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Poverty reduction approach in South Asia: Rejuvenating centuries old water bodies to improve rural livelihoods

A case of Karnataka state, India

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Abstract

South Asian countries are endowed with large numbers of village tanks, which serve as huge reservoirs. The inherent network of natural water streams and canals in the command areas connect these tanks to supply water to agricultural fields. People in the rural areas use these tanks to harvest and store monsoon rainwater for multiple uses which include agriculture, livestock, fishing, domestic use and recharge of domestic drinking wells. Most of these tanks were built between the 3rd century B.C.E. and the 12th century C.E. Later, improved designs were used to construct these tanks. Over the last few decades, several Indian states have made enormous efforts to rejuvenate these tanks by involving local user groups. This paper, reviews the traditional water bodies in South Asia, describes tanks and their dimensions in the Indian context and analyzes the community based approach adopted in the State of Karnataka in South India. It reviews the status, main components of design, execution, key achievements, impacts, benefits and critical lessons learnt.

Poverty reduction approach in South Asia: Rejuvenating centuries old water bodies to improve rural livelihoods

A case of Karnataka state, India

KV Raju, Anju Gaur and SP Wani

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About the Authors

KV Raju	Principal Scientist and Assistant Director, ICRISAT Development Center, International Crops Research Institute for the Semi-Arid Tropics, Patancheru-502324. Telangana, India. Email: kv.raju@cgiar.org.
Anju Gaur	Senior Hydrogeologist, The World Bank, New Delhi, India. Email: agaur@worldbank.org
SP Wani	Director, ICRISAT Development Center, International Crops Research Institute for the Semi-Arid Tropics, Patancheru-502324, Telangana, India. Email: s.wani@cgiar.org

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List of Abbreviations

AF	Additional Finance
ANGOs	Anchor Non-Government Organizations
B/C	Benefit Cost
CFT	Cluster Facilitation Team
CFU	Colony Forming Unit
CWII	Convention on Wetlands of International Importance
DFT	District Facilitation Team
DHAN	Development of Humane Action (DHAN) Foundation
DPU	District Project Unit
ERR	Economic Rate of Return
FERAL	Foundation for Ecological Research, Advocacy and Learning
FMIS	Farmer Management Irrigation System
GDP	Gross Domestic Product
GOI	Government of India
GOK	Government of Karnataka
GPSC	Gram Panchayat Sub Committee
IAS	Impact Assessment Study
IBRD	International Bank for Reconstruction and Development
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICRR	Implementation Completion Result Report
IDA	International Development Association
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
ITDP	Integrated Tank Development Plan
IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
JSYS	Jala Samvardhana Yojana Sangha
KCBTMP	Karnataka Community-Based Tank Management Project
M&E	Monitoring and Evaluation
M&L	Monitoring and Learning
MARI	Modern Architect of Rural India (NGO)
MEA	Millennium Ecosystem Assessment
MID	Minor Irrigation Department
MIS	Management Information System
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NGOs	Non-Government Organizations
NPV	Net Present Value
O&M	Operation and Management
PDO	Project Development Objectives
PRA	Participatory Rural Appraisals

PRED	Panchayat Raj Engineering Department
PRI	Panchayati Raj Institutes
QAG	Quality Assurance Group
RAPs	Resettlement Action Plans
RRR	Repair Restoration Rehabilitation
SC	Scheduled Caste
SEA	Social and Environment Assessment
SHG	Self Help Group
SPU	State Project Unit
ST	Scheduled Tribe
TMC	Thousand Million Cubic
TMI	Tank Management Institutions
TUAs	Tank Users Associations
TUC	Tank User Committee
TUG	Tank User Group
UAS	Universities of Agricultural Sciences
WSA	Water Surface Area
WUAs	Water Users Associations

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Background

In South Asia, most traditional water storage structures are several centuries old, and are known as tanks. Most South Indian tanks are said to have been formed between the 7th and 14th century C.E. and some, it is claimed have been formed even earlier. The systematic documentation of their existence and the use of standard manuals to develop them further, commenced in the early years of the nineteenth century. By the end of that century an elaborate system of documentation existed with a trained technical bureaucracy as well as a set of officers and engineers to deal with tanks (Samuel Best Captain 1852; William Grant 1857). The ecosystem uses of tanks such as facilitating the planting of village forestry, inland fishery, and climate control (lowering ambient temperatures, increasing rainfall, etc) were well understood during this period (John Augustus Voelker 1893).

A tank is normally formed by building an earthen bund across sloping ground and it mainly consists of two parts: the upstream part stores runoff rainwater and the downstream part creates an area for irrigable cultivation. Tanks are found all over South Asia and are extensively used in southern, central and eastern India for irrigation and domestic needs. Technical designs of tanks vary from place to place. The structure of tanks include bunds to dam the water; sluices to release and regulate water flow to fields; weirs to regulate and safely dispose flood and surplus waters; and supply inlet channels to feed water from catchments, streams or rivers into the tanks (Ellis 1963; Shanmugham and Kanagavalli 2005). Water from tanks is normally used to cultivate rice, sugarcane and other crops. Tanks are major rechargers of groundwater in the downstream areas. Groundwater recharge can extend up to two km downstream of the tank, depending on the nature of the local terrain (Raju and Shah 2000).

The South Indian states are considered to be tank intensive[1]. Many tanks are connected to water ponds through dedicated channels through which the ponds fill up. Ponds are meant for drinking, domestic and cultural uses for humans and are also used for animal watering and washing[2].

Tanks are considered as wetland ecosystems that provide an array of ecosystem services as described below.

Tank wetlands and ecosystem services

An ecosystem generally comprises living species as well as their non-living environment. The Convention on Wetlands of International Importance (CWII) or RAMSAR[3] defines wetlands thus: “Wetlands are areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters”. The convention recognizes the importance of all types of wetland ecosystems and wants the governments of the world to actively protect them for the future of humankind. India being a signatory to the convention categorized its wetlands into eight[4] classes[5]. The Class 1-Tanks in South India are peculiar for many reasons. They are

1. Tamil Nadu state has an average of one tank for every 3.33 sq. km. While most tanks hold enough water to cultivate one or more seasonal crops for five to nine months in a year, some tanks hold water throughout the year. The smallest of tanks found in Tamil Nadu irrigates less than 1 ha and the largest of all, the Veeranam tank irrigates over 20,000 ha. The area extent of tank beds where water stagnates may constitute at least half the size of the command area and in some cases equals the irrigated area served by them.
2. A conservative estimate based on counting of ponds from selected southern river basins like Gundar in Tamil Nadu reveal there may be up to five ponds for every tank (DHAN Foundation, 2003). Sizes of ponds vary from less than 1 ha to 5 ha with some even having masonry walls surrounding them.
3. http://www.ramsar.org/cda/en/ramsar-activities-cepa-classification-system/main/ramsar/1-63-69%5E21235_4000_0__ accessed on 20 June 2012
4. Eight fold classification of Indian wetlands include the i) tanks and reservoirs of the Deccan plateau together with the lagoons; ii) the vast saline expanses of Rajasthan, Gujarat and the Gulf of Kutch; iii) the freshwater lakes and reservoirs from Gujarat eastwards through Rajasthan and Madhya Pradesh; iv) the deltaic wetlands and lagoons of India’s east coast; v) the marshes, jheels, terai swamps and chaur lands of the Gangetic Plain; vi) the flood plain of the Brahmaputra and the marshes and swamps in the hills of Northeast India and the Himalayan foothills; vii) the lakes and rivers of the montane (primarily Palearctic) region of Kashmir and Ladakh; viii) the wetlands (primarily mangrove associations) of India’s island arcs.
5. http://ramsar.wetlands.org/Portals/15/India.pdf page 2 accessed on 20 June 2012.

artificial, small or large, standalone or inter-connected, simple and complex water systems entwined with social organizations.

A tank as a wetland comprises water bodies, tank bunds, field channels, supply channels, wells, wetlands, tank-fed dry lands, soils, plants, animals, birds, aquatic plants, fishes, etc. Not only humans but a range of flora and fauna depend and thrive on tanks. On the lines of the Millennium Ecosystem Assessment (MEA), tanks offer the following ecosystem services:

- Provisioning services: food, freshwater, fiber, fuel and medicinal plants
- Regulating services: climate regulation, water regulation (groundwater recharge/discharge), water purification (retention and removal of excess pollutants, diluting toxic elements), erosion regulation, natural hazard regulation (flood control, drought mitigation) and pollination (habitat for pollinators)
- Cultural services: spiritual and inspirational, recreational, aesthetic and educational
- Supporting services: soil formation (sediment retention and accumulation of organic matter) and nutrient cycling

Traditional water bodies and irrigation systems in South Asia

Sri Lanka: The irrigation systems of ancient Sri Lanka are endowed with a large number of village tanks, huge reservoirs and an inherent network of water canals connecting these tanks to supply water to agricultural fields. People in the rural areas use these to harvest and store monsoon rainwater for multiple purposes which include agriculture, livestock, fishing, domestic use and recharge of domestic drinking wells. Most of the tanks were built between the 3rd century B.C.E and the 12th century C.E. The majority of the tanks are located in the dryland zone area of the country which covers an area of about 40,000 sq km. Their occurrence is almost equivalent to one reservoir per sq km. The earliest tank constructed was Abaya Wewa in the 3rd century B.C.E. and since then tanks were built with remarkable skill and expertise. Ancient kings took pride in the construction of tanks as they brought welfare and prosperity for the people. There are 12,000 small tanks and anicuts irrigating 1,85,000 ha amounting to 35% of the total irrigable area of the country with 20% of the national rice production (IUCN 2005). Besides the efficiency in the physical structures, the culture that prevailed in these communities provided the necessary condition for their sustenance which focused on sharing resources and ownership equally.

Nepal: Agriculture is the main source of subsistence. It contributes about 32% of the Gross Domestic Product (GDP) and provides employment for more than two thirds of the population. Nepal is famous for its farmer managed irrigation systems. There are about 16,000 Farmers' Management Irrigation Systems that irrigate approximately 14,000 ha of cultivated area or 67% of the total irrigable area of the country. Historically, the Government of Nepal perceived and irrigation development as the domain of local concerns. Hence, disparate locations of the country organized themselves to construct, govern, operate and maintain a large number of irrigation systems (Drubha Pant 2010; Achyut Man Singh 2010).

Bangladesh: The use of tanks for irrigation indicates the potential of tanks in water management programs. In 1944-45, the Feni sub-division had 13,400 acres of tank irrigated area. Tank production efforts are facing constraints due to competing water uses such as the shared use of tanks between production and as household water, divided and disputed ownership of tanks and problems related to fish marketing. There is also evidence that past schemes for increasing tank fish production have failed principally due to the complex ownership patterns of tanks. Tank ownership is fragmented and it is difficult for the many owners of a tank to arrive at an agreement regarding how it should be used. The government has taken possession of some fisheries (not in tanks) formerly controlled by Zamindars (land lords). These private parties have over exploited the fisheries with no thought given to long term yields. Consequently upon expiry of these leases the union councils have taken back the

fisheries. However, many tanks under joint ownership fall outside the scope of these government programs (Mandal MAS 2001; Mustafa Mujeri and Intizar Hussain 2001).

China: China possesses approximately 2,800 lakes. Lakes account for more than 80,000 sq km. It has 25 of the world's great lakes with a total area exceeding 30,000 sq km. China's freshwater lakes, including the Tai Hu, Chao Hu, and Dian Chi, are home to numerous species of aquatic plants and animals and are not only an important source of water, but are also a critical food resource. China used to be home to 4,077 lakes, half of which have disappeared over the past several decades due to increased demand, consumption, global warming, and conversion of lakes to rice paddy fields (Chang William 2014; Wu Wanfu Yang and Jin Le 1991).

Thailand: In the Isan plateau areas of northeast Thailand, during the past two decades, there have been initiatives to construct ponds on farms. This is part of the 'New Theory' of agriculture promoted by King Bhumiphol, to mitigate drought at the farm level and promote the diversification of crops. Ponds were used to water vegetable gardens and orchards, to support livestock and to rear fish. Ponds were also used to provide supplementary irrigation for rice. Farm ponds are closely linked to local water tables. Depending on their position in the landscape, farm ponds can act as both recharge and discharge zones for groundwater. Wangkahart et al. (2005) found that lateral seepage into ponds from groundwater was important for maintaining water levels during the dry season; conversely, farm ponds can also provide seepage to increase groundwater recharge. Groundwater and farm ponds can provide complementary water sources at different times of the growing season. Farm ponds offer an effective way to store water from the rainy season for multiple uses during dry spells. Farm ponds could also provide a cost-effective solution for optimizing performance on small farms in other parts of the globe that have a tropical savannah climate. However, it is important to fully assess before implementation, the cumulative impacts of many small dams on downstream flows (Wangkahart T, Toomsan B, Patha P and Wani SP 2005; Penning de Vries Frits and Ruaysoongnern Sawaeng 2010).

Cambodia: The total irrigated area in Cambodia is nearly 473,000 ha (in 1997); it is 16% of the total cultivated area (2.7 million ha). The potential cultivable area is estimated to be 3.7 million ha. There are about 950 irrigation schemes in the country, most of which were developed by the government. An inventory conducted in 1997 found that only about 20% of them are 'fully operational' and 14% were not functional at all. There is a huge potential for improvement of the infrastructure and management of existing irrigation schemes and, unlike other countries in Southeast Asia, there is great potential to expand the irrigated area (Royal Government of Cambodia 2007).

During the late 1990s and early 2000s, small tanks with adjacent bunded areas for dry-season rice were constructed on the Tonle Sap Floodplain in several different communes within Kampong Thom and Siem Reap provinces. Between 100 and 150 ha in size, the reservoirs were designed to store wet-season floodwaters for irrigation in the dry season (Royal Government of Cambodia 2007; Raju 2008). On a technical level the tanks operated reasonably well, filling the demand for dry-season irrigation to increase crop yields. However, social and environmental outcomes were poor because the reservoirs restricted the formerly common-pool resources of land, water and fish, to a small group of wealthier farmers. This angered those who could no longer use the resources and caused conflict within local communities. The cumulative environmental impacts of multiple small-scale developments had serious consequences for floodplain biodiversity and productivity.

The Indian context

Hydro-geology

The rainfall pattern in India in highly variable spatially, as well as temporally. Eighty percent of the rainfall occurs between July and September. Northern India is comparatively rich in both surface and groundwater owing to its surface and geological characteristics. In the north, the rivers are perennial

owing to snowmelt and base flow (exchange with groundwater) and the terrain has substantial potential for groundwater in basalt aquifers with a porosity of almost 40%. The rivers with their perennial flows serve water needs throughout the year through a network of canals and shallow wells. In the south, the rivers are seasonal, and the potential for groundwater storage is limited due to hard rocks that do not possess primary porosity (<2%). The hard rock terrain allows accumulation and circulation of groundwater only in shallow weathered zones and in fractured horizons in the deeper portions. Considering the hydro-geological characteristics in the south, surface water harvesting and storage structures such as tanks have served as the best water storage structures to serve the multiple water needs of villages during non-monsoon periods. These irrigation tanks are situated in sequential chains (cascades) with the slope mildly dipping towards the southern coastal plains. As a result, the rainfall runoff flowing from a sub basin and/or watershed is effectively impounded and harnessed for multiple uses, predominantly irrigation. Although a majority of the tanks were designed to capture excess runoff from the catchment, in Tamil Nadu, the tank structures were further linked with a network of irrigation systems and were referred to as system tanks. These system tanks are connected through irrigation channels and the water is diverted from rivers by raising the water level in rivers through weirs (Shanmugam and Kangavalli 2005).

For instance, the Vaigai basin in Tamil Nadu, a semi-arid area spread over 7,200 sq km, receives less than 50 days of rainfall of which only 20 days result in any surface flows. The basin has around 3,000 tanks, almost one or sometimes more in every habitation. Most tanks in the basin are interconnected and capable of draining every drop from this river before it reaches the sea. For example, 374 tanks found in the lower Vaigai basin (an area of 2,000 sq km) have a combined storage capacity of 12,000 million cubic feet (CWR 2003). Basins like this one in Madurai are not a rarity in South India. Similar descriptions of tanks do exist in colonial records about most parts of Tamil Nadu, Karnataka, Andhra Pradesh, and Odisha[6].

Evolving hydro-geology of tanks systems

Tank hydro-geology has been influenced by various development programs around tanks which can be explained by the schematic diagram in Figure 1. The major interventions which have influenced the importance and hydro-geology of tanks are the watershed development programs and the promotion of groundwater use. The watershed basically pertains to the catchment of tanks. The development in the catchment/watershed primarily focuses on soil moisture conservation, construction of water recharge structures such as check dams, small storage structures and farm ponds. Till date a total area of 3.6 million ha has been treated under the watershed development program[7].

Simultaneously, after the 1990s, there was acceleration in groundwater development. This resulted in the replacement of the source of irrigation, from tanks to groundwater. Although there is no doubt about the irrigation efficiency of groundwater, the recharge efficiency and energy requirement, warrant further investigation. Karnataka provides free energy to about 1.8 million irrigation pumpsets (below 10 hp) annually; this drained the State exchequer of ₹ 5,250 crore for the year 2013-14 as energy subsidy payments[8].

The change in hydro-geology of tanks over time can be explained as follows: In South India, the runoff estimate is around 30% of rainfall, of which 10% caters to groundwater recharge (Table 1). During the early days, the tanks served as “discharge” structures for runoff as well as for baseflow

6. Descriptions about the extent and spread of tanks are available in the eighteenth and nineteenth century writings by engineers (like Arthur Cotton, RH Sankey), administrators (like Thomas Munroe, JH Nelson), and Travellers (like Father Martin). They describe the scale of human efforts put in by the ‘natives’ to make tanks.
7. http://watershed.kar.nic.in/areascfdeows.htm/06 September 2013.
8. Government of Karnataka, 2013. Budget Speech, PART-1, Agriculture for 2013-14, presented on 8th Feb 2013, by Chief Minister, Government of Karnataka. P, 38.

from groundwater. As it was not being used, the groundwater must have flown into tanks. This means tanks would have received almost 40% of the rainfall.

However, with the change in dynamics, watershed development reduced the runoff fraction from 40% to 30% and reversed the baseflow of groundwater from tanks. This means that instead of discharge into the tanks, there must have been a loss of an additional 10% from tanks. This water budget was further impacted when the tanks were solely used as percolation structures. The recharge potential in the southern rocky aquifer is not substantial. This means the major part must have been lost through the watershed.

Table 1. Change in water budget of tanks systems.

Water budget parameter	Before development	After development
Rainfall	100	100
Catchment	-70	-80 (post watershed development)
Runoff	30	30
Groundwater recharge	10	10
Baseflow into/from tanks	+5	-10
Total water available in tanks	30+5=35%	20%
Tank capacity	Full (35%)	50% of capacity = 10% (due to siltation)

Decline of tanks

In 2001, a Minor Irrigation Census of India counted a total of 556,000 tanks with 150,000 tanks in the Deccan Plateau. These tanks have been the backbone of livelihood in the villages for centuries. These tanks have the potential to provide 6.27 million ha of irrigated area for the whole country. Of this irrigated area, around 3 million ha has already been lost[9]. The data also implies that more than half of the tanks in India have either vanished, become dysfunctional or are in various states of disrepair. Many of them would have been encroached on or put to some other uses. Due to poor management, the gross area irrigated by them has come down from 4.78 million hectares to 3.07 million hectares even though new tanks were constructed during this period. The share of tanks in the net irrigated area decreased from 18.50% in 1960-61 to about 7% in 1990-91 at the all-India level. Physically, the tanks are in a dilapidated condition due to encroachment, scrub jungle formation, contract lands, and agricultural activities within the tank area. Silting and breached channel banks are additional factors. This has resulted in the reduction of their water harvesting and carrying capacity[10]. There are a handful of studies done to quantify the economic benefits of tank wetlands from the economic perspective of using tank water in India (Balasubramanian and Chandrasekaran 2007) and Sri Lanka (IUCN 2005). However, on the whole they do not explain or quantify the ecosystem uses and their losses.

Over the last two centuries, the general status of 'tanks as irrigation systems', has been discussed elaborately in many publications by various government agencies and academicians. All of them consistently show that the structural conditions of tanks are poor and that increasingly they serve smaller areas than they were originally designed for. By now, the *decline in irrigation* is well understood, but this cannot be said about the other ecosystem uses of tanks. Dhawan (1999) wrote, "The days of tank irrigation seem to be over. The sustained and pervasive decline of an area under this source of irrigation is an unmistakable pointer to our contention". For example, between 1960 and 2008, the tank irrigated area in Tamil Nadu alone came down from 0.733 million ha to 0.506 million ha[11], a reduction of 30%. The reduction in other tank intensive states like Andhra Pradesh, Karnataka and Odisha is even greater.

9. http://wrmin.nic.in/micensus/mi3census/chapter5.pdf accessed on 29 November December 2009.
10. (http://base.d-p-h.info/en/fiches/dph/fiche-dph-8133.html)
11. http://www.tnstat.gov.in/seasonandcropreport2007-08.pdf accessed on 11 January 2011.

The functioning tanks have too many issues affecting them which need to be understood to gauge the efficiency of their performance. For example, soil erosion and other irreversible changes in tank catchments induce siltation in almost all tanks. Siltation reduces the life of a tank. Detailed siltation studies are available only for a few tanks that are large in size[12]. Few governments have paid attention to the rehabilitation of community tanks. For example, during the year 2000, the Government of Andhra Pradesh (undivided) undertook the desiltation of water tanks under the "NeeruMeeru" scheme[13]. Under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), the Government of India promoted the country wide desiltation of tanks. Recently, in the newly formed Telangana state, the state government has launched Mission Kakatiya to desilt tanks based on the scientific study of tank desiltation and its benefits (environmental and economic) that has been demonstrated in ICRISAT studies (Padmaja et al. 2003 and Osman et al. 2009).

Water harvesting, storage and reutilization for crop production is an important component of research for sustainable agricultural development in the dry regions. Traditionally in southern India, water storage tanks are an integral part of villages and the water is used to recharge groundwater and irrigate fields. Over the years, the storage capacity of tanks has reduced due to sediment deposits from erosion and runoff processes. During 2001, the Government of Andhra Pradesh undertook the 'Neeru-Meeru' (Water and You) initiative in Medak district, to desilt tanks during the dry season.

The field based studies carried out by ICRISAT (Padmaja et al. 2003 and Osman et al. 2009) have assessed the viability of desilting operations and the economic value of potential utilization of sediments desilted from tanks, for their nutrient value. The sediment samples collected from 21 tanks spread over 11 mandals of Medak district were analyzed for their plant nutrient content and microbiological properties. On an average, the samples contained 720 mg nitrogen (N) and 320 mg phosphorus (P) per kg of sediment. The organic carbon (C) content of sediment varied from 5.3 g kg^{-1} to 27.2 g kg^{-1}, with a mean value of 10.7 g C kg^{-1} of sediment. The application of 48,777 tons of sediment to agricultural lands returned 520 tons of C to fields, thereby enhancing the nutrient availability for crop production.

The microbiological assays indicated that the sediment samples had higher counts of bacteria (20-30 x 104 colony forming units [CFU] g^{-1} of sediment) and actinomycetes, followed by fungi.

The benefit-cost (B/C) ratio of a desilting operation and its utilization as a plant nutrient source of N and P varied from 0.62 to 3.44 with an average ratio of 1.17. This suggests economic feasibility for the application of tank sediment to agricultural fields for crop production in addition to increased water storage capacity, groundwater recharge and availability of more irrigation water.

The data obtained from 21 tanks was used for extrapolating results to the entire district in which a total of 78 tanks were desilted. The approach used for extrapolation utilized the N and P composition of sediments from the nearest available sediment value to compute the corresponding values for the rest of the tanks in the district. The overall mean N, P and organic C content in the sediments was calculated to be 730 mg N kg^{-1} sediment, 357 mg P kg^{-1} sediment and 11.64 g C kg^{-1} sediment, respectively.

In the district, a total of 246,831 tons of sediments from 78 tanks were desilted and addition of these sediments back to farms would return 183 tons of N, 86 tons of P and 2,873 tons of organic carbon.

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12. For example, siltation studies done on the Veeranam tank show that it had a storage capacity of 40.8 million cubic meters in 1923 that got reduced to 27.71 million cubic meters in 1991 thereby showing a loss of around 30% of its storage in seven decades of the last century. At this rate of siltation this tenth century tank would cease to exist in another two centuries
13. The NeeruMeeru initiative (started in May, 2000) focused on sustainable developmental effort with emphasis on holistic planning on river basins/sub-basins through convergence of various departments at the state, district and sub-district levels. For ensuring convergence of the efforts of the concerned departments and to promote water conservation in an aggressive manner, the government brought all water conservation activities into a campaign mode christened as Neeru-Meeru meaning Water and You. The concept of Neeru-Meeru envisages creation of awareness amongst the people to ensure their participation and help in facilitating the conservation efforts of various government departments.

On an average, the B/C ratio for desilting operations from water tanks based on the economic plant nutrient value (N and P content) of the district was calculated to be 1.23, which reflects a positive benefit for the cost incurred in the 'Neeru-Meeru' program.

Traditionally, tanks were an integral part of rural life in India. However, decreasing collective action by the community, inappropriate soil and water management practices adopted by the farmers and encroachments of tanks and waterways by individuals resulted in the neglect of the tanks in villages. Good practices such as desilting and application of silt to agricultural fields were abandoned. Continued mining by crops and reduced application of organic manures have resulted in deficiency of several nutrients particularly that of micronutrients. ICRISAT in association with Modern Architects of Rural India (MARI), an NGO, conducted a pilot project and quantified major and micro-nutrients present in tank silt and also its impact on soil health and crop yields.

The research studies (by Padmaja et al. 2003 and Osman et al. 2009) carried out in Telangana region show that, the depth of silt in 12 tanks that were desilted ranged from 1.2 m to 3.0 m. The pH of the tank silt ranged from 6.5 to 8.5, while the organic carbon content was found to be low (0.5% to 0.8%). The available N content of tank silt ranged from 328 mg kg^{-1} to 748 mg kg^{-1}, available P from 5 to 35 mg kg^{-1} and K from 271 to 522 mg kg^{-1} of silt. Similarly, available S ranged from 12 to 30 mg kg^{-1} zinc from 1.2 to 5.6 mg kg^{-1} and boron from 0.4 to 0.8 mg kg^{-1} silt. The microbial population was found to be low and this could be due to excessive use of pesticides for cash crops like cotton and chilli which are grown in the catchment area. Textural analysis indicated 70 to 80% clay, while silt ranged from 15 to 25%. Addition of tank silt at 50, 100, 150 and 375 tractor loads per hectare improved the available water content by 0.002, 0.007, 0.012 and 0.032 g per gram of soil, respectively in the plough layer and enhanced the tolerance of rain-fed crops to moisture stress by three to five days.

The farmers could recover the investment made on transport of the silt through increased net profit in cotton and chilli compared to turmeric and maize. Further, the saving on pesticides alone was to the tune of ₹ 2,500 ha^{-1} for cotton and chilli crops, which has an indirect beneficial impact on the ecosystem. Desilting was found to be an economically viable activity both with respect to farmers and from the project's perspective of creating more storage capacity and returning silt back to the fields. Desilting activity needs greater support from government and non-governmental agencies to achieving multiple outputs like employment generation for the landless, rejuvenation of the tanks and for enhanced productivity of dryland crops (Padmaja et al. 2003 and Osman et al. 2009).

Recent studies[14] have listed out the reasons for the decline in tank irrigation in Karnataka:

- Treatment of catchment area resulting in substantial reduction in runoff due to in-situ moisture conservation as well as construction of check dams, besides improper maintenance and encroachment of feeder channels.
- Social factors such as substantial areas in tank beds being encroached by influential/unauthorized persons, neglect by local communities and authorities, water extraction from deeper layers by borewells.
- Economic factors such as heavy subsidies in power supply for irrigation pump sets, inadequate or zero financial allocation for operation and maintenance of tank projects.
- Institutional factors such as improper control and administration of tanks besides the shift in emphasis to major and medium irrigation projects.

In addition, the following problems are faced: a) Tanks are age old small water bodies. These are built with mud plastering using local masons; b) The channels are unlined and hence, about 70 percent of the water is not available to use due to percolation, evaporation and seepage. Most of the tanks do not have controlling gates at the distribution point or simple measuring structures like a v-notch. On

14. University of Agricultural Sciences, Bangalore and Panchayat Raj Engineering Department, Government of Karnataka, 2009. Report on Reconnaissance Survey of Tanks in Southern Karnataka-Phase-II. Directorate of Extension, UAS, Bangalore. September, 2009.

the embankments, there are no slope sides and turfs. Due to non-regular oiling and greasing, there are leakages at the sluice gates. Waste weirs are not maintained at the original level. The decrease in water spread area is reduced owing to non-removal of silt and sedimentation in the tank bed area. Further, the same study (UAS and PRED 2009) from its field survey carried out during the year 2009 found that, only in 106 tanks out of 5,142 tanks spread over 17 southern districts in Karnataka, are all the parameters in good condition; in other words, in 5,036 tanks at least one of the parameters is either partly or fully damaged[15].

Due to poor management, the gross area irrigated by tanks has come down from 4.78 million hectares to 3.07 million hectares even though new tanks were constructed during this period. The share of tanks in the net irrigated area decreased from 18.50% in 1960-61 to about 7% in 1990-91 at the all-India level.

Tank users' associations

Policy, legal and administrative regime: During the last decade, the centre and several states have revised irrigation water policies and the legal framework which primarily aims at empowering the users for the sustainability of systems. Governments have handed over the system to users for operation and maintenance. However, the complexity and magnitude of these policies and the legal framework has varied in terms of empowering the farmers. Based on the guidance of these policies, several Indian states have ventured into rejuvenating these tanks with a community-based approach (Raju et al. 2003)[16] and several schemes have been based on the same principle.

Inspired by the policy promoting the community based approach, the state of Karnataka approached the World Bank in early 2000 to pilot the scheme in tanks. The World Bank funded project continued for almost 10 years and was completed recently. The project rehabilitated almost 4,000 tanks. The authors present in this report, the experience of the approach used in the state of Karnataka.

Table 2. Policy and legal framework in South Indian states.

State	Policy Focus	Legal Framework
Andhra Pradesh	Setting up WUAs and management transfer to Water Users' Associations (WUAs) Integrated water resources development through 'Neeru-Meeru' program Promote water conservation, tree cover and regulate the exploitation and use of ground and surface water	a) Andhra Pradesh Farmers Managed Irrigation Systems Act, 1997 b) Andhra Pradesh Water, Land and Trees Act, 2002
Karnataka	Setting up WUAs and transfer of management responsibilities Community-based rejuvenation of tanks and management transfer Improve rural livelihoods and reduce poverty by developing and strengthening community-based approaches to manage tank systems	a) Karnataka State Irrigation Act, 2000 (with amendments to promote participatory irrigation management). b) Community-based Integrated Tank Management Act (under preparation) c) Government order for Rights of fisheries to user groups.
Tamil Nadu	Participatory irrigation management through Water Users' Associations and move towards management turnover (includes both canal and tank command areas) Empowered the Public Works Department staff to administer the tank systems (under the earlier Tank Act)	a) Tamil Nadu Farmers Managed Irrigation Systems Act, 2001 b) Tamil Nadu Tank Act

Source: Raju KV 2006.

15. Parameters include: the age of the tank, crops grown, accumulation of silt, type of soil, uses of the tank, condition of the tank bund, waste weir, sluice, feeder channel and irrigation canals and the level of silt accumulation.
16. KV Raju, GK Karanth, MJ Bhende, D Rajasekhar, KG Gayatridevi (2003), 'Rejuvenating Tanks – A Socio-Ecological Approach', Books for Change, Bangalore

Conflicting legal acts govern multiple uses

The revenue generated from different uses in terms of tanks, water fees, etc, are going to different agencies and the legal framework and state policies (in all three southern states) are unclear (see Table 3). Owing to these discrepancies, both users and the agencies get into conflict situations. Some examples of legal conflicts in a few Indian states (Karnataka, Tamil Nadu and Andhra Pradesh), are given below. One fall out of this is that tank users' associations (both formal and informal) are facing constraints in mobilizing resources, which is affecting the very survival of tank users' associations.

Table 3. Source of income and agency responsible.

Use and source of income	Agency responsible and focus of the conflict
1. Water fee	Imposed by irrigation department and collected by revenue department
2. Fishing	Fisheries department holds auctions and generally a trader sub-leases it at a much higher amount to a fishing group. No preference to Tank Users' Associations (TUAs).
3. Silt	Mines and Geology department has control and ownership
4. Nursery and plantation in the tank bed in the catchment area	Forest department claims its rights
5. Ownership and management of all water bodies in the village revenue boundary	According to the 73rd amendment of the Indian Constitution, Gram Panchayats have rights.

Owing to the above conflicting rights on the resources, tank users' associations in several places find themselves in a dilemma. This is in spite of the states having come up with a clear policy to support tank users' associations and transfer tank management to user groups. These states had not focused adequately on the legal implications. For example, in Andhra Pradesh some tank users' associations have been drawn into court cases by local village councils as a result of claims made on fishing rights. This is also true of the emerging tank users' associations in Karnataka state. While Andhra Pradesh has issued a Government Order making a provision for tank users' associations' rights on fishing, this order could not be put into practice. In the case of tanks in Rajasthan (see Fig. 1) there are multiple stakeholders betting on the benefits from the tank system (Raju and Shah 2000); catchment farmers and tank bed farmers are worried about the damage owing to high and long term storage of water and inundation of their crops; downstream farmers would prefer long-term storage for two crop season crops. On the other hand, as elsewhere, tail end farmers are deprived of their share of water owing to the poor distribution system and headenders grab more water for water loving crops.

Users share in system rejuvenation: Historically the tank systems were maintained through the community mainly through their labor and major works were undertaken by the administration. Now several schemes demand users' contribution in order to ensure the users' participation in planning, design and more importantly to ensure ownership for operation and maintenance of the handed over system and to assess their interest in the program. There is no single policy in India that suggests a uniform level of users' share for various developmental programs. It changes depending on the funding source, type of program and level of funding (see Table 4). In case of tanks, the users' contribution includes zero in central/state funded projects, 12 percent in World Bank funded projects in Karnataka and 30 percent in DHAN Foundation supported projects. Many projects/schemes, particularly the centrally funded Repair Restoration and Rehabilitation (RRR) scheme are entirely funded by the central and state budgets, and do not even envisage users' contribution as it does not feature in the project design.

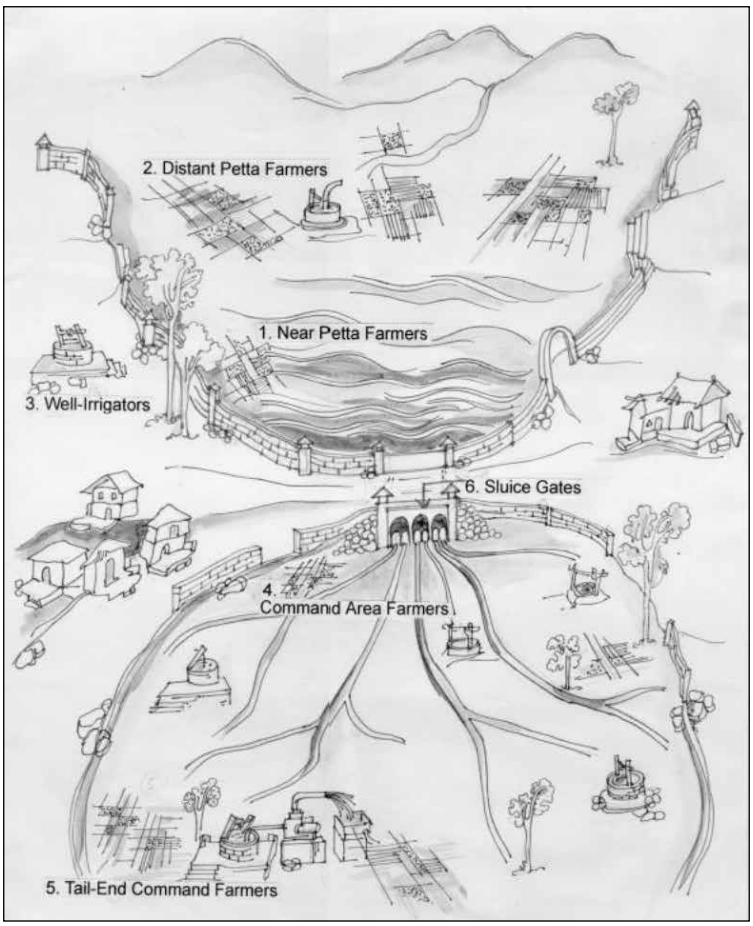

Figure 1. Multiple stakeholders in Rajasthan tanks.

Table 4. Users contribution level in India.

Scheme/project	Users share in %	Project supported by
Karnataka Community-based tank management project	12% (6% cash and 6% labor)	The World Bank
Raitha Kayaka Kere (one tank per hobli)	7	Minor Irrigation Department of Karnataka
Neeru-Meeru Program	10	Andhra Pradesh Government
Participatory Irrigation Management through WUAs	15	APERP supported by the World Bank in Andhra Pradesh
Tank rehabilitation	30	DHAN Foundation in Tamil Nadu
Tank rehabilitation	25	FERAL (NGO) in Pondicherry

Source: Raju KV 2006.

Tank systems provide multiple benefits: Rejuvenation of small and medium reservoirs through community-based approaches has benefited more local users. The benefits of silt amendments in the agro ecosystem, in a survey of 120 farmers (in Telangana region of Andhra Pradesh, India) across various tanks, indicate that it is beneficial, -economically and environmentally. Some of the benefits are (Raju, Manasi and Lenin 2011): increase in rice cultivation area and resultant increase in production levels, enhancement in fish catch, increased fodder availability and as a result more milk production, use of silt and reduction in the use of chemical fertilizers and more access to fresh water for domestic use and also for animals.

Tank Administration: In Karnataka, the majority of tanks (33,452 tanks) have a command area <40 ha. Administratively they fall under the jurisdiction of the Rural development department while tanks with a command area >40 ha (3,320 tanks) would fall under the jurisdiction of the Minor irrigation department[17]. In Andhra and Tamil Nadu, the tank sizes are comparatively large and tanks are administered by Government departments including the Minor irrigation and Public works department, respectively.

Community-based approach in Karnataka

The State of Karnataka had a 37% poverty rate before the project started, most heavily concentrated in rural areas, and where 70% of the State's population was dependent on agriculture. Karnataka has the second largest semi-arid zone in India after Rajasthan, and a relatively small proportion of irrigated areas compared to other Indian States. Over the years (Table 5), the gross irrigated area as a percentage of gross cultivated area has gone up to 32% in 2008-09, from 19% in 1980-81. Thus a large proportion of the population is dependent on highly variable rainfall and semi-arid zone water harvesting systems.

Table 5. Trends in irrigated area in Karnataka (area in lakh ha).

Year	Gross cultivated area	Gross irrigated area	Net irrigated area	Gross irrigated area as % of gross cultivated area
1980-81	106.60	16.76	13.62	19
1990-91	117.59	25.98	21.13	22
2000-01	122.84	32.71	29.43	27
2001-02	116.70	30.89	26.83	26
2002-03	115.32	28.41	27.05	25
2003-04	114.50	27.02	28.38	24
2004-05	128.07	33.28	29.06	26
2005-06	130.27	36.32	29.70	28
2006-07	124.38	36.03	29.46	29
2007-08	128.93	37.89	31.32	29
2008-09	123.68	39.42	32.38	32

Source: Water Resources Department, Government of Karnataka, 2011.

The land use/land cover information indicated that 62.75% of the total area of the state is under agriculture while forests occupy 12.9%, the wastelands cover 14.14% and the water spread area is 1.5% (derived from the interpretation of the multi-season satellite images on a 1:250,000 scale).

The annual rainfall in the state varies roughly from 50 to 350 cm. In the districts of Vijaypura, Raichur, Bellary and in the southern half of Gulbarga, the rainfall is the lowest varying from 50 to 60 cm. The rainfall increases significantly in the western part of the state and reaches its maximum over the coastal belt. The Southwest monsoon is the principal rainy season during which the state receives 80% of its rainfall. Rainfall in the winter season (January to February) is less than one percent of the annual total, in the hot weather season (March to May) about 70% and in the post-monsoon season about 12%.

17. Government of Karnataka, 2001. Perspective land use plan for Karnataka-2025. Karnataka State Land Use Board, Bangalore. P, 223.

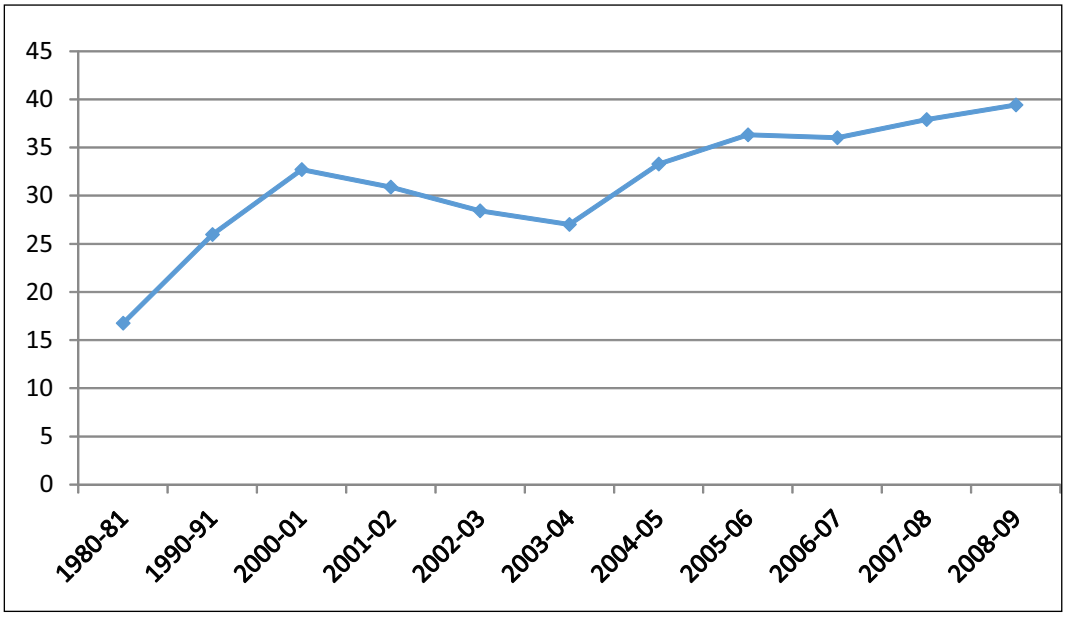

Figure 2. Gross irrigated area (in lakh ha) in Karnataka.

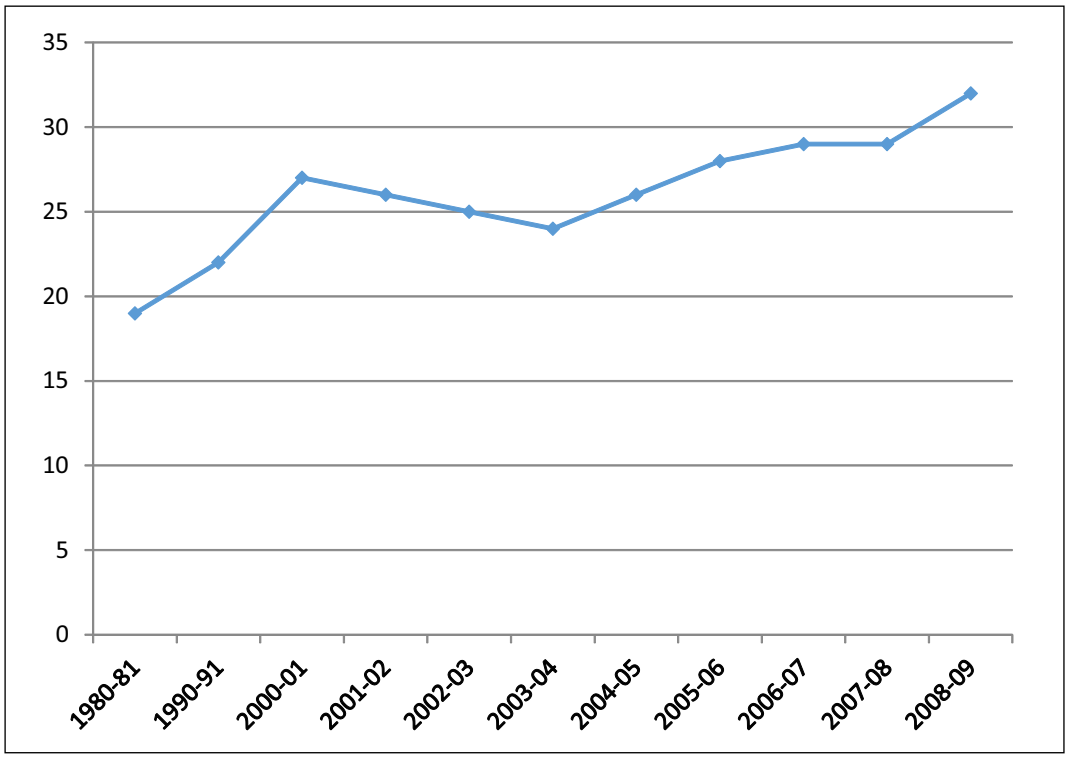

Figure 3. Gross irrigated area as a percentage of gross cultivated area in Karnataka.

Karnataka accounts for about 6% of the country's surface water resources of 1,869 thousand Mcum[3] or 66,000 TMC. About 40% of this water is in the east flowing rivers and the remaining is in the west flowing rivers. The average annual yield of the rivers of Karnataka has been estimated at 98,406 Mcum[3] (3,475 TMC). As per the master river basin plans, the total utilization likely under major, medium and minor irrigation projects[18] using surface water is 48,000 Mcum[3] (1,690 TMC). Table 6 indicates the source-wise irrigation area.

18. Irrigation schemes are categorized into "minor", "medium" and "major" with areas up to 2,000 ha, between 2,000 and 10,000 ha, and greater than 10,000 ha respectively.

Table 6. Source-wise irrigation during 2008-09.		
Source	Area (Lakh ha)	% Share
Canals	14.02	36
Tanks	2.34	6
Wells	4.58	12
Tube/Bore Wells	13.49	34
Lift Irrigation	1.45	4
Other Sources	3.55	9
Total	39.43	101

Source: Water Resources Department, Government of Karnataka. 2011.

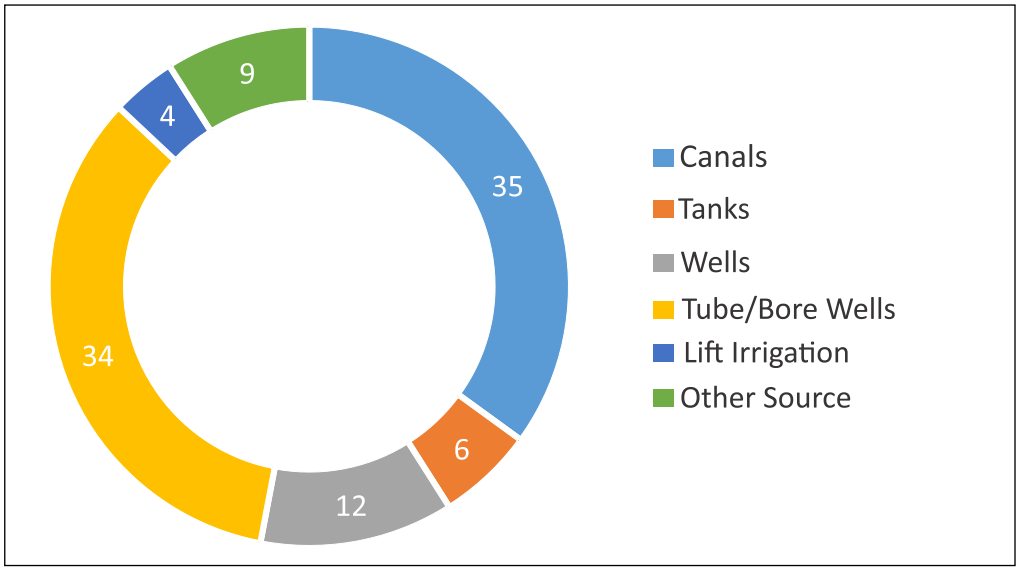

Figure 4. Source-wise irrigated area (in %).

Since the state has a hard rock region with low substantial groundwater storage capacity and no perennial rivers, the best means to meet the water demand during the non-monsoon season was found to be water harvesting structures that are tanks. These tanks mostly established over the last couple of centuries have a history of traditional management. There used to be almost 37,000 tanks in the state in the year 1995 covering 1.5% of the area of the state. A recent assessment,[19] shows that the number of tanks has reduced to almost 23,000. The size-wise distribution of tanks is shown in Table 7. These are small reservoirs which mainly provide irrigation to command areas, but also have multiple uses such as for livestock, water recharge and household needs.

Table 7. Distribution of tanks according to command area.		
Sl No.	Command area in ha	% of tanks
1	Below 4	41
2	4-20	42
3	20-40	9
4	40-2000	7
5	Above 2000	1

Source: www. jsysindia.org/06 september, 2013.

19. In the PAD a figure of 37,000 tanks is used. The figure of over 23,000 refers to findings from a more recent, yet unpublished survey.

Tank management

Historically tanks were constructed, operated and maintained by villagers using local skills and craftsmanship and also managed with the help of traditional water managers (*Neeruganthi*). After Independence, the management of these tanks was formally taken over by the State. While Panchayati Raj Institutions (PRIs, local governments) had been allocated the responsibility of tanks with a command area below 40 ha, those above 40 ha remained with the Minor Irrigation Department (MID). None of the institutions had sufficient resources and systems to support tank rehabilitation, operation and maintenance. Thus they have suffered from sporadic civil works activities and negligible maintenance, aside from whatever ad-hoc efforts the farmers could put in with the traditional (but largely disempowered) water managers.

In early 2002, the project was thus conceived, and approved in 2002 itself, to build on policy changes, such as recognition of water user groups, including multi-stakeholder tank user groups (TUGs), and greater decentralization of resource management, formulated by the State around 2000.

The State also established in 2000, a flexible and semi-autonomous support institution, the Jala Samvardhana Yojana Sangha (JSYS, literal translation 'water management improvements society'), and also moved toward the gradual devolution of rights of user groups to collect water charges for maintenance.

The project's development objective was, "to improve rural livelihoods and reduce poverty by developing and strengthening community-based approaches for improving and managing selected tank systems".

The target of the project was to rehabilitate 2,000 tanks initially and based on the success of the approach, the project was given additional financing (AF) in 2007 in order to rehabilitate another 1,225 tanks. The total project funding was US$140 million and targeted to benefit command area farmers (in 3,225 tank systems) and to cover 266,000 households, in nine dry area districts. The project was focused on improving tank systems to help increase water storage, water use efficiency, and agricultural productivity in areas where there is a large percentage of rural poverty in the State. The major economic benefits expected from the project were in improved agriculture and horticulture production, with respective net income increases, fisheries, forestry, time savings in fetching water, and livestock. Employment opportunities, especially for marginal and landless farmers, were expected to be significant, both in terms of labor for civil works, and from agriculture labor requirements to deal with increased productivity. In addition to these 'economic' benefits, there could be important (less quantifiable) benefits including increased social capital and empowerment through the formation and strengthening of village-level institutions, more equitable share of benefits for vulnerable groups, and broad capacity building for user groups, PRIs, and state officials.

With the AF, the nature of the beneficiary groups remained the same, although the expanded target of beneficiaries would be those served by about 3,225 tanks including the new talukas (sub-districts) of the Phase I 'ongoing' districts, and 8 new districts under the AF. The full target population was not specified in formal documents.

Design

The project was designed strongly in line with the World Bank's poverty reduction strategies at the time of appraisal, as outlined in the Country Strategy, and for India in the Ninth Five Year Plan, for sustainable growth and specific support to the poor and disadvantaged. At the time of design the Government of Karnataka (GoK) was also an important partner for the Bank in terms of fiscal and state level institutional reforms. The Karnataka Community Based Tank Management Project (KCBTMP) was thus established in parallel with the Karnataka Watershed Development Project (Credit 3528-IN, 2001) and the Second Karnataka Rural Water Supply project (Credit 3590-IN, 2001).

Comprehensive and pioneering design: This was the first project in the country to take up tank rehabilitation on a large scale and to test the devolution of powers to TUGs, with full user participation during project preparation and implementation as well as during the operational phase of a tank for irrigation. This was appropriate in relation to the prevailing resource management and policies, and with regards to bank involvement in the State, and interests in participatory natural resources management at the time. The GoI and GoK were committed to decentralization and participation of water users in management, operation and maintenance as per the National Water Policy of 2002. The project also built on an increasing number of Bank community-driven development experiences in India and elsewhere.

The project was designed with a vision for sustainable O&M of tanks through the active participation of users during the planning stage, empowerment during the implementation stage and thereafter handing the tanks over to the Tank User Groups (TUGs) to own and carry out O&M. Since the tanks serve multiple users, the design was comprehensive instead of focusing on only specific aspects, such as large scale desiltation. The integrated approach could place greater emphasis on managing both water supply and multiple uses of water demands (on farm water use and agricultural management), and their importance in dry land areas and for marginal groups. This emphasis on an integrated and more inclusive approach provided a greater opportunity for more sustainable development. The project was designed to address important areas of concern in the use of water, especially sustainability in management, which requires community involvement. Past irrigation projects had suffered from lack of participation, and had often resulted in skewed benefits to better off farmers, or a lack of progress.

Main components

The project adopted a programmatic approach to community-based tank management and covered in the first phase of this program, 2,000 tanks benefiting 72,000 ha (11% of the total estimated command area of 685,000 ha) through tanks. This project was to be implemented under the supervision of JSYS. The project consisted mainly of three components: a) Estimating an enabling environment for the sustainable, decentralized management of tank systems; b) Strengthening community-based institutions to assume responsibility for tank system development and management; and c) Undertaking tank system improvements. The third component is further sub-divided into: improving the operational performance of selected tank systems through a menu of physical interventions identified and executed by local users as well as horticulture development, fisheries, forestry, and fodder production to help ensure that improved water storage and efficiency is translated into increased household income.

One of the critical sub-components, which later became a trend setter for similar projects in Andhra Pradesh and Rajasthan, was the development of safeguard and gender action plans as part of Component 2 to strengthen community development. The focus is on: a) developing human resources and forming or strengthening existing local institutions; b) developing mechanisms through which the needs of traditionally vulnerable stakeholders can be sustainably addressed, through identifying project affected persons and suitable plans for their resettlement and rehabilitation; and c) institutionalizing processes for the sustainable management of tanks and derived benefits. Resettlement action plans (RAPs) have taken care of physical displacement under the project, mainly concerned to encroached land. Local tank user groups prepared RAPs for individual tanks in which encroachers were vulnerable to loss of financial and/or material assets. In addition, environment management plans, cultural property action plans, pest management plans, and gender strategy and action plans were prepared and executed.

The project results were to be achieved through the following three components:

Establishing an Enabling Environment for Tank System Development. (US$14.22 million). This would (i) help establish a conducive environment and institutional basis for community-based tank management; and (ii) develop a decision support system for planning, operation & management; and strengthen project coordination and management at all levels.

Strengthening Community Development. (US$19.56 million). This would include (i) human and institutional resource development and strengthening of local institutions; (ii) preparation and implementation of safeguard action plans and gender action plans; (iii) assistance for each tank system developed under the project; and (iv) communications. Essentially, the project cycle at tank level was for around four years, with one and a half years for establishing implementation support and two and a half years for community mobilization, training, and implementation of civil works. Communities (TUGs) were to participate in preparation of Integrated Tank Development Plans (ITDPs) through Participatory Rural Appraisals (PRAs), with planning and implementation guided by local Non-Government Organizations (NGOs).

Undertaking Tank System Improvements. (US$82.15 million). This would provide for (i) the improvement of the physical and operational performance through civil works of about 2,000 tank systems within the project area; providing the TUGs with appropriate administrative and management support for implementing and managing the subprojects; (ii) supporting on-farm demonstration and training with regards to agriculture and horticulture by the Karnataka State Universities of Agricultural Sciences (UAS); (iii) promoting other income generation activities for members of local tank user communities who have little or no access to land resources, and (iv) developing appropriate technologies especially for reducing water use, suitable to the general conditions found in tank systems.

Implementation

In addition to the 2,000 tanks targeted in the original project, a further 1,225 were added under the AF in 2007, at the request of the Government of Karnataka, as the project implementation was accelerating, and initial results were encouraging. The project was given AF as this was considered a simpler option than developing a new phase project, while still allowing for a four year implementation period. At the time of AF approval, the original closing date was extended by three years to 31 January 2012.

Further, in 2010, the original project was restructured to include 700 more tanks from the savings that were accumulated by implementing the low-cost, community based approach and because of the improved rate of INR to dollar/SDR exchange. Also, the original project considered very high contingency in the range of 28% of the total cost of the project. This meant that the final target for the project became more ambitious with 3,925 tanks. During the preparation of AF, the exchange rate of SDR/dollar to INR was 25% less than during 2011-12 when the majority of implementation took place. This means that the unit cost estimates during AF also resulted in significant savings.

The World Bank contribution to the project finished as planned in January 2012, although there were some remaining works to be done in about 1,761 tanks. An extension that was requested by the government was not granted, and 25 million SDR of IDA credit (US$35 million) was cancelled prior to closure of the project, and returned to the India portfolio. A total of US$9.71 million of IBRD has been left undisbursed. A large portion of the cancelled and undisbursed amount can be attributed to the high contingency estimates and fluctuating exchange rate.

Project Area: The program was implemented in two phases covering 18 districts (94 taluks) to rehabilitate 3,800 tanks; the cost was ₹ 50,863 lakhs for Phase I and ₹ 30,698 lakhs for Phase II (Figure 5). The Command area that was expected to be rehabilitated was around 162,000 ha.

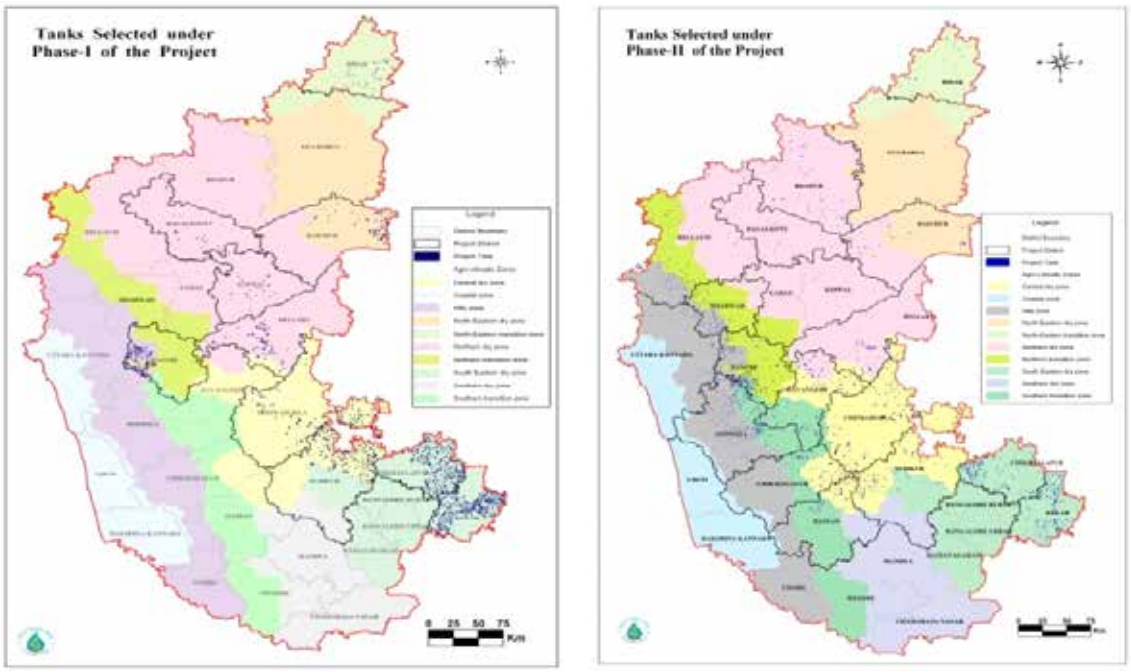

Figure 5. A location of tanks for rehabilitation in different districts.
Source: JSYS, 2013.

Establishing an environment for a community based approach: The project's success in effecting community drive and peoples participation was based on six fundamental principles viz., transparency, equity, inclusiveness, decentralized decision making, accountability and human and institutional capacity building. Intensive efforts were made with the help of NGO partners to create management structures among the users, establish functional linkages with line departments and promote participatory processes. It enabled the project to convert the resource users into planning and implementation agencies making them accountable for the project's performance. Improvements to tank infrastructure including inflow and distribution channels based on hydrological analysis and linkages with Agriculture, Horticulture, Forestry and Fisheries Departments ensured efficient and productive use of tank systems on a sustained basis.

These initiatives had enabled a multilayered system of implementation. At the community level there were three entities namely Tank User Groups (TUGs), made up of farmers who owned land in the command area and others, Tank User Committees (TUCs) elected in the Gram Sabha and Self Help Groups (SHG) comprising women from vulnerable sections of society. Support from local NGOs in the form of Cluster Facilitation Teams (CFT) is taken to mobilize the community, to form committees and build their capacities as required under the project. The CFTs acted as a main link between the District Project Unit (DPU) and TUG and facilitated implementation of the project.

The CFT provides handholding assistance to the TUG by conducting Participatory Rural Appraisal (PRA) to assess the problems and causes thereof and formulate strategies/interventions to address them for improving the tank system. The TUG is assisted to develop the ITDP including income generating activities to vulnerable groups and rehabilitation programs for the people affected by the project. Once the ITDP is approved, funds are released to the TUG for implementation. The CFT guides and monitors the TUG during implementation, and technical works are guided by the engineers from JSYS. In addition JSYS facilitates fixing of contract agencies to undertake major works by following prescribed Procurement Procedures (shopping and/ NCB) as required under the project. These contracts are executed by the TUG under the overall guidance of engineers from JSYS. The JSYS engineers facilitate the TUG to prepare Operation & Maintenance (O&M) plans for sustaining the Tank improvement program.

Figure 6. Awareness campaign.

Factors affecting project implementation

i. High commitment for preparation

The borrower provided high commitment at the start of the project, spearheading the design and development of the project, and providing a vision for the mainstreaming of the approach more widely. This was done with considerable dialogue with experienced NGOs. The GoK set up a special society (JSYS) to implement the project, supported by a highly visionary management team. JSYS was also to serve as an institutional model for scaling-up. During the preparation stage, the State introduced reforms in the Irrigation Act and in the operation and maintenance policy in order to empower communities and ensure their participation in O&M. Initially, the project commenced with a very small number of tanks (30) that were used to develop detailed guidelines and procedures for scaling-up the community based approach. Since not many NGOs were experienced in this particular task, three highly experienced Anchor NGOs (ANGOs) were engaged to prepare the guidelines and train other NGOs. Similarly the technical manuals for design and quality control were prepared for tank improvement related civil works. The training material for induction of new staff/NGOs, execution of works and quality assurance was prepared in a professional manner which is now being utilized as a guideline by other projects. Although preparation took considerable time, it ensured that the capability of the implementation team including the NGOs and the engineering team was strengthened. The project preparation of documented procedures and guidelines was done in such a way that that the JSYS team was able to maintain continuity during implementation despite a large turnover of staff and NGOs. The project design and documents now serve as examples for other tank projects in the state and in central schemes.

ii. Risks, although well considered, increased with complexity

The risks identified in design on the whole were well considered and the mitigation measures were largely sound and integrated into the basic model. The substantial risks were: the exclusion of less powerful stakeholders, lack of sustained commitment to JSYS, pressures to implement rapidly, focus on works, and weak accountability in the use of funds at the community level. Although a risk of weak post-project sustainability of benefits was anticipated, this was to be addressed through strong capitalization of TUG funds, to support O&M and village development activities. In addition, the project design mitigated for this by allocating a four-month period of training for TUGs to support O&M activities at the community level.

Although, the project ensured through its design and selection criteria that the risk of exclusion of less powerful stakeholders was mitigated, this made the project design more complex and challenging to implement from the hydrological and socio-economic point of view. In the original project, talukas with low rainfall, high percentage of marginal and small farmers as well as poor education and health indicators, were specially selected to address the Bank and Government's objectives of helping the poorest of the poor. At the same time the project was setting out to test difficult and complex concepts - participatory methods and self-sustaining institutions - on a considerable scale, in areas where the risk of failure was potentially quite high, and would pose challenges to getting early successes. All of this, combined with limited implementation capacity led the newly created JSYS to focus on capacity building of the implementation team, including NGOs and engineers in a robust and regular manner.

Monitoring and evaluation design, implementation and utilization

M&E design: As with other World Bank projects established at this time, the Karnataka Community-based Tank Management Project (KCBTMP) was designed to have a strong monitoring and learning (M&L) element. The M&L system was intended to have four components: (i) performance tracking – to measure inputs, outputs and outcomes; (ii) institutional tracking – for organizational learning and performance enhancement (for JSYS units and TUGs); (iii) Internal learning – developing project processes; and (iv) evaluation – to evaluate project impacts and outcomes.

M&E implementation: Initially an external organization was engaged to support the JSYS with the development of the M&L system. Nevertheless World Bank missions in May/June 2007 and May 2008 still found significant problems with the M&L program. These included: (i) poor and disorganized collection, processing and reporting of project data; (ii) lack of procedures for monitoring the performance of CFTs; (iii) failure to report and present data in a format useful for JSYS management and staff; (iv) lack of an understanding in the JSYS M&L Unit, of World Bank requirements and procedures for results monitoring.

Although M&E and Management Irrigation System (MIS) have been attempted under the project, this could have been done more efficiently if the large amount of data and information gathered was systematically managed and used in an integrated manner. Only recently have there been efforts to integrate the data silos within JSYS. A central difficulty with the M&L implementation has been the inability of JSYS to appoint and retain a sufficiently experienced M&L Specialist. This has meant that suitable systems have not been established at the outset in JSYS, for data collection, processing and consistent annual or quarterly reporting. Nevertheless the project did prepare quite detailed status reports for Bank missions and detailed agenda notes for Executive Committee meetings, which to some degree filled the gap.

M&E utilization: There was a tendency to collect data on everything, rather than focusing on the key data and the purpose of the data. JSYS developed and collected a wealth of information including topo-surveys, revenue maps, tank information, and socio-economic information and agricultural data for the tanks. The JSYS MIS systems for the ongoing project and the tanks taken up under AF, were set up with two different work streams making the compilation and utilization of this data challenging, especially in terms of evaluating the project in its entirety. An online MIS was developed for the procurement and civil works of the second phase of the project but the challenge remained to get the District Project Units (DPUs) to utilize the system and create uniformity in their data entry. Such an online MIS, if fully utilizable by the DPUs, would facilitate the TUG handover process and manage the mainstreaming of the project systems and their management.

Nevertheless the project did show utilization of M&E information to adapt processes. Independent M&E studies have been conducted in 2006-07 and another in 2011 to understand the impact of tanks implemented under the original credit and management of JSYS. Based on these studies and on ongoing M&E, particularly during the second phase of implementation, the following major changes were introduced in the project:

- In the first phase, the tank sizes were initially quite small. This meant high amount of effort per unit of agricultural area supported, and less chances of benefitting the irrigated area because such tanks were primarily for non-irrigation uses. During Phase II tanks which had more than 20 ha of irrigated/ command area were selected.
- Changes were introduced in NGO team structures and their outcome indicators. The engineering team was shifted from an NGO to DPUs. The engineering supervision was strengthened with more accountable engineers.
- The role of third party QA/QC consultancy was revised to cover more tanks on a random basis and soil and material testing facilities were explored through local institutes instead of mobile labs.
- All TUGs are expected to contribute 6 percent of the ITDP cost estimate in cash. This condition was relaxed to 3% for implementation to commence.
- Several changes were introduced in the specifications of civil construction works.
- During phase 1, the TUGs were allowed to implement the works directly, while during phase 2, the major works were implemented through contractors.
- In order to encourage more contractors, the procurement was facilitated through DPUs and the bidding process was simplified by allowing the quotations to be stated in percentages.

Methodological "soundness", data quality, and M&E sustainability: As noted above, the MIS was maintained by individual units and in some cases web-based applications were utilized. Despite a good collection of information, MIS systems were generally not well integrated, resulting in some inconsistencies noted in the Implementation Completion Result Report (ICRR) process. Similarly there had been a number of studies, including those of the agricultural universities, some of which were of relatively good quality. However there was relatively little integration and overall quality control and information management was not up to the mark, perhaps due to the gaps in staffing. While the earlier impact assessments had difficulties in comparisons with control years, due to differences in rainfall variability, the impact assessment study of 2012 corrected for some of this, and generally presented relatively robust and comprehensive results and analysis. Wherever it was possible, the analysis followed the results framework indicators (although as is mostly the case no significance tests were done), as well as more qualitative analysis of the intervention processes, which provide an important basis for the reporting in the Implementation of Completion Result Report.

Safeguard and financial compliance

Environmental safeguards

From Bank supervision documents, it is clear that environmental safeguards and management aspects were significantly mainstreamed from tank identification and preparation up until the implementation stage in the project. In the extended project, environmental management measures as envisaged in the Social and Environment Assessment (SEA) were being planned and implemented effectively in the field. The environmental management aspects included foreshore plantation, appropriative tank silt removal and utilization, and introduction of Integrated Pest Management (IPM) and Integrated Nutrient Management, and were largely successful. To further strengthen these elements post-project, adequate funding/budget for plantation and related works, awareness and monitoring are required. Such efforts would be useful to increase the sustainability of the project and would also add value in creating environmental awareness within the community.

Social Safeguards: The final evaluation of the social aspects of the project found that the participatory process has worked well from the planning to the implementation stage. The participatory approach helped considerably in navigating the politically delicate situation of encroachers in tank bed areas, and resulted in the voluntary relocation of 7,803 encroachers. Economic rehabilitation for all vulnerable encroachers included a productive asset grant, additional ration and food supply, and institutional credit for crop production and allied activities in many cases. The participatory process also empowered and motivated the society as a whole and women in particular, and ensured inclusion of lower castes and scheduled tribes. Linking income generating activities to tank rehabilitation helped involve marginal farmers and the landless in the entire process. The gender strategy worked very well resulting in high representation of women not only in TUGs but also in TUCs and other sub committees. The hired safeguard professionals from the market facilitated smooth implementation through building capacity within the JSYS and in the community.

Financial Management: The performance of JSYS in terms of financial management was mixed over the years. The GoK provided the required budget on time every year and there was no shortage of budget in any financial year. In the first few years till 2007, the rating was moderately satisfactory, while in the year 2008 and 2009 the rating moved to moderately unsatisfactory and finally unsatisfactory due to non-appointment of internal auditors and delay in the implementation of Tally accounting and reconciliation of accounts. From 2010, the performance improved and the rating improved to moderately satisfactory. In 2011 the performance further improved and the Financial Management rating was considered satisfactory, as reconciliation was carried out by the project. In the last 18 months, the project worked well in the Financial Management area and consistently achieved the agreed actions. In view of the large numbers of advances and the number of entities involved in this operation, the Financial Management risk was maintained as 'Substantial' for the entire duration of the project, despite all the mitigating measures put in place.

Procurement: The overall procurement under the project was generally satisfactory. A key feature of procurement under the project was that most of it was carried out at the community level. The project started off with a well-established design and concept including the most important aspect of procurement that is, procurement through communities. Procurement, capacity building, improving accountability and governance at the community level has always been a challenge. Furthermore, in this project it was time consuming and required sustained efforts by JSYS. The procurement performance was moderately satisfactory until 2007 and it turned moderately unsatisfactory during the transition of phase 1 and phase 2 when the project as a whole was affected due to turnover in leadership and supervision staff. The situation improved in the last few years of the project.

The key procurements under the project included hiring of NGOs, survey and topography consultancies and hiring of civil works contractors (more than 3,000 by shopping and 14 by National competitive bidding) for tank rehabilitation works. The civil works contractors were hired by communities, which was a major challenge and evolved during the project phases.

Some challenges experienced during phase I were addressed during phase I itself while some major revisions were introduced during phase II. For instance, the contract for desilting was changed from hourly basis to output basis. The selection of well performing NGOs that were required to mobilize the communities (TUGs) guide them during the implementation and also train them for operation and maintenance of tanks, was essential to the success of project. During phase I, the NGOs were engaged on a time basis. Although overall, the phase 1 implementation was quite successful and effective, the performance of NGOs was mixed. Their performance was adversely affected particularly during the transition of the project from phase I to phase II when the supervision mechanism at JSYS was not adequate. The major issues were the lack of a social accountability mechanism at the community level and the tendency in some communities to take advantage of illiteracy. Based on the lessons learnt, the contract of NGOs was changed from a time basis to an output basis. Because the physical progress of

tanks can also be affected by some unforeseen factors such as poor performance of contractors or the climate which are beyond the control of NGOs, future revisions on deliverables could also take into consideration individual TUGs' capacities and not just the physical progress of the tanks.

For the procurement of contractors through communities (TUGs), the majority of procurements were through shopping. During Phase I, the communities were allowed to divide the works and hire small contractors or implement them on their own. In the absence of proper monitoring and execution, it was found that it was difficult to measure the progress of actual works. In order to implement civil works in a more organized and professional manner, an agreement was reached to implement these works using certified contractors. Since the communities were not experienced in processing procurement documents, and works were small, scattered and season specific with very small windows for execution of the works, there were challenges which were overcome with changes that were introduced during phase II. These were essentially about setting up contracts in manageable packets with adequate project supervision (see Box 1 below). This strategy helped to build a model wherein, at the end of the project the capacity at the community level was built up and social accountability and governance was strengthened.

Box 1. Procurement methods supporting smaller contracts

- The letter of invitation was simplified in local language which required contractors to quote the percentage above/below the estimated cost of the bid.
- The DPU Engineer was made responsible to conduct training at the community level and ensure that the procurement process was followed.
- This strategy was improved by advertizing and opening the bids in the DPU office.
- In the case of large works (from the community point of view, around US$150,000), slice and packaging was followed. This procedure included dividing large works into several packages of smaller works which allowed small contractors to participate and hence increased the competition and at the same time attracted large contractors. Desilting, bund strengthening and farm canals were thus packaged separately.

Post-completion operation and next phase

Continuing support and expansion of the community tank management model: The World Bank closed its support to the project on 31 January 2012, as planned in the AF, which included its support to the tanks covered in the original project. The ongoing project has a disbursement of 100% of the first project. In the AF, the disbursement was 81%, and SDR which was 23.34 million (US$36.11 million) of World Bank funds was cancelled just before the closure of and project and US$10.15 million was undisbursed at the time. The GoK, nevertheless was committed to completing and handing over the civil works during the dry season in the first half of 2012, with its own resources through the implementation and guidance of the JSYS through 2012.

The overall quality of implementation by the JSYS and TUGs suggests that the process is a good model with its low cost, community-based approach and with better potential for the sustainable maintenance of tanks. After start up, similar projects were set up in undivided Andhra Pradesh, Odisha and Tamil Nadu and elements were also taken up under the National Project for Repair, Renovation & Restoration (RRR[20]) of Water Bodies, which has been implemented nationwide. The RRR program was designed to mainstream this community-based approach all over India, and KCBTMP served as a model to prepare the program. The project team guided the central and state teams and they followed the KCBTMP community mobilization model, except that the RRR schemes

20. http://www.wrmin.nic.in/index3.asp?subsublinkid=809&langid=1&sslid=839

kept the implementation of civil works with the department while with KCBTMP, the communities were empowered to implement them. Given that JSYS has appropriately trained staff, and a project design that ensures empowerment of communities, the ownership has been noted to be more effective under KCBTMP than with the RRR schemes. The communities themselves acknowledged the difference between the two programs, with JSYS emerging in many ways as a strong institution to continue to develop and support TUG formation and tank rehabilitation.

While JSYS has been instrumental in the achievements of the project, in terms of undertaking a comprehensive and holistic tank rehabilitation program, its long-term position as a support institution is only slowly developing. Commitments were made by the GoK during the ICRR mission maintaining the role of JSYS to complete the works of the present project, with government support of ₹ 1,200 million (about US$20 million). After the closure of Bank support and supervision, JSYS was able to continue with no major disruption. Now JSYS has prepared a proposal to continue support to existing TUGs for consideration by the Executive Committee, including proposals to strengthen policy through an amendment or addition of rules to the Panchayath Raj Act instead of issuing a new tank irrigation act. While a formal program for continued support from JSYS to existing TUGs is still under consideration, the development that has occurred since the closure of bank support seems quite promising. Further, post-project JSYS was approached by the Rural Development Department to rehabilitate new tanks with the project approach, and other external agencies have shown willingness to support the funding.

Post-project JSYS continued to support the TUGs and Federations in developing the linkages with several line agencies. In some cases NGOs have generated funds from other sources to provide support to TUGs and federations. More importantly, it has been noted that the District local government officers are prioritizing TUGs during the introduction of various rural development schemes. As there is no shortage of schemes with further planning and coordination, it is expected that this will considerably help TUGs in sustaining the tank system and also in generating resources for maintenance of the tanks.

Institutionalization: Based on various studies conducted by the project, a report on Institutional Reforms for Mainstreaming Community Based Tank Management was prepared in 2005 and was discussed during 2006. Based on the findings of the impact assessment studies, it was clear that the Tank Management Institutions (TMIs) need hand holding support for a minimum period of two years, to ensure that the core long term tank management functions are embedded (see section 4 on sustainability and risks to outcomes). This is to ensure (a) O&M activities are carried out by TMIs in an organized way, (b) TUCs and their sub-committees continue to function efficiently even in dry years, (c) development of organic linkages with federations, and (d) establishment of active linkages between TMIs and other line departments (agriculture, forestry, fisheries etc). Post-project some of these actions were being taken up (see above), but at the time of the ICRR, the exact mechanisms for this had not been spelled out. TUG federations have been spontaneously formed, and show great initiative and potential to support TUGs in the long term, but are only in their initial stages of development. A number of more detailed policy and operational issues with regards to tank management by communities should also be addressed, especially with regards to water charges and coordination – which would help the sustainability of O&M. These are listed in Box 2 below.

Future Supervision and Evaluation: During the ICRR mission, officials in the State government requested further supervision support from the World Bank to provide some oversight and continuity to the final stages of the project completion in 2012. It was suggested that this could be done through the ongoing supervision missions in the State for the Hydrology II project (ongoing), and the proposed Karnataka Watershed Development II project. This would be a valuable opportunity also for convergence on the wider water and catchment aspects in the project areas and could help with follow-up aspects of M&E. This would be particularly helpful with regards to monitoring the impacts of tank rehabilitation and management on water availability, distribution, groundwater

and usage. There could also be useful follow-up analysis on the sustainability of community tank management capacity, and measuring environmental management features. In particular, an analysis could take place of the entire tank project cycle to determine what steps are essential and should be incorporated in the future rehabilitation of tanks. As it may be challenging for the MID to take up a 3-4 year cycle, as a minimum there should be at the least, some focus on TUG/TUC development and their participation in determining the requirements for tank rehabilitation. An evaluation of the impacts of the implementation of tank activities under AF due to end in 2012 would also be informative for future mainstreaming of tank activities.

Box 2. Some policy and operational issues regarding ongoing tank management

Developing O&M institutional systems:

- Handholding is required for 2-3 years after TUG formation and completion of the rehabilitation works if the TUG is to be sustainable. There is a need to create a unit in JSYS to deal with all matters of tank management, operation and maintenance – setting service fees, carrying out maintenance, preparation of management, operation and maintenance manuals, fee recovery, holding meetings, etc. JSYS also needs to provide more support in order to get federations set up to provide additional support and guidance to TUGs.
- Having meaningful activities to perform are the lifeblood of any organization. The TUGs have been successful in tank rehabilitation but now there is a hiatus as the TUGs have to redefine their activities and structure (there is no longer a need for Sub-Committees as constituted for the Integrated Tank Development Project (ITDP). When there is water in the tank, there are activities for TUGs but when there is no water, the TUGs lose the purpose of organizing themselves. Many sub-committees were useful and were needed for the rehabilitation works, but they need to be restructured for post-handover and in the end there may be a requirement only for a Finance sub-committee, O&M sub-committee and possibly a Conflict Resolution sub-committee.

Water charges:

- At present water charges are fixed by the State, although TMIs can peg it higher than the minimum rate. This is good and bad, good in that there is a figure, bad in that it is not related to the needs of each individual tank. There is a need to somehow combine the two, and have community wide agreements at reasonable but effective rates.
- Operation phase – there is a question regarding what needs to be done about borehole users who benefit from recharge by the tank. They should pay, and are the ones who are in a position to pay. The challenge is to organize them as they are not traditionally part of the command area (although some are).
- Water charge recovery for villagers is difficult; they are not accustomed to collecting money from one another, especially for a tax. The tax should be renamed as a service fee and procedures should be developed to enable the TUC to establish what the fee should be for each tank and then propose this to the General Body. Problems also arise from governments pouring money into village communities through various initiatives (RRR, MGNREGA) which undermine the self-sustainability concept and practice.

Other institutional options:

- Develop linkages with the watershed projects to coordinate water resources management within catchments; otherwise there is considerable risk that upstream watershed users will increase their extracts and decrease water availability for downstream communities. This is a major issue which needs to be addressed by the GoK (and elsewhere in India).
- Explore the possibility of JSYS taking up the RRR work on behalf of the GoK at the local level and routing all RRR work through JSYS.
- Facilitate cross learning across tank projects in other states that are taking up formal programs. For instance in Andhra Pradesh, the tank water management has been integrated with community based groundwater management.

Key achievements, outcomes and impacts

Achievements

- 3,126 TUGs covering 3,710 tanks - Some TUGs cover more than one small tank. Target achieved. Most TUGs have performed satisfactorily. TUGs have further federated at district and state levels. JSYS is working with the TUGs and federations to generate funding for O&M of tanks.
- Although this has not been precisely recorded, tailenders, the landless, women, livestock users and catchment farmers are all part of TUGs and are benefiting from them. Target achieved. Out of 1.16 million TUG members, almost half of the members are women, 30% belong to Scheduled Castes or Tribes (SC/ST), a majority of members are marginal and 15% are landless.
- Total Production has increased by 47% compared to controls for which the increase is 12% (35% difference). Target achieved considerably. The results represent the total command area of 200 tanks studied in the Impact assessment study 2012 of the first phase, over a five year period (2005/06-2010/11). This is because the target of 35% refers to only the lower half of the command area of tanks.
- Net income increased by 76%, compared to 42% for control farmers: project increment is 33%. Target achieved considerably. The results represent the total command area of 200 tanks studied in the Impact assessment report 2012 of the first phase during 2005/06-2010/11. The impact refers to all the farmers in the command against the target of 50% farmers.
- The income of income generating activities beneficiaries increased by 56% and that of non-beneficiaries by 41%. Incremental increase was 15%. Target partially achieved. Impact assessment study 2012 for sample first round beneficiaries in 200 villages. A very high proportion of beneficiaries were women, belonged to lower castes or were tribals and landless.

Outcomes

Assessment of outcomes

1. Relevance of Objectives, Design and Implementation: The project in broad terms still remains highly relevant in terms of its objectives and design in the context of Bank and Government of India policies and strategies at the end of the project (ICRR). The India 12th Five Year Plan still has objectives of inclusive growth through increasing agricultural production and food security, where for rainfed agriculture, convergence is stressed between livelihoods, availability and access to food, ecosystem and human health, and where water management plays a key role. The integrated tank management approach, and the way it has been implemented under KCBTMP, still exemplifies this strategy. Similarly, the design addresses the core pillars of the World Bank Country Assistance Strategy, of rapid inclusive growth in poor rural rainfed areas, sustained natural resources management, especially relating to water, and increasing the effectiveness of watershed management related services.

In terms of national and state level strategies, implementation placed strong emphasis on convergence between communities and PRIs, as difficult as this may be in practice. The challenge in bringing together the PRIs which have broad administrative boundaries, and the TUGs which have a narrow focus around tanks, was the lack of political interest from local governments in small scale projects involving the poor. Implementation may have seen more progress if a greater effort had been placed on management of this convergence, rather than on implementing works. There have been recent discussions on integrating tank O&M works with funds from the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) but this has yet to materialize.

At the time of design the project was created to examine further institutional options and develop JSYS as a long-term support institution. In implementation however there was less emphasis on examining the higher institutional aspects and maintaining a dialogue on them – for example with regards to the relationship between JSYS and the Ministry of Minor Irrigation. The project would have also benefitted from a greater emphasis on the long-term O&M of tanks after the termination of the project. The O&M mechanisms, and TMI as well as local and State institutional support will be critical in addressing some of the deeper causes of tank degradation historically and in sustaining benefits.

2. Achievement of the Project's Development Objective (PDO): The project objectives and indicators emphasized community involvement in both implementation and management of tanks. These would result in improved rural livelihoods and thus poverty reduction of an inclusive group of tanks users, mainly from increased agricultural production and income generating activities. Achievements were made in the project's development objective and its associated indicators, and also in supporting intermediate outcome indicators. A summary of PDO indicators, largely based on the Impact Assessment Study 2012 (IAS 2012), project information and UAS studies is given below.

3. Self managed and sustainable tank user groups (TUGs) established: By 2012, the project helped establish 3,126 TUGs covering 3,710 tanks (out of a formal target of 3,925 tanks, a target set with savings expected at a later stage of the project). Out of 3,710 tanks, only 207 tanks have been dropped from direct project support, which had partial activities done by TUGs. Most TUGs have managed funds, satisfactorily implemented tank rehabilitation and other activities – and most importantly were responsive to their members. The TUGs have gone some way in generating their own resources and with operation and maintenance activities by the TUGs just starting up, there are encouraging signs of follow-up activities by federations and support from other schemes. Several policies and legal measures were put in place to support the system, and JSYS is continuing support activities, as are TUG federations. The *PDO indicator 1 was achieved to a large extent*.

4. Inclusion of marginalized groups: The first PDO indicator included a separate element of inclusion: '…Tank User Groups established… covering at least 85% of the traditionally marginalized tank users organized under the Tank Management Institutes'. While difficult to qualify, the project MIS showed 1.16 million TUG members (on average around 300 per tank) covering a wide range of farmers and other users, such as livestock keepers, often traditionally marginalized who were part of the project, confirmed by mission observations. This inclusion can be considered a major achievement of the project and the s*econd part of PDO Indicator 1* is considered achieved. Almost half of the members are women and 30% are from Scheduled Castes or Tribes, which is generally greater than in the population. In addition a majority of members are marginal and small farmers, and around 15% are landless, reflected in the TUG management ratios. Communities also picked the most marginalized to benefit from income generating activities, fisheries and resettlement support.

5. Tank Rehabilitation and resulting agricultural Improvement: Tank rehabilitation led to improved water capture and use, which was achieved through the implementation of physical works that were identified with community participation. Together with exposure to improved water management and agricultural practices, this provided a range of agricultural benefits, leading to improved livelihoods in a command area under the 3,710 project tanks that was over 150,000 ha. A detailed project study showed 20% increased irrigated area, 44% increased water volume, raised groundwater levels, 42% increased groundwater extraction, and 23% improved water use efficiency. Farmers clearly benefited from the tank rehabilitation works, with a 47% increase in total production on an average, compared to controls, which had increased to 12% (a 35% incremental difference). As the target of 35% is only for the lower half of the command area, *the PDO indicator target has been achieved considerably.* This was also distributed well in that there was a 20% incremental cropped area for tail end farmers, who usually are the last to benefit. Furthermore, in project tank command areas, the net income for farmers increased by 76%, compared to a 42% increase for farmers in non-project tank command areas (IAS 2012). Nevertheless *the incremental 33% on average is considerably better than it is for the target 25% for half of the farmers; thus this PDO indicator has been exceeded.* In addition, a number of improved agricultural practices were demonstrated by the regional Universities of Agriculture Sciences (UAS), such as for improved seeds and water management methods. This resulted in widespread adoption of basic agriculture techniques appropriate to tank farmers for water scarce situations and for lower inputs of costly chemical fertilizers and pesticides, directly covering 26,767 beneficiaries, with further exposure for over 200,000 farmers.

6. Income increases from fisheries and other income generating activities: The project directly supported income generating activities, particularly for the landless and agriculture laborers. A large portion of the allocated income generating activities support funds were channeled through women's self-help groups, a large section of whom belonged to lower castes or were tribals, with 99,453 beneficiaries. The IAS 2012 indicated that incomes of members have improved by 56% as compared to non-beneficiaries (41%), with an incremental increase of 15%. Formally this achievement, although considerable, is less than the target PDO indicator. This in part is attributable to the small loans available. In addition, TUGs supported resettlement of 7,803 poor encroachers from farming tank bed areas and helped them in new livelihoods, often doubling their incomes (not seen under other government programs). In 1,403 tanks about 7,800 landless (75%) and marginal farmers (25%) were provided incremental income opportunities from the fisheries activities generating additional income averaging ₹ 5,179 per household involved in fishing.

7. Efficiency: The overall economic rate of return (ERR) is estimated to be 17%, lower than the combined (PAD and AF) estimate of 19%. The estimated net present value (NPV) is ₹ 1.1 billion (US$23 million) at a discount rate of 12% (the same rate as in PAD/AF), which is about 3/4th less than the PAD/AF estimate of ₹ 4.6 billion (adjusted to 2012 constant prices using the Indian Consumer Price Index).

The project has over achieved the targets in terms of (i) a 6% increase in area irrigated by the tanks, and (ii) 14 to 62% higher crop yields in non-paddy cereal crops, pulses and horticulture crops. At the same time, the project has not met targets - (i) with 49% lower crop yields in paddy and 11% lower yields in oilseeds (ii) with a reduction in the Water Surface Area (WSA) covered under fisheries by 81%, (iii) with a 39% reduction in the sustainability of demonstrated fisheries management practices and (iv) with a 21% decrease in fish yield.

The impact of over and under achievements of the targets were assessed. A net incremental income impact is marginally higher by 2% at the farm level for agriculture but is lower by 22% for fisheries. However, agriculture accounted for 70% of the incremental annual economic benefits at full project development as against only 13% for fisheries as projected in the PAD/AF combined estimate. But this has not helped in achieving the targeted ERR mainly due to cost and time over runs in the implementation of project activities. Over a 25 year project life, implementation itself extended for 11 years, during which, only 46% of the project costs were thinly spread over the first nine years and the remaining 54% were spent in the last two years, consequently delaying the start of project benefits by four years and delaying the realization of phased project benefits by five years. This has substantially reduced the size of NPV by 76% while pulling down the realized ERR to 17%, despite reasonable performance in rehabilitating the actual number of tanks that were targeted (94%) and better achievement in realizing irrigated area at 6% more than what was planned for.

8. Justification of the Overall Outcome Rating: The project development objective has been achieved satisfactorily as it has demonstrated the viability of a community-based approach to tank improvement and management by returning the main responsibility of tank rehabilitation and modernization and the subsequent operation and maintenance O&M to village-level tank user groups (TUGs). This approach has contributed to improving rural livelihoods and the income of rural communities. The associated indicators, as well as the supporting intermediate outcome indicators from AF are measured. The project met several of its important targets. There were generally minor shortcomings in the achievement of project objectives, relevance and efficiency. The following justifies the rating:

TUGs managed the tank rehabilitation process in an inclusive manner, involving a large portion of traditionally disadvantaged users, including women, lower castes and the landless.

The project performed well in terms of productivity based on incomes arising from the agricultural outcomes, which in turn were a result of good rehabilitation of a considerable number of tanks and the resulting increases in water availability and distribution. More importantly the project was able to cover the majority of stakeholders in demonstrating agricultural practices which is not very common in irrigation projects

- Efficiency is reasonable, partly due to the lower than planned unit costs and complex nature of the project, that were offset due to the lengthy implementation period.
- Ensuring the sustainability of TUGs is a challenging process that requires ongoing support for some years after the handover of the O&M of tanks to TUGs. This is a major challenge and the project after Bank closure has stepped up efforts to strengthen this aspect. The detailed design and mechanisms for tank management and scaling up of the project model was slightly below expectations and could have been articulated further.

Impacts

a. Poverty impacts, gender aspects and social development

Poverty impacts: The project was generally well targeted and inclusive, as noted in the analysis of the PDO. It also provided considerable benefits to a large number of small and marginal farmers and the landless. The IAS 2012 analysis notes a doubling of the average mean net income per farmer from ₹7,547 from cropping in *kharif* (rainy) season to ₹15,573, compared to only a 50% increase for control farmers (from ₹8,779 to 13,432 per season). The project has benefited 213,900 tank command area farmers, which is 10% more than the target. 90% of them are small and marginal farmers. The average farm financial income, at constant 2012 prices, increased by ₹8,015 per year for an average holding size of 0.75 ha, which is sufficient to lift at least one member of a farm household above the poverty line based on the Indian Planning Commission estimates for rural Karnataka for 2004/05, updated for constant 2012 prices using the inflation index. About 70% of the project beneficiary farmers are resource poor marginal farm holders. In terms of directly benefited population in the project farm families, about 14% of them, namely 149,730 rural poor are potentially benefited by the poverty alleviation impact due to increased farm income.

Increased and improved irrigation coverage in the rehabilitated tanks, resulted in intensified and diversified irrigated agriculture, generating additional farm employment for 8,050 persons every year. This will help the landless and resource poor households by providing jobs for about 270 days in a year and has the potential of alleviating poverty additionally for about 40,250 rural poor in the project area.

Farm-based income and employment generation activities generated by the project through improved agriculture in the 3,710 rehabilitated tanks will have sustained poverty alleviation impacts for about 190,000 rural poor in the villages covered by the project. This accounts for 17% of the population in the project villages.

The project has further generated employment and income through rehabilitation investments in 3,710 tanks covered by the project during the project implementation period as follows: (i) wage employment, estimated as 3.2 million person-days and equivalent to 11,830 person-years in total and (ii) wage income of ₹16,200 per year per job. About 62% of the beneficiaries under this category belong to socially disadvantaged SC and ST groups.

The project has also helped 51,715 resource poor families set up and sustain livestock dominated income generating activities which have the potential of generating an average annual income of ₹3,900 per beneficiary. About 48% of these beneficiaries are from SC and ST groups and 21% of the beneficiaries are landless labor households.

Gender benefits: As noted in the achievement of the PDO section, women formed a significant part of the TUG membership and management. They were often given responsibility as TUG treasurers, recognized for their thoroughness and accountability. An important strategy was the close relationship between the TUG and SHGs in the village, primarily for management and also to ensure that the benefits of the income generating activities support reach vulnerable groups (often widows or women headed households). SHGs also mobilized diverse groups in the community towards tank related activities, and in a number of cases took the lead in tank rehabilitation and significantly, sustained O&M. The comprehensive and participatory approach to tank planning and rehabilitation was also important in identifying and implementing appropriate structures, such as steps on the bund for access to clothes washing areas mostly used by women, and highlighting drinking water needs (which form a considerable daily burden in terms of water carried by women). No detailed analysis was done of the timesaving aspects of the project.

Distribution of benefits: Comprehensive analysis was not available as to the finer details of the distribution of benefits from increased water availability, although the majority of beneficiaries were clearly the command area farmers – mainly marginal and small farmers. It is not clear how larger farmers with groundwater irrigation outside the command areas may have benefited from increases in groundwater levels as they would have larger areas of land for production (often farmers had land in command areas and outside as well). The potential negative effects of the increased number of borewells on groundwater availability as a response to increased recharge was not assessed, although ICRR mission discussions noted that the increase in the number of borewells was also heavily driven by market forces and subsidized electricity. A positive benefit that has not been thoroughly quantified, but is of potential significance to livestock keepers, many of whom are poor and often marginalized tank users, was the increased availability of water for animals for 2-3 months in the dry season, reducing traveling time, and improving animal health.

b. Institutional change and strengthening

The project has had a marked impact on the manner in which tanks are managed, or at least rehabilitated, and on the level of engagement by the local communities. A sense of ownership has been created and local leaders have emerged from the village communities. TUGs have become established as the management entity for the tank, and have been found by the impact assessment and the ICRR team field visits to be functioning entities (TUC members are knowledgeable about their role and functions, meetings are held, members attend, accounts are kept, water allocation plans are made, water management staff are employed, charges are made and recorded, etc). The processes followed by the project, the preparation of the ITDP, the transfer of funds to the TUG to carry out the physical works and other activities and the capacity building of the tank users and TUC members have enabled and supported this change.

A key indicator of this new found local capability is the “organic” growth of TUG Federations: typically once user groups have been formed and are functioning effectively they tend to start looking outwards. Since 2005, this process has been ongoing in Karnataka with the formation of TUG Federations which have been formed by TUGs grouping and working together. The Federations were established for the purpose of providing assistance and guidance to individual TUGs, protecting tanks from encroachment, mobilizing resources for tank development, representing TUGs to block and district administrations, assisting in times of flood or drought and, in some cases, organizing the provision of crop inputs and marketing of outputs. The project has assisted the process by organizing workshops, initially in November 2009 for some 500 participants including TUG representatives and JSYS DPU staff from 18 Districts, and later in individual Districts where TUGs expressed an interest in the process. An important feature of these workshops and the subsequent support extended by JSYS to forming and supporting these Federations, has been the realization that Federations represent an important mechanism for supporting and sustaining TUGs in the future. To date, some 18 District

Federations and 14 Taluka level Federations have been established in all project Districts and very recently these groups have led to the formation of a State Federation.

A Taluka Committee of Taluka level government agencies has been fostered in several areas, with a view to supporting federations and TUGs in identifying other sources of support. Given the time required to develop and operate a Taluka Committee, this is clearly an important initiative. However, the continued operation of this mechanism has not yet been formalized.

As an institution, JSYS developed valuable expertise in the formation and support of community-based, self-supporting and empowered TUGs. This experience was particularly consolidated during the last four years. In contrast to the changes that have taken place in the approach to tank development and management adopted by JSYS, the approach adopted by the State MID does not appear to have changed significantly over the project period. Going by reports from TUGs of work carried out by the MID on tanks under the GoI funded RRR program, tank rehabilitation and repair lessons using the JSYS approach have not been adopted. The MID has been focusing on physical works only, with little, if any engagement with TUGs or tanks users. The MID in turns claims that it is not optimally staffed and lacks the resources to be able to do anything more than focus on construction. This indicates deeper institutional issues with regard to irrigation and tank management.

This was among the first major projects dealing with water bodies through communities. Prior to this project, NGOs did not have the capacity to work on such water management issues. The project provided a good platform for NGOs to build their capacity in restoring water bodies and in water management particularly in agriculture. Based on the success of this project, some well performing NGOs have been able to generate funding from other sources and are helping the communities/ federations to strengthen further.

c. Unintended outcomes and impacts

There were a number of unplanned outcomes during the project period, which have been mentioned in previous sections: TUG federations emerged, and other projects and programs have adopted the basic community tank management model. It was noted in some Districts that the District Collector had requested the TUGs to handle other rural development schemes or the RRR program - a highly significant institutional achievement if replicated. Moreover the linkages with other ongoing schemes will further strengthen the changes supporting their sustainability and provide funds for O&M. Through ICRR field visits it was learned that the TUG capacity to write formal documents, for management of records and to prepare and advocate resolutions helped in wider community activities. In addition, the project also undertook specific rehabilitation works which took into account restoration of ancient historical or religious related tank structures, and also repaired bunds in such a way as to provide road access for otherwise isolated communities (sometimes reducing traveling time by over half a day).

Summary and lessons learned

1. Despite the complex design of the project and the ten years that it has taken to complete it, the project has had satisfactory achievements in terms of outputs and outcomes, albeit with some areas of moderate achievement. The project has successfully demonstrated the community based approach for improving and managing selected tanks and has improved rural livelihoods and the income of rural communities. Central sponsored schemes and several state projects have adopted a similar approach and to date this is the only project which has empowered communities to implement, operate and maintain tanks and in which, civil works were executed only after the formation of community organizations.

2. In terms of tank improvement works, the project was implemented in two phases, almost like implementing two independent projects in two different sets of districts. Out of 3,925 tanks considered, 3,710 tanks have been taken up for implementation, which account for 17% of the tanks in the State. In order to rehabilitate, modernize and manage these 3,710 tanks, the project formed 3,126 TUGs. Through NGO mobilization, inclusive Tank User Committees (TUC) and Gram Panchayath Sub-Committees (GPSC) were established, with members covering the multiple uses of tanks. The JSYS and TUGs oversaw the preparation of ITDP and the implementation of the physical works; trained TUC members and ordinary members; established TUG processes and procedures and generated community contributions. Since the project put more emphasis on preparation, it resulted in slower implementation during the start up years (with a time lag of about 2 years) which also affected the additional financing phase. At the end of the project, out of 3,710 tanks selected for implementation, 1,742[21] had been or were about to be completed with handing over to TUGs. The remaining 1,761 tanks were under implementation with an overall progress of around 50% (ranging from 10-90%) to be completed through GoK funds by early 2013. In 207 tanks, there were some TUG activities, but civil works progress was negligible, and therefore they were to be dropped, even though the non-civil works such as agricultural practices, fisheries, income generation activities, and training for operation and maintenance were completed. The civil works and agriculture technology extension were generally of good quality, with good support from JSYS and UAS. The resulting outcomes were generally good in terms of TUG inclusion and functioning, implementation of works, agriculture support activities, and the resulting water capture and agriculture production benefits. The agricultural support activities were designed in such a way that almost all the farmers belonging to the tank system were served, which is an unusual practice in irrigation projects. The project also achieved benefits in terms of fisheries and income generating activities. At the time of closure of the project, there were some concerns regarding sustainability, although developments in the period after closure of Bank financing indicated nevertheless a strengthened impetus for support to TUGs and sustainability. The factors contributing to these results are outlined below.

3. Substantial institutional commitment and adaptation: Commitment and leadership played a considerable part in the project's successes. The project started off with considerably high profile support and enthusiasm and continued under excellent leadership for most of the time. Initially this was achieved with the support of local experienced ANGOs who were mainly used for capacity building purposes[22]. The project developed excellent guidelines and manuals for both physical activities as well as community mobilization. Throughout the project phases there has been considerable evidence of strong commitment by some key JSYS Executive Directors and staff to the process. The project had some disturbance during the transition period of the AF. After some start up issues during the AF phase, with Government and Bank efforts to maintain continuity in project leadership, stability was restored and there was considerable commitment to complete the project and maintain a high quality throughout. The Government has also ensured strong JSYS leadership after the closure of Bank funding. Despite high staff turnover (dealt with in more detail below) the basic tank rehabilitation process has continued – rather robustly over the project years. Thirteen training modules have been developed for community mobilization, which are used at various stages starting from the PRA and up to the post implementation phase. The project team has also designed various training programs to induct new implementation teams.

4. The Project team at various times responded to issues and adapted processes, using the findings of various studies. This showed a considerable commitment to learning processes, as are further noted in section 2.3 on Monitoring and Evaluation (M&E). For example quality of works was a concern in the first part of the project, where Cluster Facilitation Team (CFT) NGOs were responsible for

21. 1,640 formally handed over by January 2012.
22. After about 2004 the four ANGOs were not involved as core capacity building functions and training modules had been transferred to the project staff. Also several of the mobilizing NGOs had considerable training capacities.

engineering. This resulted in considerable delays in fixing issues, and to some extent disappointment in the communities. Nevertheless, this was addressed in the second part of the project, where JSYS responded by bringing engineering support and supervision more in-house, leaving NGOs to focus on social mobilization.

5. Insufficient human resources, especially at critical times of the original project: A concern affecting project progress was the high turnover of staff at certain critical times at different levels including JSYS, District Project Unit (DPU) and at the NGO level. Key technical positions which through large parts of the project were poorly staffed included: (i) engineers working for the NGOs; (ii) engineers in the JSYS; (iii) monitoring and learning specialists; and (iv) training and social specialists. The shortage of engineers was partly due to the boom in infrastructure development around the same time and the low salary structure of JSYS. Later in the project, it was corrected by raising salaries and also by hiring retired and young engineers who were strengthened through training. Since these were small works, the fresh graduates with adequate training were able to carry out quality control and supervision. At the state level, a lack of key staff for longer periods contributed to a fragmented management information system (MIS, discussed in more detail below) and impaired training programs. The lack of a State Project Unit (SPU) Training Specialist meant that the full in-depth training needs and programs could not be looked at further.

6. Some of these issues of turnover and lack of supervision staff particularly affected the critical transition period between the original project and the AF. During this period the project experienced many changes in leadership in JSYS and lack of supervision at DPU. In the critical period of 2007-08, there were a total of seven executive directors and the project was understaffed for district project coordinators, as well as in M&E and training positions. Due to lack of supervision, the quality of works, services of NGOs and involvement of TUGs lagged during this period. In order to fix these irregularities, NGOs were replaced with district facilitation teams (DFT) for the tanks that were part of the original project and several revisions were introduced in design and procurement procedures during the implementation of new tanks.

7. In the assessment of the supervision of the project, the Quality Assurance Group (QAG) expressed concerns with regard to approving AF despite the lack of completion and sufficient confidence in outcomes of the first phase of the project in the period 2006-2007. Soon after approval of the AF, the project experienced a turnover of Bank team leaders as well. The new team leaders at both the project end and the Bank end, had a considerable task as they had to catch up with physical implementation targets and ensure a good quality process. Perhaps due to this, during this period and from then on there seemed to be a few activities introduced by the GoK to look at institutional and O&M issues in detail, which are important for consolidating long-term sustainability. Although the Bank team reminded the senior management team to look at institutional and O&M issues during each mission, it was only prior to the closure of the project that the GoK initiated the discussion on mainstreaming and the role of JSYS for implementation of other tanks in the state.

8. Challenges to start up and scale up of implementation: The challenges to starting up both in the first phase and in the second phase seemed to have been considerably underestimated. However, these challenges were overcome by stable and dynamic leaders. The challenges worsened further when the project was scaling up and turnover in leadership increased. The inadequate staffing, especially of engineers, as discussed above, was a major bottleneck in the projects an performance and the single most important factor responsible for the slow implementation of key project activities particularly during 2006-08 when the original project implementation was being scaled up with more than 1,000 tanks. Due to unstable leadership and an understaffed supervision team, the implementation was affected adversely and was of poor quality. The tanks were handed over prematurely in order to show progress for AF. After AF in 2008, the project was left with very ambitious targets to implement, with almost 1,800 new tanks in eight original project districts and

eight new districts, and to complete 1,000 ongoing tanks under the original credit in the next 3.5 years. The project had to also set up new DPU's in eight new districts and also conduct technical, social and financial audits for the ongoing tanks that were handed over prematurely. Starting August 2008, the project had a stable leadership as the second phase of the project had commenced, but with some of the same start-up challenges that came with delivering in the first phase. Although the project team started working effectively, it was a very time consuming job in the absence of an organized information system, with the additional time required to complete the work that was abandoned in the middle, and with limited staff who were already overloaded with the ambitious target for implementation. The project was expecting to have two working seasons for civil works, but preparation took longer than expected. Major delays were experienced with the procurement of the supporting key consultancies, including almost 60 NGOs and topographical survey consultancies. Scaling-up faced challenges, which also came up when the targets increased by 700 additional tanks in 2010. Due to the time taken up in preparation for the implementation and procurement of contracts, the project was left with only one working season during 2011, for most tanks.

a. Government performance

The borrower (GoK) provided high commitment at the start of the project, spearheading the design and development of the project, and providing a vision for the mainstreaming of the approach more widely. The State has also provided funding support for the implementation of the project for the entire duration, as well as commitment (₹1,200 million) to finish off works in 2012, after closure of the Bank project. During the preparation of the project, the government demonstrated its commitment by providing a working platform with the approval of O&M policies and also orders to facilitate the financial sustainability of TUGs. A society with a multi-disciplinary unit was setup which had highly trained professionals to implement this innovative approach.

The project has served as a guideline for the national program RRR and other state projects. While the concept has been welcomed even at the national level, the GoK position on the institutionalization and scaling-up of the community based tank management model, and of JSYS and its respective roles with MID, have been left hanging for a large part of the project, from 2006 up to early 2012.

Although the government orders facilitated the functioning of TUGs during the project, the Tank Irrigation Act which has been drafted to broadly address the rights of TUGs, as well as to fix water charges is yet to be approved. There were also some missed opportunities in terms of systematic convergences with line departments and PRIs, and their related programs, such as RRR. It must be recognized however, that such convergences are challenging in any place and not just in Karnataka.

During the first four and last four years of the project, there was stability in the executive directors. The JSYS team was highly committed to first prepare it well and to subsequently scale-up the approach on a larger scale. The project performance was adversely affected during the period 2006-08 when there was a very high turnover of project executive directors for the critical middle period of the project. The frequent changes (7 new Executive Directors between 8 May 2006 and 20 August 2008, 11 Executive Directors overall during the 10 years of the project) meant a loss of focus and continuity on key activities, in addition to being disruptive for project staff and real progress was only made when the current Executive Director was appointed in August 2008 and remained in post till the middle of May 2012. This continuity in leadership was important for implementation of the AF phase of the project. The Government has taken due diligence to provide a competent Executive Director as his replacement during the project close.

b. Implementing agency/agencies performance

The JSYS has overseen the implementation of a complex and largely groundbreaking process, and taken it to a significant scale. The project implementing agency (JSYS) has had a significant number of highly dedicated staff and executive directors, particularly in the beginning and in the last few years. The project had prepared excellent guidelines, and a manual and had setup induction training sessions with the help of leading ANGOs and other agencies. The turnover in engineers and other support staff was overcome through induction and by including training sessions as a part of the job. Despite the changes in leadership, some key staff at SPU were able to maintain the standard procedures and ensure smooth implementation.

Nevertheless, the several project systems due to their complexity and challenging areas took a very long period to set up. There was high turnover in the M&E specialists and training specialists at SPU and in the district level supervision staff particularly district coordinators and engineers. As a result, critical strategies and systems were not tackled comprehensively or with continuity. The project was able to collect a wealth of data through their M&L consultancy and while this data was not managed in an integrated way, it allowed for a number of studies and quantitative analyses to be carried out under the project.

Lessons learned

The mission has identified an initial set of lessons learned which may have wider applicability for scaling-up and adaptation:

Community based tank engagement in rehabilitation and management can work: JSYS has developed well-documented and robust processes and procedures for TUG formation and tank rehabilitation phases. The participatory process (with TUG ownership and stability) works very well and delivers results on the ground and also fosters further innovation. The project has demonstrated a simplified procurement process through communities for civil works that may be useful in other tanks and other programs. The training material for TUG mobilization is quite robust and is already being utilized by other projects.

Leadership is required at all levels and produces dividends when in place: It is evident that there was strong leadership and commitment to the community-based development philosophy and approach both at the beginning and at the end of the project. In addition there were some committed professionals within JSYS who maintained the approach throughout the project. This was particularly important during the middle period when there were many changes at the Executive Director level.

Well performing NGOs are the key to the success of the approach: The NGOs play a key role in the success of the community based approach. The selection criteria should set smart indicators to evaluate their performance. The NGOs with demonstrated performance in the area may be prioritized so that it ensures that they can sustain it beyond the project. For instance, some well performing NGOs have managed to continue even after the project due to their commitment and long term presence in the area.

New models and institutional mechanisms need considerable attention to start up, as well as to scale-up issues and for related capacity development – with commitment to a longer development process, and not rapid scaling-up. It requires greater realism, and an analysis of institutional issues and a gradual build up of capacities based on experience. Legal and institutional transformations need concerted assistance on change management, which is seldom given sufficient support or time. Significant institutional change including that of departments and federation type structures (not just at the community level) often requires timescales of 8-10 years.

A commitment to a longer process should also limit the pressures for scaling-up too rapidly before models are well tested: AF should perhaps be triggered after key sustainability outcomes in existing project areas have been achieved. Further expansion into new districts with required new management units, should be done only after readiness measures have been assessed.

Managing common property resources is highly challenging: In order to manage a group, it is best to first start with relatively homogeneous and small groups and identify reasons/benefits for them to be together. Nevertheless the well managed development of a multi-sector user group, with strong links to (but not control by) the local government is critical to solving conflicts and addressing multiple needs.

Also with climatic variability affecting common resources such as water it is important to allow for the project to cover several seasons to make allowances for the occurrence of dry periods in order to understand how management can cover multi-year variability.

Start simple and with tanks systems which are likely to be successful: The project had two underlying aims, to test a new approach to tank development and to provide support to disadvantaged areas, or communities. It may have been better to focus on developing and testing the community-based approaches in locations where the environment (climate, local leadership and local commitment) was likely to lead to more successful outcomes. Once the model was developed and tested, it could have been expanded to more challenging localities and communities.

There needs to be an institutional support system to continue testing and refining the model: While the process is well tested and refined, there is some room for delegating further flexibility and fostering further innovation within the approach, in certain aspects such as managing contract rates, member contributions, water charges, allocating of funds to different works, federation development, etc. These elements are ideally handled by a flexible institution like JSYS, working closely with main line departments.

Monitoring, learning and evaluation systems need to be integrated and allowed to evolve in a concerted manner: MIS systems need to be modular to address component needs, but must develop under a common framework. Further any information systems should be strictly functional, designed to specifically address stakeholder needs, from communities to managers. Developing this in turn requires strong management if the project is to grow so as not to result in fragmented and duplicated work.

Management, operation and maintenance – the managing of tanks needs to take a much more central stage: It is essential to have in place well thought out systems, detailed planning, capacity building and basic institutional support, and policy such as for water charges, and associated resource mobilization – from a much earlier stage in the process.

Agriculture extension needs farmer to farmer interactions: Farmers' field schools have been shown to be an important complementary mechanism to impact large numbers of farmers, where farmers are empowered to learn from each other and access resources – which helps strengthen post project sustainability.

Integrating tank management with agriculture is critical: This requires practical and sustained linking and coordination mechanisms between TUG farmers and participatory farmer groups, and support agencies, be they State departments, universities or other agencies. The commitment of the staff that are managing such linking and coordination, must be complemented by stability in their positions. Further the roles and convergence activities with the Department of Agriculture need to be developed and formalized.

Greater focus on water management: Though the project was essentially about the management and use of water there were no water management specialists included in the project, at any level. Water management at the tank level is relatively poorly understood, and little practical guidance was given to TUG management and water users, on alternative approaches to water management. Good water management – linked to crop planning - is central to service delivery and thus in turn to fee collection. If the TUG is not providing a decent level of service (water management) it is unlikely that water users will contribute to the costs of maintaining the service.

With increasing pressures for water and the changing nature of the rural economy, it will be important to provide conceptual and institutional support to:

Foster further convergence between water management and agriculture extension systems. The project demonstrated the benefits of grassroot level involvement in water management on agriculture, as well as the effects on related new technologies. Further it is important to strengthen the linkages between agriculture interventions, with water management, especially to optimize the use and sharing of saved water (as in the case of direct seeded rice).

Further develop planning and management and measurement systems which incorporate the tank in the wider hydrological perspective, as well as user demands on it. This can be accomplished by encompassing within these systems, groundwater and watershed dynamics and monitoring and by addressing changing agricultural trends and demands as a whole. Associated newer technology such as CAD and hydraulic simulation models can be also incorporated into tank rehabilitation and planning.

References

Achyut Man Singh. 2010. Modernisation of Farmer Managed Irrigation Systems in Nepal. Pages 55-60 *in* Hydro Nepal, Issue No.6, January, 2010.

Administration report [being part 2 of the Public Works Department administration report]. 1887. Printed by R. Hill for Public Works Department, Madras.

Administration report [being part 2 of the Public Works Department administration report]. 1931. Public Works Department, Madras.

Agarwal A and **Narain S.** 1997. Dying Wisdom: rise, fall and potential of India's traditional water harvesting systems. New Delhi: Centre for Science and Environment.

Ansari Abid A and **Sarvajeet Singh Gill** (eds)**.** 2014. Eutrophication: Causes, Consequences and Control, Vol. 2. London: Springer.

Balasubramanian R and **Chandrasekaran C**. 2007. Poverty and Natural Resource Degradation: Irrigation Tanks in South India. Pages 36–45 *in* Poverty, Health, and Ecosystems: Experience from Asia (Steele P, Oviedo G and McCauley D, eds.). Gland and Manila: IUCN and Asian Development Bank.

Chang William YB. 2014. Eutrophication in the Great Lakes of the Chinese Pacific Drainage Basin: Changes, Trends and Management. Pages 89-93 *in* Eutrophication: Causes, Consequences and Control, Vol 2. (Abid Ansar A and Sarvajeet Singh Gill eds). London: Springer.

Chow VT, ed. 1964. Hydrology and its development. *In* Handbook of Applied Hydrology: A Compendium of Water-resources Technology. New York: McGraw-Hill Company.

Chow VT, **Maidment DR** and **Mays LW.** 1988. Applied hydrology, McGraw-Hill series in water resources and environmental engineering. New York: McGraw-Hill.

Cotton ER. 1900. General Sir Arthur Cotton, RE, KCSI, His Life and Work. By his daughter Lady Hope. With some famine prevention studies by William Digby ... Portraits, maps and illustrations. London: Hodder & Stoughton.

CWR. 2003. Tamil Nadu Water Resources Consolidation Project - Post Project evaluation of Irrigation Commands. (Evaluation report). Chennai: CWR, Anna University.

DHAN Foundation. 2003. Co-management of Tank systems: A study on various conflicts of water and water use in Gundar River Basin.

Dhawan BD. 1999. Studies in Indian irrigation. New Delhi: Commonwealth Publishers.

Dhruba Pant. 2010. FMIS Research: A Reflection on IWMI's 25 years in Nepal. Paper presented in Fifth International Seminar on Dynamics of FMIS: Socio, institutional, economic and technical context. Organized by FMIS Trust, 25-26 March, 2010. Kathmandu, Nepal.

Ellis W. 1963. Irrigation Manual. Madras: College of Engineering.

Government of Karnataka. 2001. Perspective land use plan for Karnataka - 2025. Bangalore: Karnataka State Land Use Board.

Government of Karnataka. 2011. Bangalore: Water Resources Department, Government of Karnataka.

IUCN. 2005. Multiple benefits of small irrigation tanks and their economic value a case study in the Kala Oya basin, Sri Lanka (Occasional paper No 7). Colombo, Sri Lanka: IUCN.

John Augustus Voelcker. 1893. Report on the Improvement of Indian Agriculture [With map]. London: Eyre & Spottiswoode.

MacKay H, **Finlayson CM**, **Fernández-Prieto D**, **Davidson N**, **Pritchard D** and **Rebelo LM.** 2009. The role of Earth Observation (EO) technologies in supporting implementation of the Ramsar Convention on Wetlands. Journal of Environmental Management 90: 2234–2242.

Mandal MAS. 2001. Irrigation Development in Bangladesh: Socioeconomic Issues and Evidence. Paper published *in* Proceedings of National Workshop on Pro-Poor Intervention Stragies in Irrigated Agriculture (Intizar Hussain and Eric Biltonen, eds.). August, 2001. Colombo, Sri Lanka: International Water Management Institute.

Millennium Ecosystem Assessment (Synthesis report). 2005. Washington DC: Island Press.

Morgan F. 2004. Southern India: its history, people, commerce, and industrial resources, second ed. New Delhi: Asian Educational Services.

Mujeri Mustafa K and **Intizar Hussain.** 2001. Poverty Alleviation through Improved Irrigation Practices: Bangladesh Perspectives. Paper published *in* Proceedings of National Workshop on Pro-Poor Intervention Stragies in Irrigated Agriculture, (Intizar Hussain and Eric Biltonen, eds.). August, 2001. Colombo, Sri Lanka: International Water Management Institute.

National Wetland Atlas: Tamil Nadu (Atlas). 2011. Ahmedabad: Indian Space Research Organisation, Space Applications centre, National Wetland Atlas: Tamil Nadu.

Nelson JH. 1868. The Madura country. Madras: Asylum Press.

Osman Mohammed, **Wani SP**, **Vineela C** and **Murali R.** 2009. Quantification of Nutrients Recycled by Tank Silt and its Impact on Soil and Crop - A Pilot Study in Warangal District of Andhra Pradesh *in* Global Theme on Agroecosystems, Report no. 52. Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics.

Padmaja KV, **Wani SP**, **Agarwal Lav** and **Sahrawat KL.** 2003. Economic assessment of desilted sediment in terms of plant nutrients equivalent: A case study in the Medak district of Andhra Pradesh. Global Theme 3: Water, Soil, and Agrobiodiversity Management for Ecosystem Resilience, Report No. 4. Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics.

Raju KV, **Karanth GK**, **Bhende MJ**, **Rajasekhar D** and **Gayatridevi KG.** 2003. Rejuvenating Tanks – A Socio-Ecological Approach. Bangalore: Books for Change.

Raju KV and **Tushaar Shah**. 2000. Revitalization of Irrigation Tanks in Rajasthan. Economic and Political Weekly 35 (3 June): 1930-1936.

Raju KV. 2006. The Legal Framework for Water Management and its Working. *In* Managing water scarcity: Experiences and Prospects (Vaidyanathan A and Oudshoorn, eds.). New Delhi: Manohar Publications, IDPAD Series.

Raju KV. 2008. Financing Irrigation Development in Cambodia: Emerging Options, Report Submitted to FAO, Phnom Penh, Cambodia. This study was supported by FAO and Ministry of Water Resources and Management, Cambodia.

Raju KV, **Manasi S** and **Lenin Babu K**. 2011. Tanks in Mid-Godavari Basin, India: Building Techno-Ecological Status. LAP Lambert Academic Publishing.

Revenue Department Policy note. 2012. Chennai: Government of Tamil Nadu, Revenue Department.

Royal Government of Cambodia. 2007. Strategy for Agriculture and Water (2006-10). Prepared by Technical Working Group on Agriculture and Water. Ministry of Agriculture, Forestry and Fisheries and Ministry of Water Resources and Meteorology. Phnom Penh.

Samuel Best Captain. 1852. Notes on building and road-making, with rules [by Captain Samuel Best] for estimating repairs to tanks and channels: compiled for surveyors and overseers, in the Department of Public Works Illustrated Second edition enlarged with an appendix, etc. Madras: printed by Pharoah and Co.

Shanmugham CR and **Kanagavalli J.** 2005. Technology of Tanks: The Traditional water bodies of rural India. Madurai: DHAN Foundation.

Sharma CBSR. 1996. Tanks of Tamilnadu: An ecological revival - A national tank authority is urgently needed. Pages: 73–81 *in* Conservation & Development of Tank Irrigation for Livelihood Promotion. Gainesville, Florida, USA: Conservation and Development Forum (CDF) & Network of Institutions Engaged in Tanks (NET).

Sharma CBSR. 1997. Ecography of Small Water Bodies - A pilot study of five irrigation Tanks and a coastal wetland in Tamil Nadu and Pondicherry (Ecography). Pondicherry: Salim Ali School of Ecology, Pondicherry University.

Sivasubramanian K and **Gandhiraj V.** 2009. Irrigation in Tamil Nadu: With Special reference to Tank irrigation (Monograph No. 8), Themes in social sector research: The S.Guhan memorial series. Chennai: Madras Institute of Development Studies.

University of Agricultural Sciences, Bangalore and Panchayat Raj Engineering Department (UAS and PRED). 2009. Survey of Tanks in Karnataka. Government of Karnataka.

Vaidyanathan A. 2001. Tanks of South India. New Delhi: Centre for Science and Environment.

William Grant. 1857. The circular and standing orders of the Department of Public Works from 1833 to 8th July, 1857: forming a complete code of rules for the guidance of the members of the Department on all matters of official routine / compiled by William Grant, first uncovenanted Assistant to the Chief Engineer, DPW. D.P.L.C. Connor, at the Press of the Society for the Promotion of Christian Knowledge, Madras.

Seenivasan R. 2012. Ignorance and Neglect: India's Manmade Tank Wetland Ecosystems (Draft)**,** Ph.D student, School of Law, University of Westminster.

The World Bank. 2012. Implementation of Completion and Results Report on India; Karnataka Community Based Tank Management Project. Washington DC, USA: Rural Development Sector, India Department, South Asia Region.

The World Bank. 2002. Project Appraisal Document: Karnataka Community-Based Tank Management Project. 22 March 2002. Rural Development Sector Unit, India Country Unit, South Asia Regional Office.

Penning de Vries Frits and **Ruaysoongnern Sawaeng**. 2010. Multiple Sources of Water for Multiple purposes in Northeast Thailand. IWMI Working Paper 137, Colombo, Sri Lanka.

Wangkahart T, **Toomsan B**, **Patha P** and **Wani SP**. 2005. Integrated watershed management for land degradation and improving agricultural productivity in north-east Thailand. *In* Watershed Management Challenges: Improving productivity, Resources and Livelohoods (Sharma BR, Samra JS, Scott CA and Wani SP, eds.). Colombo, Sri Lanka: International Water Management Institute.

Wu Wanfu, Yang Ningsheng and **Jin Le**. 1991. On China's Lake Fishing Development. Naga, The ICLARM Quarterly, Jan 1991.

http://factsanddetails.com/china.php?itemid=1892&catid=9&subcatid=63

http://www.arlingtoninstitute.org/wbp/global-water-crisis/457

http://www.fao.org/nr/water/aquastat/countries_regions/MDV/index.stm

http://www.icid.org/v_vietnam.pdf

http://www.iwmi.cgiar.org/Publications/Other/pdf/Summary-Improving_water_use_in_rainfed_agriculture_in_the_greater_mekong_subregion.pdf

www. jsysindia.org/06 september, 2013.

http://southasia.iwmi.org/Data/Sites/15/Documents/PDF/iwmi_south_asia_brochure-latest.pdf

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ICRISAT-India (Headquarters)
Patancheru, Telangana, India
icrisat@cgiar.org

ICRISAT-Liaison Office
New Delhi, India

ICRISAT-Mali (Regional hub WCA)
Bamako, Mali
icrisat-w-mali@cgiar.org

ICRISAT-Niger
Niamey, Niger
icrisatsc@cgiar.org

ICRISAT-Nigeria
Kano, Nigeria
icrisat-kano@cgiar.org

ICRISAT-Kenya (Regional hub ESA)
Nairobi, Kenya
icrisat-nairobi@cgiar.org

ICRISAT-Ethiopia
Addis Ababa, Ethiopia
icrisat-addis@cgiar.org

ICRISAT-Malawi
Lilongwe, Malawi
icrisat-malawi@cgiar.org

ICRISAT-Mozambique
Maputo, Mozambique
icrisatmoz@panintra.com

ICRISAT-Zimbabwe
Bulawayo, Zimbabwe
icrisatzw@cgiar.org

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