Sacred Water and Sanctified Vegetation: Tanks and Trees in India

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Introduction

Indian villages are famous for their traditional water management. This includes, in particular, village tanks (also called village ponds), important and often overlooked, examples of riparian commons. These are variously known as *talab, taal, talai, johad* etc. There are between 1.2 to 1.5 million tanks still in use and sustaining everyday life in the 0.66 million villages in India.

Official records in India (GOI 2000) classify inland water resources of the country as rivers and canals; reservoirs; tanks & ponds; beels, oxbow lakes, derelict water; and brackish water. Other than rivers and canals, total water bodies cover an area of about 7 m.ha. Out of this the tanks and ponds have maximum area (2.9 m.ha.) followed by reservoirs (2.1 m.ha.). Most of the area under tanks and ponds lies in Southern States of Andhra Pradesh, Karnataka and Tamil Nadu. These states along with West Bengal, Rajasthan and Uttar Pradesh, account for 62 percent of total area under tanks and ponds in the country.

As far as reservoirs are concerned, major states like Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Uttar Pradesh account for larger portion of area under reservoirs.

The natural resource management and water conservation efforts are at crossroads today. On the one hand, the sustainability of essential ecological processes and life support systems is threatened in the wilderness, and on the other, at stake is the security of a just and dignified livelihood of the people living in and around forests and protected areas.

Tanks serve various purposes including the ground water recharge by reducing the runoff and enhancing the water stagnation time. There is positive correlation between water impounding in tanks and ground water recharge. Ground water withdrawal through tube wells needs to be balanced by recharge through simple technologies, such as tanks. Since tanks are neglected and remain devoid of water for most part of the year, recharge is a problem. Depletion of ground water has serious consequences. It not only reduces the availability of potable water to people and their livestock, it also reduces the quantum of surplus water that can be used for irrigation and enhancement of agricultural productivity. People in Rajasthan have

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traditionally been conserving and managing water through the innovative methods. These methods are based on repeated experiences validated over several hundred years. Some of these methods have survived the onslaught of value erosion in the society and consequential disappearance of traditional water management technologies. However, several local communities in water scarce areas of India are still using these technologies.

In close association with the traditional water management, we find interesting practices of plantation ethnoforestry. Forest research scholars throughout the world have produced the *vast* quantum of research material for the use of forest managers. However, we have not been able to solve the problem of deforestation, primarily because we have not been able to provide the low-cost options and acceptable and easily understood technology for forest management and afforestation. What is the reason? The basic reason behind this is that we have ignored the equally *vast* quantum of local knowledge and local technology on forests available with the local communities. This paper provides empirical examples of indigenous knowledge on tanks and vegetation.

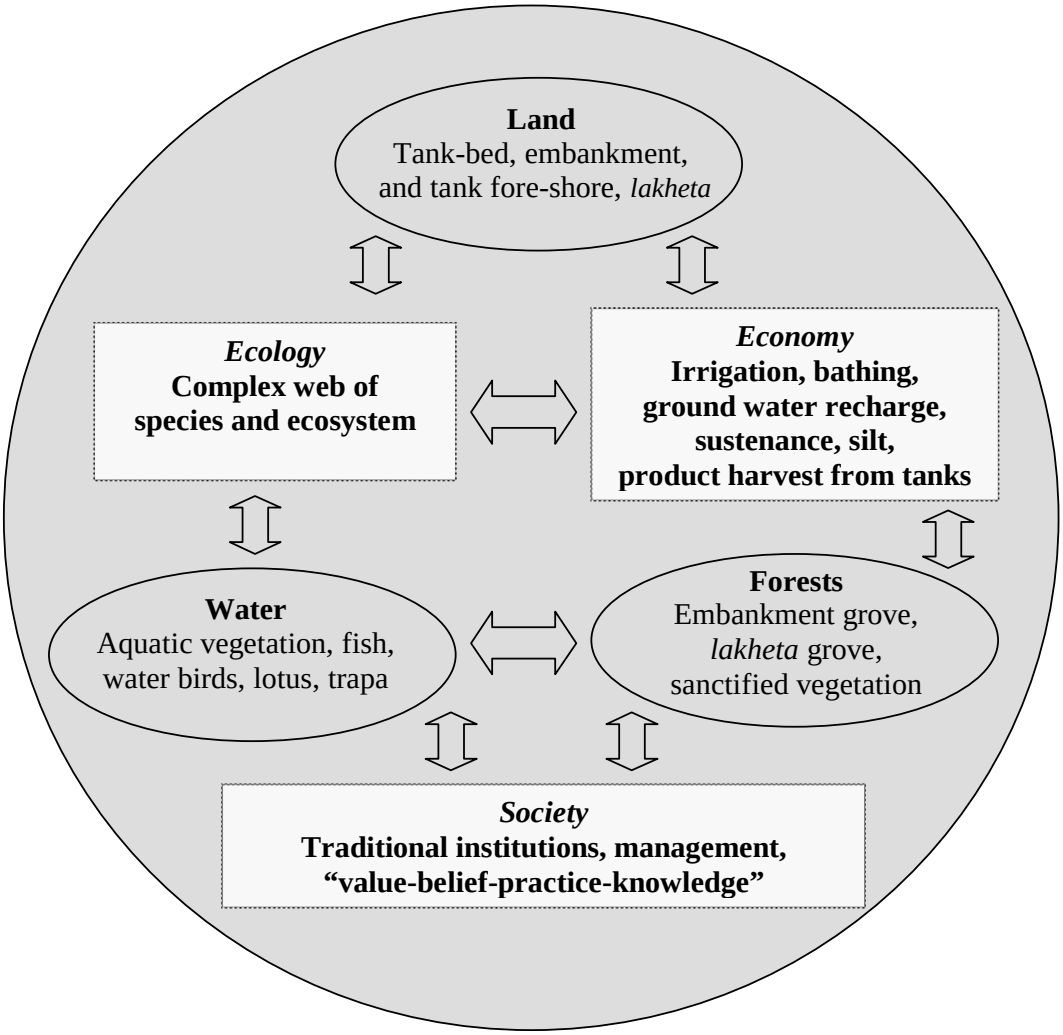
It is not a common practice to include tank vegetation in a discussion either on forestry or in the traditional water management. This aspect has remained unexplored in both these dominant streams of debate. The only references that we could lay our hands on are by Brandis (1897), Mishra (1993) and Mosse (1997, 1998). Mishra (1993) suggests that some of the tanks, in fact, have been named or have come to be known by the type of trees associated. Thus, the tank predominantly surrounded by aam (*Mangifera indica*) is called *amaha* or *amraah.* Similarly, a tank with pipal (*Ficus religiosa*) is locally known as *pipraah* or *pipraha*.

From the point of view of physical structure the riparian commons are the common property resources that encompass the interacting web of land, water plant and animal life. Tanks fit into the category of riparian commons for they encompass complex issues related to ecology, economy and society on the one hand, and on the other involve an interacting web of land, water and vegetation. These elements of the village tanks are virtually inseparable. The complex web of riparian commons and the hypothesis of inextricable links among the ecology, economy and society for the sustainability of natural resources is depicted in the figure 1. The Figure suggests that the elements of village tanks, such as land, water and forests and ecology, economy and society all have bearing on the continued survival and management of the village tanks.

This framework is necessary to understand the issues that are involved in constituting the riparian commons. The ecology, economy and society framework is dependent upon the resource. The resource in this case is not land, water or forests in isolation, but an interacting system of all. It will be pertinent to note that any effort to revive the tank management or craft new commons must rest on the understanding of the linkages shown in the figure1.

The inextricable links between tank and trees discussed in this paper are vital for the sustainability of the development intervention that attempts to either revive the system or constitute the new riparian commons. This is the fundamental premise of the arguments in this paper.

Figure 1: Tanks and Trees: Relationship between Ecology, Economy and Society



Part I of this paper discusses the tanks in general. Part I is a macro view, a top-down view, based on external perceptions. It focuses on the history of tank management and examines why such an elaborate network of tanks developed in India. It then discusses the causes of decline. This perspective is necessary to understand the dynamics of the traditional knowledge discussed in part II. This part though draws substantially from the secondary sources, it also provides a case of Kota district in Rajasthan and presents a general hypothesis as to why an intricate network of tanks might have evolved.

Pert II of the paper describes the traditional knowledge of collective creation of groves on tank embankments, islands, and the seepage area. The compensatory conservation of wild vegetation adjoining the tanks, in lieu of the vegetation that may have been submerged because of the tank construction is discussed. Part II, thus is a micro or bottom-up view that relies on traditional knowledge. It discusses the case of village-tanks in Kota district of

Rajasthan in western India, This part also dwells, based on a case of *Talwas* village, on the functions that these riparian commons continue to serve.

Part III draws upon the theory and practice and discusses the value of integration of indigenous and formal knowledge and makes a case for the equity of knowledge for village tank management. It also discusses the institutional arrangements connected with participatory efforts to revive, create and support modern and viable common regimes of groves on tank embankments, tank islands and compensatory sanctification of the adjoining vegetation.

Regarding the applicability of the broad conclusions it must be stated at the outset here that these findings may be considered valid only for eastern Rajasthan. Nevertheless, preliminary observations during 1998-99 in Madhya Pradesh, Andhra Pradesh, Gujarat, Uttar Pradesh, Bihar and Tamil Nadu revealed that visited tanks in these states too conform to the general framework provided in figure 1. To this extent a fairly general scenario can be assumed for a large part of the country. There is, however, a pressing need to systematically investigate the issue before drawing a countrywide conclusion.

Part I
History, Significance and Decline

History of the Tank Management in India

Tanks have been the most important source of irrigation in India. Some tanks may date as far back as the *Rig Vedic* period, around 1500 BC.[2] The *Rig Veda* refers to lotus ponds (*5.78.7*), ponds that give life to frogs (*7.103.2*) and ponds of varying depths for bathing (*10.71.7*).[3] Reference to the tanks is also found in the *Arthashastra* of Kautilya[4] written around 300 BC (Rangarajan 1987: 231-233). The *Arthashastra* refers to the ownership and management of the village tanks in the following verses:

> Waterworks such as reservoirs, embankments and tanks can be privately owned and the owner shall be free to sell or mortgage them (*3.9.33*)[5].
> The ownership of the tanks shall lapse, if they had not been in use for a period of five years, excepting in case of distress (*3.9.32*).
> Anyone leasing, hiring, sharing or accepting a waterworks as a pledge, with a right to use them, shall keep them in good condition (*3.9.36*).
> Owners may give water to others in return for a share of the produce grown in the fields, parks or gardens (*3.9.35*).
> In the absence of owners, either charitable individuals or the people in village acting together shall maintain waterworks (*3.10.3*).
> No one will sell or mortgage, directly or indirectly, a bund or embankment built and long used as a charitable public undertaking except when it is in ruins or has been abandoned (*3.10.1,2*).

[2] Some scholars date the *Rig Veda* to *c*.1200-900 BC; see for example O'Flaherty (1981).
[3] Numbers refer to the verses in the original *Sanskrit* text of the *Rig Veda* as recompiled by Maharshi Dayanad Saraswati and later on translated by V.N. Shastri (1976).
[4] Kautilya was a political economist of ancient India who compiled the *Arthashastra* around 300 BC.
[5] Numbers refer to the book number, chapter and verse number as arranged by Kangle (1969), and translation referred here is by Rangarajan (1976).

A study edited by Agrawal and Narain (1997) on traditional water-harvesting systems cites archaeological and historical evidence suggests that there were sophisticated irrigation systems and hydraulic structures on the Indian subcontinent at least 5000 years ago. Similarly, in southern parts of India rulers supported the construction of tens of thousands of village tanks in the medieval period (Ludden 1985).

Pant (1998) described the *ahar-pyne* system of indigenous irrigation that is historically the most important source of irrigation in South Bihar. Even at present this provides a good example of participatory irrigation management. "This indigenous system is the outcome of the natural conditions and physical configuration of the country, and has been evolved to meet the obstacles which they place in the way of cultivation." (O'Malley 1919:144). There are three factors responsible for the wide prevalence of this mode of irrigation in this region: the region is characterized by scanty rainfall, a rapid slope off which the water quickly runs, and a soil which is either a stiff clay or a loose sand that does not retain much moisture.

Significance of the Village Tanks

The general reasons for why people built tanks are well researched and known (e.g. low rainfall, increasing population, preventing the soil erosion, saving water for scarcity etc.); there are equally clearly, important regional and local variations as discussed here.

There is a series of tanks found scattered across the Indian villages. These structures used to stop the high runoff and used to recharge the ground water, which in turn was used for irrigation and other agricultural purposes. One such pond used to acquire a submergence area of 30-40 *bighas*[6]. Some were even larger and they used to support 5-10 villages throughout the year. Close to these ponds, wells and *bawadis* (step wells) were dug to get drinking water throughout the year. Construction of such wells, *bawadis* and ponds were done even in urban areas like Kota and Bundi. Arguably, for these reasons the erstwhile rulers of Kota constructed a series of tanks in more than 200 villages between the years 1500 to 1942 AD. It is also significant to note that though the rulers provided resources to construct, the responsibility for management was vested in the village communities (Pandey 1998a & b).

We shall explain the specific reasons of the existence the village tanks in Kota city and environs. Kota is a city of 0.5 million people in eastern Rajasthan. The average annual rainfall generally varies from 600 mm to 725 mm. The average annual rainfall data for the forest areas is 1040.20 mm. The city is located on the southern edge of rolling Akelgarh-plateau made up of the impervious sandstone sheet rocks. To the south beyond this plateau lie the fertile farmlands of Kota and Bundi district. The plateau area is south rolling and spread over 127 sq. km. and the city now extends to 32 sq. km.

In order to harvest the rainwater a series of tanks were created 300 years back across the streams of Akelgarh-plateau culminating in the large tanks at the edge of the plateau in the city. Tanks at the end of plateau were placed in such a way that all the water finally got impounded in one of the 5 tanks namely, Kishoresagar, Kotri, Sursagar, Raipuria and Ummedganj tanks. It is hypothesised that there must have been at least three context specific reasons as to why this series of tanks might have been created (Pandey 1998b: 56-57):

[6] *Bigha* is the local land measurement unit; one acre may contain 4 to 5 *bighas* depending upon the local traditions.

(1) Without a series of tanks to impound rain water speedy runoff would have eroded the fertile lands that lie south of the Kota city. This would have made the farming unproductive, costly and largely impossible, as soil in Kota district is prone to ravine formation. This consideration for food security and land productivity may have prompted the construction of the village tanks.

(2) Without a network of tanks Kota city would have faced danger of flood every year. This would have made settled life gruelling in the city (as indeed has happened now due to disrepair of the tanks in the plateau). Rulers living in the Kota city, therefore, financed the construction of tanks in the villages even in upper reaches.

(3) The third reason for the creation of tanks would have been the long-term use of the water for irrigation of the fields in the plateau as well as beyond. Collected water remains available and is used for irrigation during the lean period. This consideration may have played a decisive role in placing the large tanks just before the wide strip of farmlands starts. Even in the otherwise uncultivable upper plateau region small-scale subsistence farming must have became possible by placing the farms around the tanks. This is particularly significant because it was not always possible to dig out wells in this region.

There is a societal reason too for a series of village tanks. Scattered placement of small village tanks also provides benefits in terms of risk sharing and collective action. For example, in a rain-deficient region like Punjab, water availability imposed limitations that the small farmer could only overcome by observing the rules of sharing (Chakravarty-Kaul 1996: 80-88):

> "Such obvious care in scattering[7] deserves equal respect in analysis. One such hypothesis suggests a logical link between risks sharing and collective action. Scattering was an institutional device to provide insurance to individuals against uncertainty, provided they co-operated. Therefore it was both a product of and a means to reinforce collective action...further, the more diverse a resource distribution and the greater the inequality in incidence of individual risk, the greater was the inducement to bring about collective action."

Though the rulers, built the tanks until the abolition of *jagirdari*, management, the village communities and local user groups carried out desilting, and routine maintenance. In the next section we shall discuss how this system started declining?

The Decline: a Product of State Take-over and Subsidies

As has been discussed rulers, *zamindars* (landlords), *talukdars* (feudal lords) and village communities took a keen interest in tank construction in pre-independent India. Abolition of *zamindari* and *talukdari* in the post-independent era led to an end of private ownership, and the confiscated tanks were vested mostly in State Governments and, in some cases, handed over to village *panchayats*. On the one hand, state was not so efficient, and *panchayats* lacked resources to manage the property, and on the other people, bereft of access to tanks, lost interest in management. One would assume that *panchayats*[8] should have managed the

[7] 'Scattering' denotes the distribution of the ponds over the entire region (i.e. not clustered in one place).
[8] *Panchayat* is the collection of politically elected representatives from the villages that constitute it. One *panchayat* may have more than one village that may or may not have the stake in the particular tank.

tanks efficiently, but unfortunately these bodies are not as apolitical and coherent as the traditional local village councils and village institutions that operated on the principle of caring and sharing.

Thus, tanks became open-access, and all farmers in the command area could receive access to water and groves even without any obligation to help in the management. This resulted in a gradual breakdown of the traditional system of repair and maintenance of the tanks.

For example, encroachment of the tank beds and embankments in Kota district of Rajasthan was restrained by customary regulations laid down after a series of trial and error over hundreds of years by the community. But, once the large dam called Kota barrage constructed across the river *Chambal* brought the subsidised supply of water tanks virtually became redundant for the people. People no longer needed to contribute for the upkeep of the water source. This resulted in the large-scale encroachment on tank-beds and embankments for farming, sandstone mining, expansion of the city, waste dumping, establishment of the industry and several other reasons. Table 1 shows a variety of other reasons for the decline of the specific tanks near the Kota city in Rajasthan.

Table 1: Decline of the tank management in Kota

No.	**Reasons for decline**	**Examples of the tanks (*talab*)**
1	Expansion of Kota City	Ganesh Chattrapura
2	Dumping fly-ash of Kota Thermal Power Station	Jwahar Sagar Abheda
3	Establishing industrial units of Indraprasth Industrial Complex	Dakaniya
4	Alignment of canals of the Kota Dam	Kotree, Rampura Umedhpura
5	Fissures in the impounding area	Anantpura
6	Siltation by sediment	Kheda Ganesh ji Rangbari

Mentioning the decline of traditional water management system called the *ahar-pyne* system in Bihar, Pant (1998) provides reasons why the system is deteriorating. First, before the abolition of *zamindari* system, the *zamindars* used to maintain these systems for they had the capital resources and a vested interest. Tenants were required to pay *gilandazi* (improvement of irrigation works) charges. "Gilandazi is an excellent form of investment as the capital spent on it returns a dividend of 40 to 50 percent in the first year itself, in some cases 100 percent if the landlord even received only half of the produce of the land irrigated by these works, they would get a very good return on their capital outlay" (O'Malley 1919:158, quoted by Pant 1998). But after the *zamindari* abolition there remains the paucity of recurring funds for the repair except during drought period when some relief schemes such as food for work programme etc. are started by the governments in the name of renovation of these systems. Secondly, a large number of alternatives have now become available to the farmers in the post-independence period such as canals and tube wells.

Commenting on the catastrophe that is destroying the tanks, Gadgil and Guha (1995) provide interesting explanation. While promoting the construction of the large dams, the sate apparatus has overlooked the collapse of traditional systems of smaller village tanks. During the British rule these community management systems survived because they were efficient and made possible collection of land revenue at higher levels. After independence agricultural land was not seen as important source of revenue. Instead, state's policy to enhance the control over the resources resulted in the takeover of the tanks by the Minor Irrigation Department. This led to breakdown of the community control and management practices that were so vital for the sustainability of the system. A substantial number of tanks so acquired by the state have fallen into disrepair because on the one hand village communities have stopped contributing the voluntary labour for desilting, and upkeep of the tanks, and on the other state is not able to perform or pay for the functions earlier executed by the people. State has on the other hand shown, by design or default, that it is better to construct the new large dams rather that revive the efficient network of the village tanks across India (Shankari 1991, Sengupta 1991& 1996, Singh 1994, Von Oppen and Subba Rao 1980).

There is yet another interesting reason for the decline of the tanks. The subsidised availability of inputs for agriculture has taken its toll (Gadgil and Guha 1995). This has happened in several ways:

(1) Subsidised electrical power from large dams reduced the dependence on the village tanks over large parts of India as water could be drawn either from tube wells or from the canals at a distance using the power of electricity.

(2) Subsidised supply of fertilizers reduced the dependence of farmers on the tank silt that was used as an excellent source of productivity enhancing material.

(3) Subsidised availability of water from large dams reduced the dependence on village tanks for irrigation water.

(4) Distribution of subsidised diesel pump-sets (that run on subsidised fuel) too reduced the dependence on the water from the village tanks earlier taken to the field with the help of gravity-flow.

Situation Today

Not all tanks are now destroyed, but there has been a decline in the importance of tanks as a source of irrigation. The net area irrigated by tanks in India in the year 1950-51 was about 8.9 million acres (17 percent of total net irrigated area in the country), which fell to 7.6 million acres in 1985-86, i.e. 7 percent of total net irrigated area in the country (Singh 1994).

Part II
Traditional Knowledge on Tanks and Trees

Tanks and Trees: a missing combination in contemporary studies

Studies of village settlement and collective efforts to create tanks are well documented. Similarly, studies of tanks as the source of irrigation, fish, ground water recharge and other

products are also available (see for details, Gadgil and Guha 1995, Somashekara Reddy 1988, Shankari 1991, Bandyopadhyay 1987, Singh 1994, GOI 1965, Von Oppen and Subba Rao 1980, Whitcombe 1982 & 1993). Traditional water management has received good attention and excellent studies have appeared. Some notable readings specifically focussing on Rajasthan are by Mishra (1993 and 1995), Agarwal and Narain (1997) and Pandey (1998b).

These studies notwithstanding, what has been overlooked in contemporary studies is the traditional knowledge of tank construction, maintenance and customary planting and sanctification of tree-groves on earthen embankments and islands within the impounding area. The islands, locally called *lakheta*, are constructed of soil; act as a refuge to plants and animals. Such groves are prominent parts of the tanks, and serve vital social, religious, ecological and economic functions.

Trees in the embankments and *lakheta* provide livelihood goods to the people during scarcity. People believe that trees shelter or harbour village god and goddess. Local people never destroy or harm these trees. For example, *Johad*, the small community ponds located in the vicinity of villages in Alwar district of Rajasthan in India support several Pipal (*Ficus religiosa*) trees on embankments protected by village community. Though leaves are lopped for fodder and small twigs are used as fuelwood, trees as such are never felled. Villagers believe that trees provide protection to bunds of the sacred ponds. Water from the pond is used for bathing, irrigation and drinking (Pandey 1996).

Tanks and adjoining wooded areas have caught attentions of the first Inspector General of Forests in India (Brandis 1897). Commenting on the indigenous systems of resource management in Rajasthan, he wrote that for their crops the inhabitants of the area almost entirely depend upon irrigation. Water is furnished by numerous tanks formed by embankments thrown across valleys at convenient points. Coming from Todgarh on 1st January, 1870, Brandis entered the territory of the Thakur of Bednor, a feudatory to the Maharaja of Udaipur, and the contrast in appearance of the country greatly surprised Brandis. In British territory the hills, which at one time had been covered by a good forest of Khair (*Acacia catechu)* and Dhaukra (*Anogeissus pendula*) were denuded, the trees having been sold to the charcoal contractors of the British Cantonment of Nasirabad. Brandis found that in the territory of Bednor, the hills were wooded. Brandis was told that it was the tradition in the State to protect the *birs*[9]. Knowing well that the grass, which, even in dry seasons, maintained itself under the shade of the trees, and the branches of the trees themselves, had saved the cattle of Bednor in years of drought, and more than this, that the water supply in those tanks, upon which the fertility of the country depended, was maintained by the forest growth upon the hills.

Some of the recent studies that discuss the relationship of tanks and trees pertain only to modern interventions of planting the tank foreshore areas. Though, not an indigenous system, it throws light on the relationship between water and trees and provides interesting insights for the reviving and constituting the modern viable riparian common.

For example, commenting on the tank fore-shore afforestation, Mosse (1998) writes that not only water, but also other tank resources such as fish and trees are managed in culturally distinctive traditions. In many tanks (where not auctioned to individuals) fish catches are

[9] *Birs*, the wooded closures, still exist in several parts of Rajasthan on private and common lands. Udaipur and Chittorgarh districts are particularly rich in such Birs. They are a source of income for the owner in terms of grass, deadwood, fruits and gum. Owners maintain them like a bank balance to be used during the scarcity.

apportioned into regulated 'shares' *(kur*) publicly distributed to households in ways, which acknowledge status through privileged shares. Certain tree usufructs are treated in similar fashion. However, tank foreshore trees that were planted in recent past are usually auctioned to generate the village common funds. With the recent harvest of 1980s SIDA-funded Social Forestry plantations the amounts of money involved are substantial. However, what is noteworthy is that common funds generated from tank resources are barely ever used for the maintenance works such as desilting, clearing channels, and repairing bunds and sluices as is expected of the 'community management models'. In the majority of cases (73 per cent of tanks surveyed) income from all sources is expended on temples — on construction, repair, inauguration or the celebration of festivals (Mosse 1997).

Place of Trees in Indian Ethos

Sacred trees symbolize specific arrays of human conditions, possibilities and anticipation. In India, species of trees are worshipped as manifestations of gods, as representatives of particular stars and planets, and as symbols of the natural elements-energy, water, land, air-each of which has its own independent and relational meanings. As sources of social cohesion, continuity, and control, religious trees shape human actions (Chandrakanth and Romm 1991).

Vatsyayan (1992) informs the sacredness of trees seen in every part of India. Deodara (*Cedrus deodara*) is considered the abode of the gods; Sal (*Shorea robusta*) is venerated in Uttar Pradesh, Bihar and Madhya Pradesh. Similarly Rudraksha (*Elaeocarpus* sp.), Bel (*Aegle marmelos*), Ashok (*Saraca asoka*), Kadam (*Anthocephalus chinensis*) and Pipal (*Ficus religiosa*) are considered sacred in Rajasthan. Certain vulnerable stage in the life history, or the phenological cycle, of a plant may be offered protection. Thus *Kols* people living in the Vindhyan hills in India, refrain from eating the unripe fruits of Kainth *Feronia limonia* and Aonla *Emblica officinalis* before *Dussahara* festival in the month of October. This saves the species from getting locally extinct, for fruits might otherwise be consumed even before the tree has produced viable seeds.

All individuals of certain species are totally protected. For example Bad (*Ficus benghalensis*), Pipal (*Ficus religiousa*) and Gular (*Ficus glomerata*) are afforded total protection in southern Aravallis in India. *Ficus* is now considered a keystone resource playing a significant role in the conservation of many insects, birds and mammals (Terborgh 1986). These are an important species providing the site for beehive to honeybees in Aravallis. People in Aravallis also protect *Boswellia serrata, Diospyros montana, Feronia limoni*a and *Emblica officinalis.*

Trees of different species also have special associations with particular deities. For example in India, the Lord Vishnu is associated with the Pipal (*Ficus religiosa*), Bargad (*Ficus bengalensis*), and Gular (*Ficus glomerata*); the Lord Shiva with Bel (*Aegle marmelos*) and Maulashri (*Mimusops elengi*); the Lord Dattatreya with Gular (*Ficus glomerata*). Bel (*Agele marmelos*) and Rudraksha (*Elaecarpus ganitrus*) are associated with Lord Rudra(an incarnation of Lord Shiva). Devotees of Shiva wear the seeds of the Rudraksha as rosaries which are used in meditation. *Acacia ferruginea* is the most feared and respected tree because it represents the dangerous planet Saturn, and *Agni*, the powerful fire god. Although these species are particularly notable, many common species in India, including species currently planted in participatory forestry, production forestry and social forestry plantations have religious significance.

Traditional knowledge of collective creation of groves

An empirical study was conducted in Kota district of Rajasthan on construction of village tanks and creation of tree groves in the tank embankment and tank-bed-islands during 1996-98 by using open-ended interviews supplemented by participants observations. This was complemented by observations from other parts of Rajasthan and other states of India.

Starting from the embankment the entire process of village tank construction, tank-bed-island formation, planting of the tree groves in tank embankment and compensatory afforestation involves a complex social, economic and ecological interaction. Village tanks have six main segments: the embankment, reservoir, *lakheta*, seepage area, *upra* and the watershed. Embankment is the physical barrier erected across the streams or outlet of the watershed and is made of elongated heaping of earth, 3 to 5 meter of height that may run 40 to 100 meter length depending upon the physical features of the land. It is locally known as *paal* or *bandha*. Close to the shallow end of the embankment an arrangement is made to drain of the excess water during the rains. This structure is locally known as *upra*. Reservoir is the impounding area where water remains stagnant for most part of year. Reservoir is locally known as *peta* or *aagar*. Beyond the reservoir, towards upper slopes, lies the watershed of the tank locally known as *aagaur* or the watershed. Various activities related to tank construction are shown in Box 1.

Box 1. Activities of Tank Construction and Maintenance

Engineering works

- Construction of embankment and *upra*
- *Lakheta* construction
- Drainage for excess water

Forestry Works

- Embankment planting
- Planting in the *lakheta*
- Garden in the seepage area
- Compensatory sanctification
- Planting/sanctification in the watershed

Maintenance

- Maintenance of embankment
- Desilting
- Replanting

Trees in Embankment

After the construction of embankment, heaping the soil in the form of *lakheta* and excavation of the impounding area it is used for the planting of the tree groves and construction of small temple. The commonly used species for plantation are given in Table 2. It may be noted that the main species selected for planting reflect the Indian ethos as discussed in part II.

Basic reason given by the villagers for planting in embankment is the protection needed to the embankment because soil is prone to erosion if left unprotected by the grove. The second reason given by the villagers is that ideal setting of pond and grove provides a meeting place on various occasions including social gatherings, marriage, after-death rituals etc. Groves are also used as a place for village fairs during the festivals. The groves are the favorite places for *goth* (picnic in rains) in Rajasthan.

Embankment without trees is perceived as temple without deity. Based on an excellent study on the traditions of tanks in India, Mishra (1993) informs that embankments are found to have been planted with pipal (*Ficus religiosa*), bargad (*Ficus benghalensis*), and gular (*Ficus glomerata*) immediately after the construction of embankments. Mango (*Mangifera* indica) is also planted but mostly towards the outer slopes of the embankment. In a central Indian region called *Chhattisgarh* in Madhya Pradesh neem (*Azadirachta indica*) was necessarily planted as the abode of goddess *shitalamata*. Age of the tank can be guessed by the age of the oldest surviving tree there. His conclusions are interesting: 'once the trees are felled the tank too goes into peril. If the tanks are imperiled trees follow the suit.'

Table 2: Trees in the tank embankments in Kota

No.	**Tree Species planted**	**Percent out of 12 tanks where the species was found**	**Percent of all the tree species in the sample (12 tanks)**
1	*Ficus Benghalensis*	91	20
2	*Ficus religiosa*	55	17
3	*Mangifera indica*	82	12
4	*Azadirachta indica*	29	19
5	*Holoptelia integrifolia*	61	12
6	Other species	91	08

Trees in Seepage Zone

In order to make use of seepage water that goes down-stream beyond embankment, beautiful gardens have been developed near some large tanks. These gardens are planted by water-loving species such as *Terminalia arjuna, Pandanus tectorius,* and *Syzygium cuminii.* Some of the best gardens are to be found close to embankments of these tanks in India. Examples include *Gulab baug* in Udaipur, *Bada baug* in Jaisalmer and *Chatravilas* Garden in Kota, Rajasthan. Area of these gardens varies between 1 to 50 ha. The wide variation is found because of the differing size of the village tanks.

It is not always the case that only seepage water is used for the gardens. Some of the large tanks in Rajasthan additionally have the arrangements, such as small canals, to irrigate the gardens (Mishra 1993).

Trees in Lakheta

Lakheta or the tank-bed island is a very small area made up of heaped soil that remains surrounded by the water for most part of the year. *Lakheta is* often planted with small number of trees ranging between 5 to 10 that act as refuse to reptiles, amphibians and birds.

Commonly found tree species include *Phoenix sylvestris, Azadirachta indica* and *Butea monosperma*, and a variety of shrubs and herbs. Unlike the embankment groves villagers seldom use vegetation in *lakheta*. Thus, it acts as refuse to various species of animals, which may use the place for breeding and roosting. Absence of any biotic pressure in *lakheta* has helped the natural succession in the vegetation. A variety of plants are often seen growing from the seeds that either fall from the older trees or carried in the *lakheta* by birds and animals. Thus, a dense and multy-storied view of the vegetation is not uncommon.

Erecting a religious or spiritual place, such as temple or platform for the deity often sanctifies vegetation in the lakheta. Some of the *lakheta* today contain large *Ficus religiosa* and *Prosopis cineraria* trees (Mishra 1993).

Trees in *Aagaur*

In the *aagaur* area either naturally occurring vegetation is protected or mango garden locally known as *bagicha* is planted. One of the study found that 90 percent of *aagaur* area was planted with mango (*Mangifera indica)*, 5 percent jamun (*Syzygium cuminii)*, 1 percent mahua (*Madhuca indica)* and rest of the 4 percent species planted were *Feronia limonia, Emblica officinalis, Ficus benghalensis, Ficus religiosa and Acacia nilotica.* The species selected for plantations are such that these continue to yield one or the other product round the year. It is interesting to note that these *bagicha*[10]*s* are the storehouse of about 40000 ethnocultivar of mango species in India (Pandey 1998a).

Sometimes, *aagaur* may support the sacred groves. For example, *Khade ganesh* tank in Kota has a sacred grove opposite the embankment. This grove spreads approximately over 2 ha. area. Jharan Mahadeo, sacred grove in Jhalawar district in Rajasthan is situated along the stream leading to a large tank that ensures round the year supply of water to the city of Jhalawar. This is the only green patch in the area. It is important because it protects the catchment of tank that might otherwise be silted very quickly in the absence of vegetation. Rare plants include *Bambusa hamiltonii* and *Scleichera oleosa.* It is also important because in effect it is a *sanctum sanctorum* of threatened plants, all of which have become extinct from the adjoining area outside the grove. The Jharan Sacred Grove is also an indicator and benchmark of forests that might have existed in the region. Today, it is a natural laboratory, a habitat island, a gene-bank, and a storehouse of ethno-medicine. There is a perennial water spring too.

Compensatory Sanctification of Vegetation

In some of the cases, as in case of *Sorsan-brahmanimata* tank in Baran district of Rajasthan, natural vegetation occurring downstream has been sanctified in lieu of the vegetation submerged because of the construction of tank. About 5 ha. area equivalent to the submerged land of the tank has been protected as a sacred grove. These sacred groves are like botanical

[10] *Bagicha* is the sacred garden also known as *baug*. It is an etnhno-silvi-horticultural grove traditionally planted near tanks, settlements or amidst forests for fruit, fodder, fuelwood, medicine, non-wood forest products and shade. They are backbone of indigenous method of drought proofing, acquirement of entitlements and food security. Probably no other landscape is as productive and valuable as the *baug*. The vegetation consists of utility trees such as *Mangifera indica, Madhuca latifolia, Feronia limonia, Syzygium cumini* etc. They are one of the ethnoforestry practices of local communities in India. They are cultivated counterparts of sacred groves. Some of the gardens are as old as 300 to 400 years. Every garden has a sacred place dedicated to village deity. Green felling is totally banned by the community; thus they also offer excellent habitat for birds (Pandey 1998a).

gardens. However, unlike a botanical garden where a wide range of trees and plants are collected and cultivated the sacred grove is a mode of protecting natural forest patches. Groves support plants and life under various agro-ecological condition.

Sacred groves and sanctified vegetation is of great economic significance. Some of the species so preserved are already known to be of considerable value for the pharmaceutical industry, while others could acquire importance in the future. These green patches constitute a unique example of *in situ* conservation of genetic resources. Such areas show micro-climatic conditions with their own distinct floral and faunal values, and are important in terms of providing a variety of goods and services.

Present-day Riparian Commons: A Case of *Talwas*

Village tanks and associated land and vegetation continue to serve the humanity in several ways. For example, village tanks in village *Talwas* in Bundi district of Rajasthan yields various products from the aquatic plants such as lotus seeds and rhizome, trapa fruits and grass for thatching. Tank is also a source of animal protein such as fish and water birds. It not only sustains a variety of wildlife, but also provides drinking water to the livestock. Since water remains impounded for most of part of the year in the tank, it helps in recharge of the wells (see box 2).

Villagers have formed a tank management committee giving membership to each household. The committee meets every month and attends to routine maintenance of the tank. The major achievement of this institution has been its ability to stop the illicit felling of trees and encroachment. The committee has expanded its area of work to joint forest management[11] of the public forestlands. JFM has emerged as one the leading tools for sustainable forest management (JFM).[12]

Box 2: Current Resource Use from the tank of *Talwas* Village

- Vegetation, lotus, thatching grass
- Fish as animal protein
- Tank silt as farm manure
- Drinking for wildlife and livestock
- Water for irrigation
- Water for bathing
- Habitat for migratory birds
- Ground water recharge
- Flood prevention
- Mango fruits from the garden in seepage area
- Meeting place for the villagers

[11] Across India, as on January 2000, a total 36,075 village institutions have brought 10,24,795.41 ha of land under JFM. In Rajasthan, 2705 village forest protection and management committees are managing 235634 ha. of forest land under joint forest management (V. K. Bahuguna, Deputy Inspector General of Forests, JFM Cell, Ministry of Environment and Forests, Govt. of India, personal communication).
[12] See an analysis by Dr. Ram Prasad (1999) on sustainable forest management in south Asia

Part III
Revival and Reconstituting the Commons

Participatory village tank management

As mega sources of water are scarce, expensive to develop, require more expertise and technical know-how for planning, design, implementation and operation it becomes necessary to revive the traditional systems. Modern water harvesting methods have had their own drawbacks like drying up of a water source due to over use, break down of pumps, shortage of energy, high maintenance and operational cost, etc., the attention should be focussed to tap potentials of traditional methods.

The environmental benefits of traditional water harvesting structures, improved soil moisture, increased bio-mass production, improved water quality, enhanced land value, flood moderation should be taken into consideration The community-based water harvesting structures have also contributed to social cohesion and self-reliance (Dayal and Pant 1999).

In order to craft the new riparian commons and manage the existing ones a theoretical framework is presented here. A dominant suggestion on the issues that should be taken into consideration for common property management is that knowledge, values and institutions play a decisive role in the common property management (Karlsson 1997). To these issues it is necessary to add the 'resource' to be managed as well. Drawing from the integrated experiences and various theories broad principles that should guide our efforts for management of the riparian commons are presented.

(a) The Knowledge

In theories applied on the management of common property resources knowledge of the stakeholders plays a dominant role in determining the outcome of the collective action (Karlsson 1997). In fact, empirical cases suggest that the very foundation of collective actions rests on the stakeholders' knowledge. Management of riparian commons should rely not only on the capacity of knowledge generated or held in the formal development sector. It should also draw on the traditional knowledge of the communities.

Management of the commons ought to occur through the integration of indigenous knowledge with formal science. This is referred here as equity of knowledge[13] (Pandey 1996, 2000a & b). Equity of knowledge is in consonance with the dominant development discourse. Equity of knowledge will not only help in the management of common property it will also enhance the security, empowerment, opportunity and sustainability.

It is argued[14] that Integration of indigenous knowledge with formal science can be valuable for common property resource management in three ways:

- Equity of knowledge as Empowerment:

[13] For a discussion on equity of knowledge in formal forestry and ethnforestry, and how it has helped in the community-based forest management in Rajasthan, see Pandey (1998a)

[14] Based on the author's contributions to the debate on draft world development report 2000 of the World Bank. The basic framework of empowerment, equity and opportunity is adopted from the discussion. See also Pandey (2000b).

This can be understood as making the state and formal institutions pro-people and pro-people's knowledge, thereby reducing the social barriers to participation in common property resource management and enhancing the capacity of the local people to make choices to solve the problems of decline of the riparian commons. Traditional societies have accumulated a wealth of local knowledge, transmitted through generation to generation. Experience has taught them how the tanks, trees, and other natural resources should be used and managed to last long. Its innovativeness, genuineness, cultural uniqueness and socio-cultural usefulness for a given environment is well established.

In terms of people's participation in common property resource management, respect for cultural values of communities, entitlements, cost effectiveness, removal of vested interests, multi-tier biodiversity enhancement, flow of non-wood forest products, productivity, equity, sustainability, and adaptive management, and decentralization of decision making equity of knowledge is more efficient than contemporary practice of the reliance on scientific technology and formal institution alone.

- Equity of knowledge as Security

By making the productive use of collective wisdom of formal and traditional sciences we shall be able to help people address the problem of declining commons and to manage the risks they face because of the destruction of the resource-base. Collective wisdom can help the planning and implementation of suitable programmes for managing the existing commons and crafting the new ones. This results into ecological, economic and social security.

- Equity of knowledge as Opportunity

Indigenous knowledge provides local people enhanced opportunity to participate in the management of common property. It also provides space for right to self-determination. The process of access, transmission, integration and field application of indigenous knowledge with formal science promises to enhance the productivity and efficiency of context specific interventions for the tank management.

(b) Culture and Values

Values are related to the objectives and goals of managing a common resource. Objectives are important not only to achieve what is intended but also to measure the success of the common property management using the yardsticks designed by the stakeholders. As Karlsson (1997) suggests, there may be multiple uses for a resource, but it is not necessary that these are always incompatible. Local people still have some vestiges of cultural traditions of prudent resource use that could be revived and integrated with the multiplicity of stakeholders' aspirations.

As discussed in Part II traditional practices on tanks and trees are embedded in the local values, culture and belief systems. For examples, cultural elements contributing to conservation in the village tanks include embankment groves, sacred trees, seepage gardens, sacredness in the pond itself, traditional irrigation systems, ethnoforestry etc.

Any effort that encourages growing trees on the embankments, especially Pipal (*Ficus religosa)* and Banyan (*Ficus bengalensis*) and Mango (*Mangifera indica*), which are associated with divine characters and gives sanctity to the site will succeed. This will also ensures regular maintenance and care of the entire tank area. These need to be taken into consideration for participatory efforts to revive, create and support modern and viable

common regimes of groves on tank embankments, tank islands**,** gardens and compensatory sanctification of the adjoining vegetation.

(c) Institutions

Institutions, both formal and informal, are crucial for formulation of the policy and plans and implementation. People shall organise into local institutions only when they have a genuine stake in the resource to be protected. As has been discussed *Talwas* village community protects tank and forest plantations for water, grass and other products. It is logical for people to examine the costs and benefits of participation and behave according to the basic economic drive. People will participate when benefits of participation outweigh the benefits of staying away.

While creating the institutions it should be kept in mind that participation of the dominant categories of people alone in the village shall not achieve the objectives of participatory tank management. Men and women should be treated as equal partners in the development, and as equal right holders in terms of control over their social, economic and political life. The participation of rural women in the traditional water harvesting programmes such as village tank management is vital because they are its prime beneficiaries. People would participate if the management provided the benefits to them quickly, are available at local levels, and are tangible and distributed to the members who share the management responsibility.

To revive traditional methods of tank management by local institutions an important role can be played by the formal and sate institutions (refer table 3). They can provide resources, innovative technical knowledge and offer support to the initiatives of local people. So far, the policies and programmes on water harvesting have been guided by the over-riding consideration of power generation through hydroelectric projects, food production through maximisation of irrigation facilities and making available potable water to urban areas by transporting it through long distances. By providing enough funds to revive and sustain traditional structures, governments can help local people to become self-sufficient (Dayal and Pant 1999).

Similarly, non-governmental organisations that may have the knowledge and information about the area, trained volunteers to mobilise local resources, support of local people, effective communication skills and cultural friendliness can provide training and support to the local people.

Table 3 provides various approaches on management institutions and their knowledge, values, institutional arrangements, resources, and management practices that can be weighed and applied depending upon the context and intended outcome of tank management. It is clear that knowledge with communities has a scope for integration of the formal science. While on the other extreme, it is difficult for the state structure to integrate the traditional knowledge. In terms of values of the stakeholders that decide the goals the village communities are more favourably placed. In terms of institutional arrangements there is room for every household to participate directly through village committees. While rigid hierarchy of the state department will require elaborate arrangements to solicit the participation of village communities. In terms of getting the local contribution, and constitution of village common fund village committees are favourably placed. More important are the management practices where two extremes can be seen. Village committees again are more suited to address the management.

Table 3: Institutional Approaches to the Tank Management

No.	Management Issues	Institutions		
		Village committees	**Panchayats**	**State Irrigation Department**
1	Knowledge	Traditional, with scope for integration with formal knowledge	Formal, with scope for integration with traditional knowledge	Formal, no or little scope for integration
2	Values	Values of the villagers, with bottom-up view, get pre-eminence	Conflicting values of more than one villages generate conflicts	Values of state, with top-down view, get pre-eminence
3	Nature of institutional arrangements	Every household is member of the committee	Several political representatives from villages constitute the panchayat	Rigid hierarchy of the department
4	Resources	Local contribution, village common fund etc., plus resource flow from the panchayats	Mostly dependent on the budget flow from the government	Budget flow from the government
5	Management Practices	Collective management, owned and sponsored by the people	Panchayat takes the responsibility	State takes the responsibility; people perceived as beneficiaries

Conclusions and Policy Recommendations

The paper reviewed the cases of tanks and associated vegetation in India. It was noted that the existing management can be traced as early as from around 1500 BC. The cases reveal that besides engineering works forestry operations were important aspect of tank management. The empirical case of tanks and associated vegetation discussed that integration of indigenous knowledge and formal science for management of riparian commons, such as tanks, is a distinct possibility. Though the tradition of tanks is in decline we cannot overlook the opportunity to learn from their continued survival. Villagers had a well-developed technology, institutions and strategies, which can be of help to overcome the situation. Equity of knowledge between the indigenous knowledge and formal science should be viewed as a case in point for empowerment, security and opportunity and sustainability.

Emanating from the paper, following policy recommendations are proposed:

1. Using the traditional knowledge and institutions restoration of the existing tanks should be taken up.
2. Tanks and associated vegetation must be viewed as one entity. Strategy for the revival of the tanks should include a component of tree planting and creation of groves. The local people should be helped to decide the choice of species for planting.
3. Responsibility for the routine management should be transferred from the state and *panchayats* to the village institution or user groups, with commensurate allocation of resources by the state.

4. Village common fund for collective tank management should be created; the welfare state and the community that will benefit from the tank may pool resources to this fund.
5. Subsidised water supply to farmers should be scrapped and water from the mega-dams and tube wells should priced appropriately. Ground water mining arrangements should be fitted with withdrawal-meters in order to charge appropriate price from the users. Ground water should not continue to be treated as a free commodity,

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