford University Press, New York.
[11] And then again, there are unique developmental models such as the 'Kerala Model'. The Kerala model refers to the paradoxical co-existence of very high levels of social development with low and even stagnating economic growth in this south Indian state. In 2001, Kerala ranked first among the major states in India in the Human Develoment Index, though the state stood only ninth in terms of per capita net state domestic product (NSDP).
[12] Panos Environment Briefing, 1998, *Liquid Assets: Is Water Privatisation the Answer to Access?*

people in the developing world". It illustrates this through the usage of certain WaterAid, figures: the average person in Britain consumes about 150 to 200 litres of water a day – for gardening, washing the car, showering and bathing, washing clothes, drinking, cooking, personal hygiene, cleaning the house and so on. The average British person – and the more affluent in the developing world – flushes the toilet more than five times a day, using up to 50 litres of water for that purpose alone. By contrast, many people in the developing world have less than 10 litres of water a day to cook, wash and drink. The briefing goes on to state what is by now a well-established fact – the poor pay more for accessing water. Quoting from World Bank studies such as the one conducted by Ismail Serageldin13 it asserts that, " the very poorest…are often forced to pay the highest fees for water, primarily because of politicised inefficient bureaucracies." This aspect of the poor missing out on access to basic services and having to pay much higher rates than the rich to gain access has been much discussed as a failure of institutions and proof of the corrupt, inefficient Third World bureaucracies. This approach to studying lack of access as being symptomatic of poverty is closely linked to the next one that highlights the inequities in the system of distribution due to poor institutional arrangements and governance.

Lack of Access a 'redistribution failure'

As a response to the much-publicised falsity of the above 'trickle down effect of economic development', there has been a growing realisation of the need to ensure equitable redistribution. Thus, lack of access to a resource (in this case, water) is interpreted as there being enough water but not enough money or technology or human resources or political will to bring that water to the weaker sections of society (in this case the rural sector). Much international financing of water resources and water supply projects during the period 1950 to 1990, reflects this thinking[14.]

The aspect of redistribution is increasingly focusing on the study of institutions. Various studies of institutions focused on the question why villagers in certain developing countries engage in collective action and develop institutions to allocate and manage natural resources and whether such institutions can be created and sustained elsewhere[15]. Since water supply is a private good, others have focussed more on property rights issues than on the question of collective action [16]. Another strand of studies relating to institutions focused mainly on privatisation of infrastructure and dealt with questions such as whether the British, French or other models of privatised water utilities can be applied in the context of developing countries[17]. Though water supply is a private good, it is publicly provided in India, mainly because of two reasons: (1) Water supply infrastructure is capital intensive with natural monopolies; and (2) that the needs of the poor can be best protected by keeping water supply in the public sector. In recent years, both these arguments have been questioned. The need to evolve institutions to strike a balance between insulating infrastructure provisions from political control and capture on the one hand and the need to maintain accountability on the other has been widely recognised. Depending on how much faith one has in state and market institutions, the various generic arrangements for water supply have been shown in Figure 2. Experiments with the provision of water to different regions in India have been on for some time now. A particularly well known one is the World Bank initiated Swajal programme (see Box 1.)

[13] Ismail Serageldin, 1996, *Our Planet*, World Bank
[14] P.B. Anand, 2001*, Water Scarcity in Chennai, India – Institutions, Entitlements and Aspects of Inequality in Access*. Discussion Paper No. 2001/140. United Nations University, WIDER.
[15] Wade R. (1988), Village Republics, Cambridge University Press, Cambridge.
[16] P.B. Anand, 2001*, Water Scarcity in Chennai, India – Institutions, Entitlements and Aspects of Inequality in Access*. Discussion Paper No. 2001/140. United Nations University, WIDER
[17] Government of India. 1996. India Infrastructure Report, Report of the Committee of Commercialisation of Infrastructure, National Council of Applied Economic Research, Government of India, New Delhi.

Box 1. Experiments with rural water supply and sanitation - the state of Uttar Pradesh.

The existing water supply service delivery in the northern state of Uttar Pradesh is undertaken through a large state-level public sector organisation, the *Uttar Pradesh Jal Nigam*. Funded mainly by government grants, the Jal Nigam constructs and maintains water supply schemes in most parts of the state. Its approach has been widely described as top-down as it rarely takes consumer preferences into account. There is no capital cost recovery, and operation and maintenance costs are seldom collected. The poor sustainability of investments in the rural water supply sector encouraged the UP government to adopt two major policy reforms through the World Bank assisted Swajal project: (1) Partial cost recovery and full operation and maintenance cost recovery from user communities; and (2) The creation of an alternative service delivery mechanism for rural water supply and sanitation.

The new institutional model is specially designed to serve as a vehicle for the community based, demand responsive approach envisaged in the project. This consists of a close inter-relationship between three distinct social actors: village communities (represented by their water and sanitation committees), NGOs and the Project Management Unit, an autonomous State-level society.

Source: Water and Sanitation Program, South Asia Region, World Bank (2001). Field Note – Community Contracting in Rural Water and Sanitation: The Swajal Project, Uttar Pradesh, India.

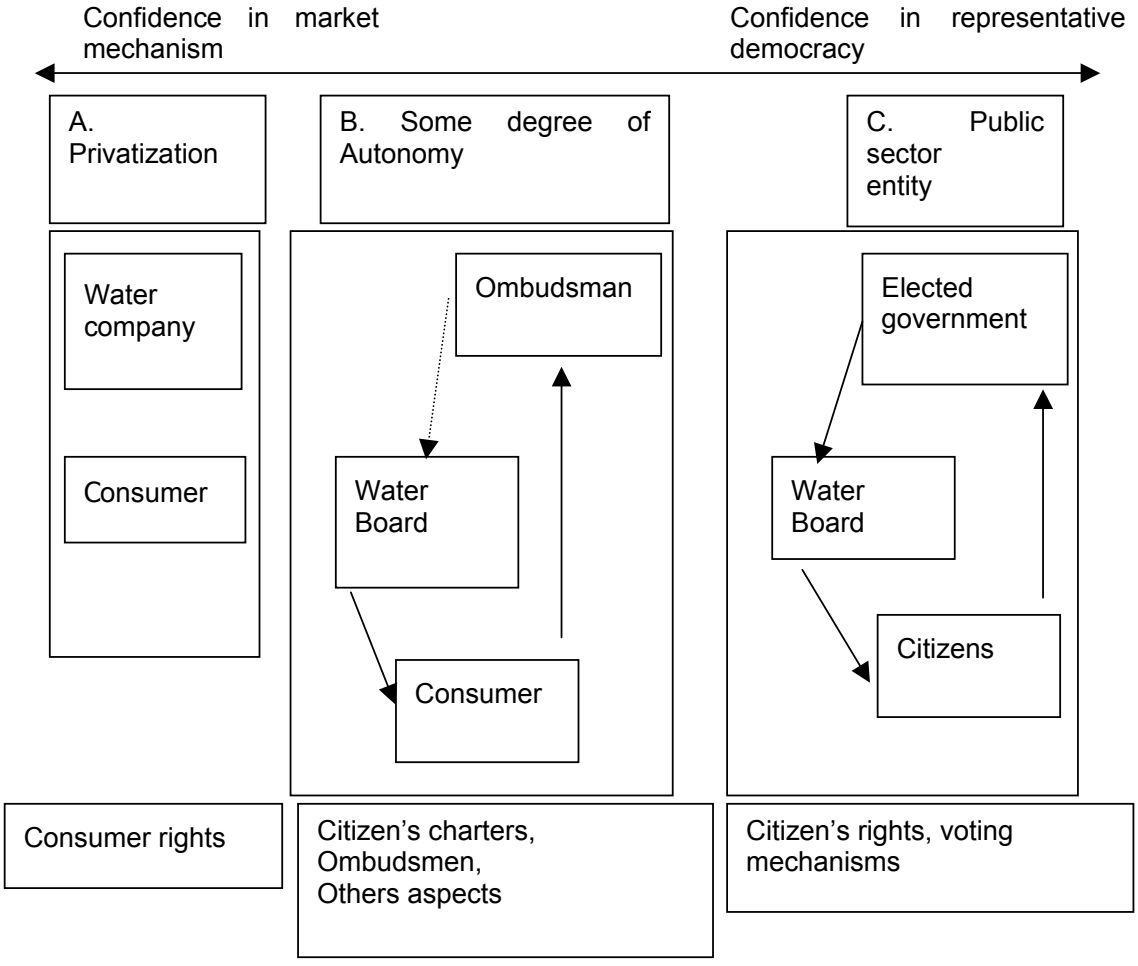


Figure 2. Alternative Approaches to Reforming Water and Sanitation Provision in India

Lack of Access a Capability Deprivation

A fourth approach is to consider access an important ingredient of quality of life and lack of access to the resource/service a capability deprivation. Attention to poverty is shifting from income-based measures of poverty to inequality and capability deprivation18. Sen's capability deprivation argument has its genesis in his entitlements concept19. Arguing with regard to famine and starvation, Sen
had said that they are matters of "…some people not having enough food to eat, and not a matter of there being not enough food to eat". For Sen the expression entitlement connotes "…the legal, political, economic and social characterisitcs of the society in question" and the individual/community's position on it. Entitlements approach helps us to see famine and starvation as an acquirement problem in relation to specific institutions and as "economic disasters, not just as food crises". Sen argues that a policy response such as rushing more food to famine stricken areas may not alleviate starvation, when the main cause of famine is one of entitlement failure20. A similar argument can be culled out for access to water21.

Thus, individuals have various endowments (either in the form of things they have acquired such as land, or a capacity that enables them to acquire, such as labour or knowledge and certain rights). These endowments combined with institutional arrangements determine the individuals entitlements, which in turn determine the various functioning's which can be achieved. "The totality of all the alternative functioning vectors a person can choose from…reflects the person's capabilities." These functioning's reflect well being because "…how well a person is must be a matter of what kind of life he or she is living, and what the person is succeeding in "doing" or "being". Sen's entitlements thesis has been much discussed and proves to be extremely helpful when studying access issues.

Present Water Policy Environment in India

'Access' the key to development. In 1992, Principle 10 of the Rio Declaration articulated public access to information, participation in decision-making, and access to justice as key principles of environmental governance. A decade later, one hundred governments reaffirmed these goals during the World Summit on Sustainable Development. Agenda 21 elaborated on these principles and acknowledged their essential role for sustainable development. The United Nations' Millennium Declaration emphasized the importance of "creat[ing] an environment - at the national and global levels alike - which is conducive to development and to the elimination of poverty." This year the World Bank's World Development Report (WDR 2004) addresses the challenges of making essential public services reach the poor. Mirroring the international realisation of the vital need provide access to a variety of resources and services – information, justice, basic to serivces - to the poor, it develops a framework for understanding the political economy of institutional failure, of anti-poor bias, in public services. In particular, it attempts to understand how accountability relationships are affected by uneven power relationships and elite interference in the relationships between public service clients and providers, citizens and policy-makers, and policy-makers and providers.

Sources: http://www.accessinitiative.org/ - World Development Report 2004

The National Water Policy (1987) of India provided a broad direction and set of guidelines that reflected the central governments' approach to the water sector. However, it had been argued from several quarters – in particular the World Bank - that this policy needed to be revised further in light of major national and international developments since then. The National Water Policy was revised in 2002. Some of the thrust areas of the National Water Policy are the emphasis on participation among users, improving water quality, emphasis on

18 Sen A.K. 1999. *Development as Freedom*, Oxford University Press, Oxford.
19 Sen A.K.1990. Food, economics and entitlements, in Dreze J. and Sen A. K. (eds). *The Political Economy of Hunger*, Clarendon Press, Oxford.
20 *Ibid.*
21 See, for instance, P Sainath's 'Everybody Loves a Good Drought', 1996, Penguin.

rehabilitation and resettlement in large-scale irrigation projects, the need for an integrated approach within the water sector, revamping institutional mechanisms and improving sustainability of water projects. While these areas of thrust are significant and noteworthy, given India's federal structure, the National Water Policy remains a mere statement of intent in the absence of state level programmes to translate these intentions into concrete action.

India had formally embarked on reforms in the water sector after 1999 with some guiding principles. The most important of these was to view water not only as a social good but as an economic good that has to be priced. This has resulted in the Central government's recent *Swajaldhara* initiative, which seeks to complement drinking water needs with sanitation, and mandates a decentralised approach with the government switching its role from that of a provider to a facilitator of water market. Under this system, the Panchayati Raj institutions will bear all operation and maintenance costs; they will bear 10 per cent of the total capital cost by collecting funds from the people. The rest of the money for the project, which follows the market-centric World Bank model, comes from international donors. It has been argues that this policy move effectively rules out the poor, particularly women, from having any say, leave alone control, over water[22].

In the past, many such schemes for drinking water did not succeed because they failed to build an institutional mechanism at the level of the users to ensure service delivery. To that extent, the emphasis in such schemes on involving users is well placed. In the last ten years there has been increasing policy level acceptance that natural resources such as water shall be best managed through the active participation of the users, viz. the local community. The emphasis on community has been seen as a superior alternative to nationalization and privatization of natural resources[23]. It is seen as a way of reducing the role of the state, sharing management responsibilities and generating resources. This reasoning comes with a long pedigree, dating at least from The Ecologists (The Ecologist, 1972) "Blueprint for Survival," Schumachaer's "Small is Beautiful" (1972) and, more recently, the Brundtland Commission (WCED 1987). Statements of intent on global environmental problems issued following the 1992 Earth Summit, including Agenda 21 and the Desertification Convention, strongly advocate as solutions a combination of government decentralisation, devolution to local communities of responsibility for natural resources held as commons and community participation. Such approaches – evident in the policies and programs of national governments, donor agencies[24] and non governmental organisations- argue for an appropriate sharing of responsibilities for natural resource management between national and local governments, civic organisations, and local communities[25]. In the case of rural India it still remains to be seen how well local level governance responds to the challenges that ambitious schemes such as the *Swajaldhara* programme imposes and how well local level mechanisms are able to represent the collective interests of the users at large, without being hijacked by the dominant few.

[22] Sara Ahmad. *Mainstreaming Gender Equity in Water Management in India: Policies, Institutions and Practice*. Procedings to conference on right to water at the M.S. Swaminathan Research Foundation, Chennai

[23] Bardhan, P.1993. Symposium on management of local commons. *Journal of Economic Perspectives* 7 (4): 87-92

[24] See Box 1 on community-based approach to water and sanitation scheme for the state of UP,initiated by the World Bank.

[25] Baland, J., Platteau J. P. 1996. *Halting degradation of natural resources: Is there a role for rural communities?*, Clarendon Press for FAO, Oxford.

Water and Related Energy Politics in the Syrdarya Basin: Current Challenges and Future Prospects

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Introduction

Water in Central Asia is a scarce and shared resource. Since countries of the region became sovereign nations in 1991, its management and development has been subject to the rules of interstate agreements. Conditioned by some of the newly emerged national priorities with respect to water utilization, transboundary water management in Central Asia had to reflect a changing pattern in management, development and allocation of shared water resources among the riparian countries. This paper outlines peculiarities of recent developments in the Syrdarya River Basin of Central Asia and analyzes on-going interstate controversies over water and related energy resources sharing and management in the basin.

The main transboundary issue in the Syrdarya basin involves a seasonal operation of the Toktogul Reservoir located on the upper tributary of the Syrdarya in Kyrgyzstan. Demands of the downstream countries, Kazakhstan and Uzbekistan, for the waters of the Syrdarya River dictate the operation of the reservoir to be in "irrigation mode",2 whereas the economic interests of the upstream countries, Kyrgyzstan and partly Tajikistan, drive these countries to regulate the Syrdarya River flow, most of all, to meet their demands for energy. To balance the conflicting interests of both upstream and downstream states for the Syrdarya waters, since 1994 the countries in the basin have entered into an ad-hoc annual water and related energy exchange agreements, which subsequently led to the signing of the Syrdarya Framework Agreement in 1998. The practice with an implementation of the 1998 Syrdarya Agreement has revealed that the provisions lack a compliance mechanism in the context of infrastructure and economic problems that have weakened the capacities of the Parties to fulfill their treaty obligations. As a result, there is still a shortage of fuel for winter electricity generation in upstream countries and the downstream countries still report serious irrigation water shortages, and water losses into natural depressions remain high. Nevertheless, the agreement can not be regarded as a complete failure but as an obvious evidence of evolution of transboundary water sharing practice towards the integrated basin-wide management of water and related energy resources.

Water and Energy Inter-relationship in the Aral Sea Basin

Prospects for sustainable economic growth and social progress in each of the Central Asian countries, and in the region as whole, to a great extent are predetermined by the availability of water resources. As it is elsewhere, they are unequally distributed in time and space, and Central Asia is not an exception. Kyrgyzstan and Tajikistan (hereinafter – upstream countries) are rich in water but do not possess fuel resources. In contrast, in Kazakhstan, Turkmenistan and Uzbekistan (hereinafter – downstream countries) this correlation turns out in a reverse order: they are the largest regional exporters of hydrocarbon resources but poor in water. Hydropower, for instance, accounts for about 80% of the total energy production in the upstream countries. Nevertheless, this is not enough and in order to meet their energy demands, upstream countries have to import fuel resources from downstream countries.

1 Scientific Information Centre of the Interstate Commission for Water Coordination of Central Asia (SIC ICWC)

2 Irrigation mode is defined as the regulation of water facilities to accumulate water in the storage reservoirs during winter and spring and to meet the demands of irrigated agriculture with large releases made from the Toktogul Reservoir during summer periods. In contrast to "irrigation mode", operation of Toktogul Reservoir in "energy mode" means that the water releases from the reservoirs are dictated by the energy demands of the upstream countries for hydropower generation.

Availability of water and hydropower resources and lack of other fuel resources generate a need for the upstream countries to develop their hydropower potentials. However, meeting the demands of the upstream countries in energy through increase in the rate of hydropower production de-emphasizes existing uses in the downstream countries that are dependant on transboundary water resources. Therefore, any future plan with respect to development of water and energy resources must take into account economic variances in each of the countries, which in turn, requires a necessity to develop a clear mechanism for economic integration in the sphere. If this integration process will lack cooperation among Central Asian countries, it may lead to negative social, economic and environmental consequences.

The region has closely interconnected water and energy infrastructure. This consists of cascades of dams, hydropower stations and storage reservoirs. Rules of water allocation between Central Asian countries were established based on the seasonal exchanges of water resources, electric energy and fuel resources. Under a single jurisdiction, this arrangement has proved itself sufficiently effective mechanism, and it is still the case for the region as a whole, but changes of geopolitical and economic nature that have taken place since 1991 require newer approaches of cooperation in utilization of water and energy resources of the region. Gradual disintegration of sustainable linkages that were in place during the pre-independence water-energy scheme for the region, economic and financial difficulties, deteriorations of technical conditions of water management and energy infrastructure, unevenness of economic reforms in each of the region's countries, resource-absorptive style of management have brought a number of challenges for the joint utilization of water and energy resources and worsened the technical capacities of the water management and fuel energy infrastructure. The situation is further exacerbated by reductions of effective system of observations and control over the transboundary water facilities, water diversions and distributions, forecasting and monitoring. It is obvious that current efforts towards restoration of former monitoring system are not enough. Moreover, protection of transboundary water pollution and deltaic ecosystem are not yet adequately represented in regional arrangements and the Aral Sea itself has broken into several distinct water bodies. These very backgrounds undermine the execution of regional initiatives provided by the interstate agreements on the use of water and energy resources, and hence, weaken economic, energy and environmental security in the region.

During the former-USSR times, the annual demands of the Syrdarya riparians for water were satisfied through operation of the Naryn-Syrdarya cascade of reservoirs mostly dictated by the irrigation demands of the downstream countries. During the first half of the 1990s, a gradual increase of hydropower generation by upstream countries have brought conflicts with the existing uses located downstream. Starting since 1993, the operation of the Kyrgyzstan's Toktogul cascade has been transformed into energy mode with accumulation of water during summer periods and large winter releases. Since 1994, the Syrdarya flow regulation has become a major subject of interstate negotiations between Kazakhstan and Uzbekistan, on the one side, and Kyrgyzstan on the other. In order to meet the demands of Kyrgyzstan in increased supply of thermal-power resources and to satisfy the demands of Kazakhstan and Uzbekistan for irrigation water during summer, it was decided to define the riparian states rights and obligations with respect to fuel and energy exchange. This has led to signing of the Syrdarya Framework Agreement on the use of water and energy resources in 1998. The Agreement was designed to meet different riparian interests through integration of respective state claims to the waters of the Syrdarya River and balancing the competing uses of water through inter-state trade-offs between the competing uses of water for energy and agricultural production in the basin. It has created the principles of compensation of fuel for water between downstream and upstream countries whereby the downstream countries, Kazakhstan and Uzbekistan, agreed to purchase in equal portions the excess power (beyond the needs of the Kyrgyzstan's demand in electricity) generated by the Toktogul hydropower plant during the summer, and provide compensation to Kyrgyzstan in the form of equivalent volumes of electricity and fuel (coal, natural gas) during the winter seasons.

Although the agreement has brought some stability in the transboundary water relations in the basin, it could not completely eliminate some of the pressing concerns. It became clear that the interests of the downstream countries in irrigation water supply can be met only when all Parties to the agreement strictly follow their obligations towards the fulfillment of the provisions of the agreement concerning the supplies of fuel, electricity and purchase of excess powers. It appeared that even the slightest violation of the provisions of the agreement could increase insecurity in water supply and undermine the shared execution of the agreement. During the implementation phase of the agreement it has been revealed that the conflicts between irrigation and energy interests of the Parties generate complications while executing the agreed provisions of the agreement concerning the water allocation and therefore require further development.

Establishing fixed operating rules for the Toktogul Reservoir and the use of the decision support system for managing the Syrdarya flow will simplify and stabilize river management, reduce annual winter releases from the Toktogul dam in Kyrgyzstan, make more water available for the ecosystems needs, and provide greater energy security to Kyrgyzstan and water security to Uzbekistan and Kazakhstan. One of the alternative solutions towards resolution of the issue is seen in creation of the Water and Energy Consortium in the Syrdarya Basin.

New Approaches: Creation of the Syrdarya Water and Energy Consortium

An idea to create the Water-Energy Consortium (hereinafter, the Consortium) in the Syrdarya River Basin has been under consideration among the riparian community for the past several years. The subject has also being attended in intergovernmental level; however, a common point of view about what is meant by the Consortium has not been reached. The Kyrgyz side would like the Consortium to act as an institution, which would attract, first of all, funds from concerned countries and development banks for completion of the constructions of the Naryn Cascade Hydropower Stations, and criticizes its opponents (Uzbekistan and Kazakhstan) for their tendencies to attaché the Consortium functions of transboundary water resources management. In reality, no party proposes to duplicate existing institutional structure of management but intends only to strengthen interactions among them, using newer and more effective mechanisms for cooperation.

The ICWC agencies[3] promoted the creation of the Consortium with a purpose to create a financial mechanism, which would ensure established order of water-energy exchanges between countries. In this context, the Consortium can be regarded as a mechanism to prevent potential water and related energy disputes. Securing the coordinated policies in the field would be one of the main tasks of the Consortium. The Consortium would be involved in developing and promoting efficient methods of joint actions and propose to where the resources must be allocated that would generate maximum profits. Potential participants of the Consortium should represent a union of participants of the water-energy exchanges of the four Central Asian countries – Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan, members of which are entitled to have an access to the financial sources assigned for rendering assistance in supplying of fuel and energy resources. Participants of the Consortium can be: governmental management structures (guarantors), commercial banks, enterprises, manufacturers and energy consumers, consumers of irrigation water, and manufacturers, suppliers and consumers of fuels.

[3] The ICWC (Interstate Commission for Water Coordination) was established by an agreement between the five states of the Aral Sea Basin. It has a jurisdictional competence over the management and development of transboundary waters of the Aral Sea Basin. The ICWC operates through a Ministerial-level Commission, Secretariat, Scientific Information Centre and the two River Basin Organizations. The ICWC has an overall responsibility to act as a basin-wide water policy-maker and to develop a long-term water supply program for the region.

The Consortium should become an organization for cooperation establishing well-ordered system of payments and cash deposits among the countries and securing sustainable functioning of the water-fuel-energy facilities (timely execution of the interstate agreements, the ICWC Resolutions on the reservoir operational modes), as well as introduction of newer opportunities: searching and setting the optimal monopoly price, which would secure the interests of the parties and efficiency of inter-supplies, banking services, insurances (from damages of natural character), introduction of penalty provisions (for damages caused by irregular actions of the operational services of the water facilities and organizations that provide compensational supplies). At that, it is necessary that guarantors would have determined limits of annual cross-flows and supplies and take responsibility on forming a minimum starting capital and ensuring necessary subsidies. A wok of the Consortium on providing of the sustainable functioning of water-energy system comes to the following actions: (1) situation analysis (water management, economic, commercial); (2) development of actions and their coordination with all countries and the ICWC bodies (on disputed issues); organizational and financial operations. A subdivisions of the Consortium may carry out a comparative assessment of predictable and actual hydrologic situation and modes of reservoir releases (applying existing at their disposal instruments – economic-mathematic methods and modeling), develop and adjust schemes of main flows of fuel transportation (on alternative options), carry out assessment of agreement executions at conditions of natural and human-made deficits – in case of disregard of adopted resolutions, perform economic estimations on damages and their compensations from insurance fund.

Strengthening the Legal Base

Cooperation of the Central Asian countries in the field of rational and effective utilization of water and related energy resources should be based on certain principles which must be derived from the acknowledgements of legitimate rights of both downstream and upstream countries to use of their own shares of water and energy resources. Their legitimate shares need to be in line with national interests, but equally important, they need to take into account the interests of neighboring countries and sustainability of the ecosystems. It is also important to acknowledge priority of legal provisions in the interstate agreements over national laws and regulations and there must be closer harmonization of legal bases in the field of water and energy use and protection. One of the important pillars on which the foundation of interstate should be built among the countries is the principle of not to cause significant harm in utilization of water and energy resources. Information exchange and timely notification of planned measures that could impact on the interests of other countries need to be established to avoid major economic and environmental costs. Joint management of water and energy resources in the region must be based on sound principles of river basin management. Only close cooperation and trust and adherence to the principles of basin management would enable to develop coordinated actions for agreed regimes of the water and energy infrastructure in the basin. This in turn would allow considering collective cost sharing and investments for the construction and operation and maintenance of interstate water and energy facilities and access to the markets of third countries. In order to ensure the realization of these measures and to guarantee sustainable operation of water and energy infrastructure, it is important to develop dispute settlement mechanisms. These may include obligations to notify on planned measures, consultations and negotiations between authorized state representatives, establishment of ad-hoc joint commissions or arbitration.

Implications of Hydropower Markets for Regional Water Management

One of the recent developments in water and energy sphere in the region has been an appearance of a new player – the Russian energy giant the RAO UESR (Joint Stock Company – Unified Energy System of Russia). The RAO UESR and the Government of Kyrgyzstan have concluded an agreement to supply hydroelectricity from Kyrgyzstan's Toktogul Hydropower Station (HPS), located on the upper reaches of the Syrdarya Basin, to

the Russian Siberia.[4] In other words this implies that there will be greater variations in the regime of the hydropower stations which generally tend to boost electricity generation for the interests of out-of-basin consumers, which, hence, are not really concerned with the issues of water resources management and environmental situation in the region. These arrangements also extend to the reconstruction and completion of additional HPSs in Kyrgyzstan and also in Tajikistan. Whatever the plans, the Russian RAO UESR will become one of the key decision-making bodies in electricity transmission operations in the future, and this may be dictated by the growing energy demands in Siberia, and in the near future, similar markets in other neighboring countries, where the price of energy is much higher, may become attractive for water rich upstream countries.

Growing extra-regional markets for the Central Asian hydropower may intensify upstream versus downstream relationships. For these reasons, adherence to the agreed interstate water allocation rules and seasonal and long-term regulations of transboundary water flows appear to be the key tasks of regional cooperation. However, decisions at the regional level need to be made following recent changes and newer priorities. It could be useful to introduce liability rules for compensation of incurred damages caused by the failure or violation of interstate obligations.

Sustainable future would be largely dependent on to what extent each riparian state in the basin is willing to respect and fulfill its rights and obligations in the use and protection of water and related energy resources. Irrespective of the fact that whether a state considers water resources in its territory as its own property and extents its full national jurisdiction or not, it cannot benefit from ambitiously formulated controversial plans on its own. In addition, international practice in utilization of shared water resources dictate that neither of the basin states possess the right to take unilateral actions on a watercourse that will cause or substantially interfere with existing downstream uses, at least without any notice and consent of the states whose interests are at stake. In this respect, it also should be stated that the maximum benefit from utilization of shared water resources can be possible only if decisions are taken with full participation of all concerned parties.

Outcomes of regional and international high-level meetings put emphasis on closer economic, social and political integration in Central Asia. This would in turn enable to increased benefit gaining from participation in the processes of global economy and protect their small and vulnerable markets from extra-regional market powers. Collective decision-making in joint utilization of water and energy resources is the basic prerequisite for further economic integration in other sectors. Without careful consideration and resolution of problems facing water sector in the basin countries it is not possible to progress in regionalization.

Penetration of extra-regional parties into the power market of the Central Asian states have a tendency to detach further energy sector from the water sector. The evidence suggests that only a combination of water and energy will be profitable for both upstream and downstream states. A more complex scheme incorporating interests of each state is needed for the regional benefit. Hydropower sector cannot be separated from the water and other sectors. Utilization and management of water and related energy resources are only a part of the larger framework of interdependent region and therefore should be viewed in an integrated manner.

[4] *See* RAO-UESR Press Release from 18.09.03, available at http://www.rao-ees.ru/ru/news/pr/pr180903post.htm. The agreement was signed between the Subsidiary of the RAO-UESR, the Inter RAO UES, and the Kyrgyz Joint-Stock Company "Energy Stations of Kyrgyzstan". This source also adds that realization of the project became possible owing to integration and parallel operation of energy systems of Russia with other CIS countries and Baltic States. It further exerts that the import of cheap electric energy from the Toktogul HPS to Russia will further promote improvement of the balancing cost of the Federal wholesale market of electric energy and its capacity.

If cooperation will fail to address these issues, it is possible to predict an appearance of various speculations in the water agenda of the Aral Sea basin politics. One of such promising factors is the interests in reviving an old plan of transfer a part of Siberian river water to the basin. A rationale behind the plan for the recipient downstream countries is seen to access to additional water resources, and for the Russian government it could mean a new lever of influence in the region. However, it is still questionable, taking into account the enormous investment costs and possible environmental impacts.

Water in the Aral Sea Basin has become a limiting factor for further economic growth and social progress. At the national level, the significance of water's role in the economy is readily illustrated by the comparison of the gross figures for the proportions of water used in various sectors of an economy and the relevant GDP figures. In the Aral Sea Basin, agricultural sector consumes 85% of water and generates close to 30% of the GDP.[5] Moreover, it creates jobs for overwhelming majority of the working population whose very livelihoods and their quality depend on incomes generated in the sector. When such vital concerns are at stake, Central Asian leadership should recognize the limitations to the extra-regional forces in the dynamics of water politics and must give consideration to them in their strategic planning and decision-making.

Conclusion

The Aral Sea Basin shared water resources are becoming increasingly vulnerable to the interests of the external economic forces. In the context of Aral Sea Basin water politics, these include individually followed trends towards creation of export-oriented hydropower markets and re-emerged plans for Siberian River flow transfer to the basin. Nonetheless, these factors will continue to contribute shaping the future of water politics in the basin. But it is crucial to achieve and ensure that any decisions regarding major water management investments affecting overall water management regime must be made with the full participation of all riparian countries; otherwise this will undermine trust and the foundation of regional cooperation in the sphere. Central Asian leadership should recognize the limitations to the extra-regional forces in the dynamics of water politics and must give consideration to them in their strategic planning and decision-making.

[5] The World Bank Group Data: Countries at a Glance, available at http://www.worlbankgroupd.org. Respective figures by country are as follows: Kazakhstan – 8.5%, Kyrgyzstan – 38.6%, Tajikistan – 30%, Turkmenistan – 28.8%, and Uzbekistan – 34.6%.