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Farhat Naz, Saravanan V. Subramanian

Abstract

This paper attempts to give a spatial and temporal overview of water management in India. It traces how people and the successive regimes made choices across space and time from a wide range of water control and distribution technologies. The paper divides the water management in India into four periods: (i) the traditional system of water management before colonial times; (ii) response from the colonial rulers to manage the complex socio-ecological system; (iii) large scale surface water development after independence; and (iv) finally, the small-scale community and market-led revolution. Hence an attempt has been made to describe the water management over the four periods, which has transformed the irrigation and water management scenario in India. Moreover the paper shows how development of water management and its practices are linked with the social, religious, economic development with the rise and fall of the ruling regime. While these different periods attempts to manage water in different ways, the paper reveals a gap in research towards understanding the ability of community to integrate by default these diverse technologies to achieve their social goal of survival.

Keywords:

Water Management, Canal Revolution, Groundwater Governance, Watershed Management, Community-Based Water Management

Abbreviations

APMs	Adjustable Proportional Modules
ARWSP	Accelerated Rural Water Supply Programme
CADP	Command Area Development Programme
CBNRM	Community Based Natural Resource Management
CBWM	Community Based Watershed Management
CDP	Community Development Programme
CGWA	Central Ground Water Authority
CGWB	Central Ground Water Board
COWDP	Comprehensive Watershed Development Program
CPCB	Central Pollution Control Board
CPR	Common Property Resource
CWC	Central Water Commission
DPDP	Drought Prone Areas Program
DRDA	District Rural Development Agency
DTWs	Deep Tubewells
FYP	Five Year Plan
GoI	Government of India
GoTN	Government of Tamil Nadu
IC	Irrigation Commission
ICAR	Indian Council of Agricultural Research
ID	Irrigation Department
IIFM	Indian Institute of Forest Management
IMT	Irrigation Management Transfer
ISI	Indian Standards Institution
IWDP	Integrated Watershed Development Project
KVK	Krishi Vigyan Kendra
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forest
MoRD	Ministry of Rural Development
MoWR	Ministry of Water Resources
NABARD	National Bank for Agricultural and Rural Development
NASDORA	National Authority for Sustainable Development of Rainfed Areas
NGO	Non-Government Organization
NIRD	National Institute of Rural Development
NWDA	National Water Development Agency
NWDPRA	National Watershed Development Project for Rural Areas

NWMP	National Water Management Project
NWP	National Water Policy
PIA	Project Implementation Agency
PIM	Participatory Irrigation Management
PWD	Public Works Department
RCAI	Royal Commission on Agriculture in India
RGNDWM	Rajeev Gandhi National Drinking Water Mission
RWS	Rural Water Supply
SGWA	State Ground Water Authority
SID	State Irrigation Department
SPCB	State Pollution Control Board
SRP	Sector Reform Project
STWs	Shallow Tubewells
UGC	Upper Ganga Canal
UP	Uttar Pradesh
WHO	World Health Organization
WRO	Water Resources Organizations
WUAs	Water Users Associations

1 Introduction

India is credited with having a long history of human intervention in the management of water because of its distinctive climatic binary conditions of intense monsoons followed by prolonged droughts. Furthermore, rainfall is confined to a few months each year and that too uncertain, erratic and uneven. Thus, historically making Indian agriculture dependent heavily on various types of irrigation. This dependence has led people and the successive ruling regimes from pre-colonial to colonial and the post colonial time, to make choices across space and time, from a wide range of technologies[1] of water control and distribution.

This review paper aims to explain how water management has been interplay between cooperation as well as conflict over space and time trajectory in India. Water holds its association to culture and spirituality along with economic value. This in the process of sacred and profane makes its management more complex, as various stakeholders and parties are involved with different aspiration. Water management has been a cautious affair in India due to socio-economic-political and ecological reasons that has affected water management policies across diverse social groups.

In this paper, water management of India have been classified into four broad periods starting from pre colonial - colonial to post colonial and to current situation. The paper elaborates on the lines of a) traditional system of water management before colonial times, b) response from the colonial rulers to manage the complex socio-ecological system, c) followed by the era of large scale surface water development after independence, d) and lastly, an era of community- based management and along with groundwater revolution.

The following section discusses the water management in the pre-colonial times in India, explaining how kings, feudal lords and local communities managed water as a resource. It further explains why pre-colonial India was not a 'hydraulic society'[2]. Section three elaborates the water management under the colonial rule and how India became a standard bearer for the world in the use of modern science and engineering in the design of huge and multifarious irrigation structures. Section four illustrates the Independent India's water management measures and policies with regard to surface, groundwater and community based water management in detail. Section five, discusses in brief the reason why in India water management is a tricky affair. Lastly, section six concludes with an overall summary of the paper.

2 Water management in pre-colonial India

Before the advent of British colonial rule, investments in water development and management were made in different parts of India. Evidences of this could be found in ancient text, inscriptions, local traditions and in archaeological remains. Even the Puranas, Mahabharata, Ramayana and various other Vedic, Buddhist and Jain texts mention about numerous canals, wells, tanks and embankments (Agarwal and Narain, 1997). Moreover ancient religious texts, commentaries and stone inscriptions provide references of governing principles such as ethical, moral, spiritual, social and ecological which were applied to water management during pre-colonial Hindu and Muslim rule in India (Vani, 2009).

The Arthashastra[3] one of the ancient historical canon written by Kautilya in the 3rd century B.C, gives a clear account of water management in the Mauryan Empire. It states that the local communities were

[1] Here the word technology is used in sociological sense. It means machines, equipments, productive techniques associated with them, and type of social relationship dictated by the technical organization and mechanization of work (Oxford Dictionary of Sociology, 2004).

[2] Karl Wittfogel in his book 'Oriental Despotism' (1957) mentions that in oriental societies, in order to regulate water for irrigation and to cope up with natural disasters, hydraulic structures like canals, embankments were build which created a social order which were characterized by strong organization structure of rule making it a hydraulic society or state.

[3] Arthashastra was the book written by Kautilya the chief adviser to India first emperor Chandragupta Maurya (321-297 B.C) on politics and statecraft.

very well aware about the rainfall regimes, soil varieties, and irrigation techniques in the specific micro-ecological context. Furthermore Arthashastra mentions that state rendered help, support and promoted the small water harvesting structures (Agarwal and Narain, 1997).

In the traditional India[4], irrigation/ water structures of all types were built by the order of the kings. Indian kings encouraged the activity by giving grants like revenue free lands to nobles, ordinary people and even temples to construct (Agarwal and Narain, 1997) tanks[5], for seeking agricultural prosperity and to increase the state revenue. For example in the case of the tanks development, for centuries, work was done by the support of local chiefs with the technical guidance from specialist surveyors and craftsmen. The villagers made their own institutions for the construction, maintenance and for operation of the tanks as a common property resource (Bottrall, 1992). Often the tanks were built in a chronological manner, with smaller systems at the upstream of a catchment and moving with increasing- size towards downstream. Each successive tank was build in a chain manner and height of each was calculated by keeping and respecting the rights of upstream and downstream user—thus it was a way of regulating the amount of the catchment runoff and how much should flow on to others (Ibid). In some areas there existed supra-village organization, which had the power to mediate over inter-tank water disputes (Bottrall, 1992; Agarwal and Narain, 1997). Nonetheless, investment and the operation of tank system was linked to legitimate political overlordship, thereby establishing a link between honor linked caste hierarchy and tank irrigation works in the articulation of authority at different layer of administrative levels; making it one of the significant community-management systems in contemporary sense (Mosse, 1999).

Whereas in the larger delta systems of South India, major finance and organization came from the kings but day-to-day management was entrusted to local cultivators (Ludden, 1978; Sengupta, 1991). Small community managed schemes were also developed in other parts of India for example tank like -the ahar-pynes[6] of South Bihar (Pant, 1998). The pynes[7] feed many ahars[8] and numerous distributaries originated from each other. The irrigation organization was designed in such way that all the irrigators needed to cooperate in order to get water from a single distributary (ayacut) (Sengupta, 1985). The landholding of each farmer was fragmented, leading to the formation of small group of people (goam) for the maintenance of the ahar-pynes (Ibid). Pant (1998) argues that zamindars[9] maintained the ahar-pyne system as they had the capital and vested interest. In the river diversion system of Himalayan kuhls, descent and affinity as well as local customs played a key role in the management of the kuhls (Coward, 1990). In multi-village kuhls inter-village coordination for channel repairs and maintenance and water distribution was practiced (Baker, 2003).

In water-managed agriculture, wells played an important role by supplementing the surface water irrigation systems in the Northern and Western India. Open-lined and unlined wells were used for domestic water needs and also for complementing irrigation needs, about which the evidence in the Vedic literature is available. It was the Satwahanas in the ancient India who introduced the ring wells – dug wells for irrigation use (Shah, 2009). Whereas privately owned open wells operated manually or powered animals in the high water table areas of the Upper Gangetic Basin (Whitcombe, 1972). During the Mughal period some large-scale canal constructions were undertaken but its contribution to irrigated agriculture was relatively irrelevant (Habib, 1982) and irrigation through wells was far more important at that time (Habib, 1970). The productivity enhancing potential of well irrigation was quite acknowledged in the revenue calculus of ancient and medieval rulers and therefore well -construction was encouraged through incentives and tax remissions. From the time of Arthashastra (third century B.C) to the Mughal rule during the sixteenth to eighteenth centuries A.D and later on even during the colonial era, lands irrigated with wells were assessed at a higher rate than the rainfed lands (Hardiman, 1998). While in the flood prone Eastern Gangetic Plains, agriculture was largely rainfed. Although there was

[4] In this chapter, for the pre-colonial India, the word traditional India is being used, that is ancient and the medieval time period of India.
[5] Tank is a man-made reservoir created by a simple earthen construction (the bund) that captures surface run-off.
[6] Ahar-Pyne is a floodwater harvesting system.
[7] Pynes are channels constructed to utilize the water flowing through the hilly rivers of Bihar.
[8] Ahars are rectangular catchments basin with embankments on three sides.
[9] Zamindars are the landlords.

some partial additional irrigation from surface sources through small private low-lift devices called 'overflow irrigation' (Willcocks, 1984). River embankments in the Gangetic delta were built by zamindars in the pre-colonial period for flood protection during monsoon through deliberate post-monsoon breaching for flood irrigation (Ibid).

Hence it can be understood that traditional Indian society had a significant technical sophistication with decentralized institutional arrangement towards water management with well-defined local water rights (Bottrall, 1992). Moreover, there were various forms of irrigation in pre-colonial India; this could not be characterized as a 'hydraulic society' in the sense used by Karl Wittfogel (Hardiman, 2008). Thus, in ancient and medieval India, farming was in a way 'hydro-agriculture' with a strong role of village communities rather than hydraulic farming under state domination (Shah, 2009). The next section deals with the water management in the British India.

3 Water management in colonial India

> 'Environments' are in essence models of the relationship between communities and the natural world around them, and as such, they are, like all models, 'made by humans for specific communities'. (Gudeman, 1986:37).

A quantum leap in irrigation was initiated in 1830s through the works of Sir Arthur Cotton and Major Proby Cautley in Southern India and Northern India respectively. By this time the East India Company was ruling most of India and realized the immense opportunity in irrigation to combine the interest of charity and the interest of commerce (Whitcombe, 2005) in repairing one of the greatest irrigation works of pre-colonial times, the Grand Anicut in Tanjore[10] and the Jamuna canals[11] in the Delhi region. The canal systems of Tamil Nadu and the East Jamuna Canal which were improved and extended in the 1820s were the only exceptions to this rule (Hardiman, 2008). In order to have quick economic returns from water development, colonial government made an attempt on large-scale irrigation projects in the Deccan region, which was not successful. This initial debacle provoked the British raj to look towards rehabilitation of traditional irrigation tanks system. Attempts to revive traditional irrigation system miserably failed due to failure to understand the complex social system involved over its management. One of the efforts was the revival of the Kudimaramat[12] (Refer Box. 1).

[10] This refers to the repair of Grand Anicut on river Cauvery by the Colonial Government.
[11] These canals were originally dugout in the regime of Firuz Shah Tughlaq about 600 years ago (Habib, 1982: 49).
[12] The term Kudimaramat is a amalgamated of the Tamil word kuti- meaning 'inhabitant' or 'subject' and the Arabic word maramat- meaning 'repairs' (Mosse, 1999).

"Colonial Myth of Kudimaramat"
(Box.1)

In order to bring all the bigger tanks under the direct control of Public Works Departments (PWDs) for repair and maintenance, a modern centralized administration for irrigation was evolved. The Public Works Department (PWD) tried to induce kudimaramat (people's maintenance by donated labor) in the mistaken belief that local communities would undertake voluntary labor to maintain the tanks as a tradition (Maloney and Raju, 1994; Mosse, 1999). The colonial government enacted the Madras Compulsory Labour Act of (1858) known as the Kudimaramat Act and later several Kudimaramat Bills were drafted (1869, 1883) to enforce the custom by law (Vani, 1992; Mosse, 1999).

Eventually, all this led to more destruction of the traditional management institutions as the Public Works Department (PWD) did not have the budget or the staff to take care of such widely scattered independent systems of tanks; besides people were under the impression that state would look after these tanks structure with the formation of Public Works Department (PWD) (Bottrall, 1992). The Kudimaramat was recreated as a myth; of a traditional autonomous village institution by the colonial government in order to invent a village tradition in the image of the state's planned irrigation administration (Mosse, 1999). The myth was build by the colonial government that the village communities would undertake voluntary customarily labor of kudimaramat, which they had abandoned (Agarwal and Narain, 1997). In fact in the pre-colonial time, cultivators did not voluntarily donate their labor for the maintenance of the tanks but were paid from the funds mobilized at the village level (Ibid).

Nonetheless the kudimaramat tradition of official discourse was recreated in order to fulfill two administrative crucial aspects. Firstly, diverse local irrigation maintenance practice was empirically fixed and rendered as a generalized standard, and this was set by engineering standards of efficiency; secondly the government's demands on village labor, resources and management acquired the legitimacy of custom (Mosse, 1999: 311-312). But in spite of all this the colonial government failed to get the support of the villagers for the upkeep of the tanks.

Other factors which added to the ruin of tanks in South India were (a) the colonial commercialization of dry agriculture in the late nineteenth and early twentieth century's; (b) the establishment of a centralized colonial government and building up of technocratic irrigation bureaucracy from 1850s; (c) the consolidation of British power, its revenue systems and the property law by the 1840s; (d) the dismantling of the South Indian 'old regimes' around 1800 (Mosse, 1999: 307-308).

In Bengal, the traditional irrigation system of building embankments along the flood prone rivers served the purpose of irrigation as well as flood protection measure. The peasants who required water for irrigation would simply breach the embankment for diverting water which was termed as 'overflow irrigation' by Willcocks (1984). However with the zamindari settlement of Bengal Presidency, the colonial engineers were least concerned with the water issues and due to their indifferent attitude they were not able to understand the principle of 'overflow irrigation'. The colonial officials were not able to grasp the zamindari embankments benefit of irrigation as well as flood mitigation functions, and thus they prohibited its breeching in 1855, and later brought them under their direct control (Sengupta, 1985). For railways, roads and for flood control British Government constructed many new embankments, which only led to water logging, drainage problems and loss of irrigation benefits (Ibid). When agricultural production started declining rapidly in prosperous Bengal, the British Government invited William Willcocks, a British irrigation expert, to advise them on irrigation development. In a series of lectures delivered in Calcutta in the 1920s, Willcocks astonished everyone by arguing that the best government could do was to revive the ancient flood irrigation system of Bengal (Willcocks, 1984).

Thus the colonial rule redefined property relationships, and took absolute control through ownership of all resources such as land, water, forest, and minerals without understanding how the irrigation systems functioned. Furthermore there were taxes of all kinds like land taxes, water taxes, well taxes, subsoil water taxes, canal charges etc (Hardiman, 2008) which imposed immense burden on the communities.

3.1 The Colonial era of canal revolution in the nineteenth century

The failure to understand the traditional irrigation systems to meet the coffins of the British regime, paved the way for colonial rulers to resort to large-scale publicly funded irrigation development. For example in the Southern Deltas, the system operation responsibility of structural renovation work started

by Sir Arthur Cotton's on the Grand Anicut on the Cauvery River could not be left to the long established local institutions (Bottrall, 1992). Grand Anicut reconstruction in 1838 and the Jamuna canals launched a phase of massive canal construction activity by the colonial ruler which led to a paradigm shift in irrigation thinking (Shah, 2009).

In the lower rainfall territory of the Upper Ganges Region, the colonial engineers started massive construction of vast network of new canals and this later became the mode of development (Stone, 1984). The British raj focused first on the 'productive' irrigation works on canals that could generate annual revenues equal to the interest on their capital cost (Stone, 1984: 25) In 1880 Indian Famine Commission made visible the indirect returns of irrigation work in the form of curtailment of famine relief expenditure (Stone, 1984). This judicious showing made the British Raj shift to 'protective' irrigation works in the form of constructing large-scale storage dams and canals in Bombay Deccan (Attwood, 2007).

The completion of the Upper Ganga Canal (UGC) in 1847, the first great northwestern scheme, led to the establishment of the fact that artificial irrigation is best suited for the topography of the area (Stone, 1984); as its simple operational design went hand in hand with the homogeneity of the physical environment (Bottrall, 1992). The rational supply of water by proportional flow through uncontrolled watercourse to as many farms with strict upstream control was possible due to the design layout of the water distribution pattern of the canals (Berkoff, 1990). This was best suited to the three main colonial objectives: a) the financial (low operational costs, high revenue); b) socio-political (famine and drought preclusion); and c) administrative (limited field staff with little possibility of conspiring with farmers in maneuvering the centrally determined water schedules) (Bottrall, 1992).

As a consequence, a new specialist cadre of irrigation engineers were created in order to govern the canal management with the passing of 1873 North India Canal and Drainage Act. In the canal irrigation system, Irrigation Department (ID) was vested with all rights such as control over regulation of water supplies; power to withdrawal of water supplies to non-cooperating farmers etc (Stone, 1984). The British colonial policy in the nineteenth century drew from an international discourse of water engineering, which had its roots in transformation of water into a commodity (Worster, 1985). The outlook of British irrigation engineers towards environment was that of seeing environment as a mathematically modeled system, which included modeling of flow, distribution and use of water (Gilmartin, 1995). The capitalist state promoted science and technology 'to extract from every river whatever cash it can produce' and thus transform the water into a commodity (Worster, 1985). The mathematical creation of an integrated hydraulic environment gave colonial color to colonial India. Moreover the British regarded the local communities "in a language of 'naturalism' that defined them as parts of the 'natural' environment to be modeled and controlled" (Gilmartin, 1995). In 1860s and 1870s, British irrigation policy though principally inclined for larger strategic, financial and political concerns, endorsed local initiatives in private or semi private canal buildings by local landlords and tribal chiefs (Ibid).

For the first time under the British rule, water was carried on a vast scale from one river to another. "For some engineers (and other administrators), the effective control of the state over the larger environment simply empowered the state to frame rules of proper irrigator behavior[13] that would enable them to control people as canal controlled water" (Gilmartin, 1995:224). There emerged a highly centralized system of irrigation management with a huge bureaucratic structure extending even to Britain.

One of the finest examples of the colonial irrigation policy is that of Punjab 'canal colonies', as these lands were called, which were brought under cultivation by the interlinked irrigation canals. The colonial engineers in the 1880s, began the construction of a series of interlinked irrigation canals in Western Punjab which brought about 14 million acres of arid land under agricultural colonization and settlement (Gilmartin, 2003). The history of Punjab 'canal colonies' depicted a complex character of a relationship between the state, science and nature in a colonial context, by linking science and colonial empire in a manner to control and commodify the nature in order to tap its productive powers (Ibid).

[13] Here 'proper irrigator behavior' means farmers following a) the correct rules of irrigating the fields, b) not wasting water, c) following the rules of proper construction and clearance of village watercourses, and d) not growing crops which were forbidden like rice in certain areas etc (Gilmartin, 1995).

At one level colonial water engineering in the Punjab grew out of the idea of seeing Punjab's river water as 'resource', open to increase the state control for purposes of productive 'use' and 'development' (Gilmartin, 2003). As 'developing' such resources were critical to enhanced income, it was also critical to new forms of state power (James Thomason cited in Gilmartin, 2003:5057). With increasingly, state control over water and then over the land led to new framework of control over the local 'communities' comprising Indus basin society.

On the one hand, Northwestern canal schemes were outstandingly successful during the British period. It enormously increased the agricultural production and incomes in backward areas and the Punjab settlement became the pioneer of modern agriculture and irrigation (Stone, 1984). Widespread layout of the canals made it possible for the government to earn considerable superfluous revenue over the costs of operation, thus leading to high standard of operation and maintenance of the canals (Stone, 1984). On the other hand, canals schemes have been criticized on the environmental grounds (Whitcombe, 1972; Stone, 1984).

Another example of this kind, is of Nira Left Bank Canal, which was constructed in the Deccan region of Bombay Presidency as a famine relief work during 1876-85 and was initially conceived for the purpose of 'protective irrigation' (Bolding et al., 1995; Attwood, 2007). In the course of time 'block system[14]' was introduced in the Nira canal which was based more or less on the traditional crop rotation system, the bhandara or phad[15] system, which was practiced in Northern district of Bombay Presidency (Bolding et al., 1995). The 'block system' turned out to be successful with the introduction of sugarcane cultivation along with food crops in rotation.

Although the canal schemes were highly centralized and bureaucratically controlled, they did serve the interest of its users[16], due to three main reasons a) firstly, the physical and technical: the environment of the northwestern plains was best suited for the adoption of supply-driven water rationing system which was cheap, efficient and equitable; difficult to manipulate and unparticipatory; b) secondly, the political and social factors: there was lack of strong political forces capable of challenging the authority of the colonial government on the issue of water rates, throughout that period; c) thirdly, the source of inducement to perform: although the Irrigation Department (ID) staff were not legally accountable to the water users, but they were under strong pressure from the higher authorities in the colonial government to ensure that the canals' financial and famine prevention goals should be met fruitfully (Bottrall, 1992).

Thus the design and management systems of canals were the product of a long continued process of learning, adjustment and refinement over a long period of time—a full century from the completion of the Upper Ganga Canal (UGC) until India independence. In fact many serious canal design mistakes were made and with the introduction of Adjustable Proportional Modules (APMs) in 1920s a strict controlled management system became widespread in colonial India in canal management (Stone, 1984; Bottrall, 1992).

From 1900 onwards-colonial engineers started realizing that low cost canal development sites for run-of-the-river schemes were slowly declining in the NorthWest of India, although new work continued in Punjab province and was extended into Sind in 1920s and 1930s (Stone, 1984). The construction of the Sharda canal in central Uttar Pradesh (UP) in 1920s, made visible that in Gangetic Plains, expansion of canals and its management would be difficult due to higher rainfall, higher water tables areas which were vulnerable to water logging (Ibid).

For further water development for irrigation, upper river valleys of South India and Deccan for large and medium canals schemes and in upland areas small surface systems which included tanks and mechanized groundwater development were identified by the colonial administration (Bottrall, 1992). Uncertainty of economic returns because of high construction cost of canals due to uneven topography and rainfall conditions led to only modest upstream canal development in the South and West of India

[14] For detail on Block System see 'Modules for Modernization: Colonial Irrigation in India and The Technological Dimension of Agrarian Change' (Bolding et al., 1995).

[15] Phad was a community managed irrigation system in which series of dams were built on rivers to divert water for agriculture use.

[16] Users here are the farmers who were getting water for irrigation from the Northwestern canal schemes (Bottrall, 1992).

(Ibid). The rehabilitation of tanks by the colonial government was very much undertaken but with little success and insignificant impact (Sengupta, 1985).

Hence the British had established the commercial viability of canal irrigation by the end of colonial rule (Whitcombe, 2005). But the performance of Indian agriculture due to canal irrigation facility has been controversial with scholars such as Mason (2006) glorifying that canal irrigation curtailed famines in India. Whereas others were of opinion that 'unbalanced irrigation development' of focusing irrigation projects and investment in Punjab, Madras and United Provinces, failed to feed the rest of India and could not prevent Bengal famine of 1942 leading to the starvation deaths of four million people (Shah, 2009).

The colonial government was more interested in canal construction due to obvious reasons. But in the state of Gujarat, they encouraged the well construction through tax exemption as they believed that irrigation could only be carried out effectively in Gujarat from wells (Hardiman, 1998). In Gujarat well irrigation was the most important source of irrigation even during the colonial times as there were no major colonial canal projects in this part of India (Ibid). During 1930s about 78 percent of the irrigated area of British Gujarat was irrigated by wells and only 10 percent by the canals (Desai, 1948). Whereas in the North-West of India, use of groundwater started increasing slowly through bullock-powered lift from small private open wells during the 1900s period, but cost per unit of water lifted was high due to higher labor and energy cost (Stone, 1984; Bottrall, 1992). This resulted in low crop yield and low cost of surface water in the canal areas became hindrance in the expansion of groundwater development (Ibid).

In the province of Uttar Pradesh (UP) and of Punjab, mechanized tubewells were promoted by the Agricultural Department. But due to the availability of cheap energy sources cost remained high of tubewells in comparison to the returns. Colonial research led to the conclusion that the best option for developing groundwater is to promote large-capacity deep tubewells (DTWs) rather than the shallow wells. With the passage of time, large capacity deep tubewells (DTWs) scheme was being promoted by the colonial government and around 1500 public tubewells were installed in Western UP in 1934, with each well irrigating 150-200 hectare of land (Dhawan, 1982). A significant aspect of the colonial government at the turn of the century was the creation of Provincial Agriculture Departments with the aim of providing new professional expertise on issues relating to water and agriculture. Furthermore in 1928 the Royal Commission on Agriculture in India (RCAI) provided fourteen-volume report about irrigation issues across the geographical regions of India (Bottrall, 1992).

Hence it could be summarized that the main interest of the colonial government was to maximize revenue generation, which led to massive canal constructions by the British Government. This laid down the foundation of new irrigation ideology of opening up vast-often unpopulated-areas for farming by manipulating the large untapped rivers and reconfiguring the basin hydrology. Moreover an unbalanced irrigation development without regional equity was initiated by having centralized structures for constructing and managing large irrigation systems on commercial lines. Colonial irrigation in India successfully advocated that the state in partnership with science can tame the rivers for improving the human welfare. This ideology survived until the end of the Empire and began dominating the water management vision in the postcolonial Independent India.

Last two decades before India's independence were marked by economic recession, approaching end of colonial empire and World War II. All these three factors contributed to the slowdown in irrigation development of colonial India. India became a standard bearer for the world in the use of modern science of engineering in the design of huge and multifarious irrigation structures only during the colonial era. The modern epoch of construction of big dams had its roots in nineteenth century India (Postel, 1999), and it was only in colonial period that India experienced its role as a hydraulic society to some extent with strong centralized bureaucratic control on water development and management. India's independence came with partition, which brought about new forms of water management and strategies to manage water for irrigation and the next section deals with this in detail.

4 Water management in independent India

India attained its independence from the British rule in August 1947. With independence came partition of India and loss of large productive irrigated lands to Pakistan; and bulk of the public irrigation networks that British had created ended up in Pakistan (Shah, 2009). Government of India's main aim after independence was to accelerate development and address the regional disparity of investment, as it was facing serious food grains shortage and rapid rates of population increase. The slow pace of irrigation development during the last decades of colonial regime had also aggravated to the current problem situation of food shortage.

4.1 Large scale irrigation as 'temples of modern India'

To overcome the food grain shortage, huge investment in large-scale irrigation project was considered to be the best option to redress all these problems. And this was apparent from the Five Year Plans (FYPs), which started in 1951. Investment in the large scale surface irrigation was targeted under the first two plans and giant projects like Bhakra-Nagal, the Damodar Valley and Hirakud projects were undertaken during that time. Minor Irrigation Projects[17] did receive some attention but the importance was given to the Major[18] and Medium[19] Irrigation Projects after independence. The large-scale irrigation schemes were multi-purpose and depended on reservoirs unlike the run-of-the-river irrigation schemes of the colonial India.

The early post independence era was taking pride in launching vast new projects and large dams were seen as 'modern temples of modern India' keeping in view the vision of Pundit Jawaharlal Nehru, the first Prime Minister of Independent India. With the zeal of commitment for rapid social progress, the vast new multi-purpose irrigation projects were projected as a matter of pride in the early post-independence years. More than 90 percent of public investments in agriculture were allocated for large-scale projects during the first 40 years after independence (Kishore, 2002). This also led to lobbyism by engineers, irrigation bureaucrats and contractors who had vested interest in the construction of large dams in the hydel projects. This further led to a severe deterioration in the quality of programme planning and project design, during the second Five Year Plan, 1955-60 (FYP) (Hanson, 1966).

These 'temples of modern India' were flawed on three counts: a) Firstly, the construction of big projects at many places led to major delay in project completion due to budget constraints (Hanson, 1966; Bottrall, 1992). b) Secondly, these projects failed to take into consideration, the complex topographic environmental condition that was not viable to build and extend canals in areas such as eastern floodplains, and in Deccan (Bottrall, 1992). c) Finally the old colonial legislation of giving unlimited powers to the government and the Irrigation Department (ID) continued to be practiced in all matters relating to surface water development and management, leaving no rights to water users (Ibid).

Although there were few exceptions like the new schemes that were introduced in the North-West of India, which led to the disappearance of the centralized bureaucratic canal management system introduced during the colonial time (Bottrall, 1992). The Northwest supply-driven rationing principles and the delta water management of the South were neither appropriate nor could be implemented due to the rigidly designed and often incomplete delivery systems. Which was left at the end of the construction process to meets its failure in other parts of India. The strict formal allocation rules made Irrigation Department (ID) officials, vulnerable to pressures from influential farmers to mismanage the distribution of water to their mutual advantage. This in turn led to a large network of corruption involving local politicians, large farmers, and contractors in influencing the planning and construction phases of surface water development as well as its managements (Pant, 1981; Wade, 1982). Vote bank politics centering on relaxations of offering canal water at cheap rates by the local politicians, also undermined the earlier performance incentives, which were imposed on the scheme managers by the

[17] Minor irrigation schemes is the one in which the arable command area is less than 2000 hectares.
[18] Major irrigation schemes is the one in which the arable command area is more than 10,000 hectares.
[19] Medium irrigation schemes is the one in which the arable command area is more than 2000 hectares but less than 10,000 hectares.

need to raise substantial revenues. Fall of water rates, squeezing of the budgets corresponding to the fall of the salary levels of the Irrigation Department (ID) staff further added to the mismanagement and poor performance of big irrigation projects (Chambers, 1988).

Widespread official acknowledgment of large schemes having severe water management problems began from early 1970s, after the second Irrigation Commission (IC) report was released by Ministry of Irrigation and Power under the Government of India. But for a long time Irrigation Department (ID) professed that the main problems of water management is because of the farmers and the need of the hour is to educate farmers about how to use water effectively and properly (Chambers, 1988). Thus, in 1974-75 Central Government initiated the Command Area Development Programme (CADP) for water management in the command areas, but the programme did not take account of studying the vital central issue of system design and management practice (Bottrall, 1992).

4.2 Small-scale revolution

Independent India's water management can be further divided into small scale community based management and groundwater revolution which is described in detail in the following sections.

4.2.1 Community-based management

In 1980s attempts were made to bring about reform in the management practices of Irrigation Department (ID), through the World Bank supported National Water Management Project (NWMP)[20]. But none of these programmes made an effort to address the issue of the Irrigation Department's (ID) legal powers, lack of accountability in the system management and the monopolistic control of public funds assigned for surface water development (Bottrall, 1992). During the early 1990s in India, Participatory Irrigation Management (PIM) through Irrigation Management Transfer (IMT) to farmers was officially acknowledged as the best method to bring about efficient utilization of irrigation water, equitable distribution and sustainable irrigation service (Swain and Das, 2008).

The concept of PIM in India has evolved through three distinct phases a) Firstly in the early 1980s, the concept was limited to farmers' participation through their representatives in project management committees, but this was not very successful; b) In the latter part of the 1980s, farmers' organization such as chak (outlet) committees were formed but many of these committees remained only on paper and became dysfunctional after a while; and c) In the early part of 1990s, the concept of creating farmers' organizations and of system turnover to farmers' was adopted through the World Bank-funded Water Resources Consolidation Project. Through which thousands of Water Users Associations (WUAs) were formed to take the responsibility for operation and maintenances of the downstream parts of irrigation systems, distribution of water among water users and collection of water rates from the farmers (Maloney and Raju, 1994; Swain and Das 2008).

Nonetheless the implementation of PIM has been a bumpy ride in India due to heterogeneity of farmers, caste-class differences, physical system inefficiency, half-hearted support from irrigation bureaucracy, lack of committed local leadership, inadequate capacity building and lack of proper incentives (Swain and Das 2008). In spite of all this, since independence the expansion of irrigated area by canals has been significant, from 8.3 million hectares in 1950-51 to 18 million hectares in 1999-00 (GoI, 2006a).

Furthermore in regard to community participation in irrigation management, Government of India had also launched National Water Policy (NWP) of 1987 putting emphasis on farmer's participation in the management of irrigation systems especially in water distribution and collection of water charges (Randhawa and Sharma, 1997). The National Water Policy (NWP) of 2002 emphasizes on participatory approach for the management of the water by having cooperation between various governmental agencies and other stakeholders including women participation in various aspects of planning, design, development and management of the water resources schemes. Moreover, involving the local bodies such as municipalities and gram panchayats in the operation, maintenance and

[20] For detail see 'Irrigation Management in South India: The Approach of The National Water Management Project (Berkoff 1988).

management of water infrastructure was done in keeping in view the eventual transfer of management rights to the user groups (GoI, 2002).

The post independence era has seen impressive increase in the irrigated areas by large surface systems under state management. But on the contrary, small water surface systems under community managed continued to decline due to low level of public investment and government measure of increasing its legal and administrative control over them. For example kuhls system (farmer-managed gravity flow irrigation) of Himachal Pradesh, ranges from kuhl regimes which operate independently of any state involvement, to regimes which are totally managed by the Himachal Pradesh Irrigation and Public Health Department[21] (Baker, 1997). The phads[22] of Maharashtra have been physically absorbed into large new canal schemes. Whereas in the tank systems, population pressure on the upper catchments resulted in rapid siltation, denudation and erosion of the areas on which they depended for their run-off. Secondly, with the expansion of modern groundwater extraction technology along with Green Revolution in 1960-70s acted as key factors in the dysfunctioning of the tanks (Mosse, 1999).

The micro-watershed based approach to natural resource management has been hampered due to compartmentalization of various government programmes and the centralization of various programmes meant for the water development. For example Community Development Programme (CDP) was started in 1952 with the aim of community participation in the development of the village (Neale, 1983). But it resulted only in the administrative and developmental functions of a centralized state in the form of replacement by introducing from the 1960s, centrally sponsored programmes and schemes of individual departments (Jain, 1985).

Whereas Indian watershed projects started spreading widely in the late 1980s and 1990s with the aim to develop semi-arid areas that Green Revolution had circumvent (GoI, 1990, 1994a; World Bank, 1990). Watershed projects approaches have evolved from the highly technocratic, large scale top-down approach to greater local participation, use of local technologies which resulted in better performance in terms of conservation and productivity (Farrington et al., 1999; Hanumantha Rao, 2000; Hinchcliffe et al., 1999). Three extremely successful village level projects initiated in the 1970s: Sukhomajri, Ralegaon Siddhi and Pani Panchayat which focused on the link between soil conservation and water harvesting are seen as having the modern roots of the century old assortment of soil and water conservation efforts in India (Kerr, 2002).

In order to replicate the success of these three projects several large-scale projects were started in 1980s[23] and all these projects operated in relatively poor degraded areas and adopted the technological approaches of Sukhomajri, Ralegaon Siddhi and Pani Panchayat. But none of them adopted the institutional arrangements and no or little efforts were made to organize communities as benefits and cost were unevenly distributed in the watershed development project (GoI, 1990, 1994a; World Bank, 1990). The project fails to take note, that collective action to manage the common pool was tough as benefits were gradual, incremental and unevenly distributed (World Bank, 2007).

A significant step for participatory and decentralized forms of decision making and fund allocation was started with the comprehensive common guideline which was evolved for all programmes with the

[21]Tensions has been generated within kuhl regimes due to increasing nonfarm employment as those who have access to new economic opportunities are not very keen to contribute labor in voluntarily cleaning of canals and other resources required for the upkeep of kuhl irrigation, as that time spent could be used in earning a wage (Baker, 1997).

[22] Phad was a community managed irrigation system in which series of dams were built on rivers to divert water for agriculture use. The Phad system was prevalent in northwestern Maharashtra and came into existence 300-400 years ago; the Phad system operated on three rivers in the Tapi basin- Panjhra, Mosam and Aram in Maharashtra (Agarwal and Narain, 1997).

[23] Such as, Government of Maharashtra initiated a major watershed scheme called the Comprehensive Watershed Development Program (COWDEP) for water harvesting (Pangare and Gondhalekar, 1998), Ministry of Rural Development (MoRD) reorganized its Drought Prone Area Programme (DPAP) around water harvesting in 1987 (GOI, 1994a), World Bank supported Pilot Project on Watershed Development and the Model Watershed Program of the Indian Council of Agricultural Research (World Bank, 1990; Kerr, 2007), and in late 1980s the Ministry of Agriculture began the National Watershed Development Project for Rainfed Areas (NWDPRA) which was also on the lines of World Bank projects (GOI, 1990).

recommendation of the Hanumantha Rao Committee in 1994 (Kerr et al., 2000; Kerr, 2002, 2007). The watershed guidelines of 1994 advocated the need for different institutional arrangements at various levels to fulfill the task of community based watershed management. It aimed to begin State-NGOs partnership oriented approach to address environmental problem, to achieve best possible utilization of natural resources, employment generation, restoration of ecological balance and to alleviate poverty through Community Based Watershed Management (CBWM) (GoI, 1994b). The 1994 Guidelines were revolutionary in the respect that they went hand in hand with the literature on Community Based Natural Resource Management (CBNRM), which at that time focused on local people's ability to manage their own natural resources under some enabling conditions (Kerr, 2002).

Over the years many modifications have been made in the 1994 Common Guidelines. In 2001 Revised Watershed Guideline were introduced, which placed importance to seeking a combination of Government Organization /Non-Government Organization (NGO) as Project Implementation Agency (PIA) (GoI, 2001). Whereas Hariyali[24] Guidelines launched in 2003 gave importance to Panchayati Raj institutions by recognizing it as the implementing authority, rather than forming of watershed committee thus making watershed programme, come directly under the supervision of the village panchayat[25] (GoI, 2003)

Again some changes in Hariyali Guidelines were made in 2006 under the name of Neeranchal Guidelines (GoI, 2006b), which aimed at establishing series of institutional structures to govern watershed management in the country. It created a National Authority for Sustainable Development of Rainfed Areas (NASDORA), a quasi-independent authority to manage the Central Government-funded watershed programmes. Recently again in 2008, modifications were made in the New Common Guideline of 2008 (GoI, 2008) which gives prime importance to community participation, by involving all the stakeholders at the centre of planning, budgeting, implementation, and management of watershed projects. Hence the New Common Guideline of 2008 emphasize in making community organizations closely associated and accountable to gram sabha[26] in project activities.

The way community has been conceptualized in watershed programmes has flaws in selecting community for watershed project. Two inter linked aspects need to be kept in account in order to understand the way in which the official watershed guidelines and norms conceptualize community. The first is 'the unit of operation and implementation of a watershed development programme should be watershed (that is the entire area that supplies water to a river) (Sangameswaran, 2008). But to avoid problems of co-ordination between different administrative units, the village is used as the unit of operation than the watershed (Ibid). Second aspect is on conditions, which are believed to facilitate collective action for example through size and homogeneity (Sangameswaran, 2008). Thus the choice of a village as a unit for implementation of watershed programme takes into account the assumption based on commonalities, that people share a common history, ethnicity, interest and are willing to work for common goal and at the same time having homogeneity in terms of landholdings, low percentage of commons land, so that conflict is eliminated in watershed development (Kerr et al., 2002); and villages which are at least perceived as having no factional relationship and promoting harmony is favored (Baviskar, 2001; De Souza, 2001; Chhotray, 2004).

Hence the way community is conceptualized in watershed guidelines either ignored the individual differences in a village, assuming that the common good for the village will override these differences. Moreover it is believed that the new-institutionalist perspective will facilitate the cooperation of the village community by developing institutions, which would enable difference to be resolved. Thus the way community construction is conceptualized in the implementation of the watershed programmes has serious drawbacks. As mere presence of particular features does not always lead to feeling of togetherness, sense of belonging and moreover does not result in collective action in spite of purposively choosing the villages for implementation of watershed project (Sangameswaran, 2008).

The point to note is that watershed is a hydrological unit but not a natural unit of human social organization (Rhoades 1999; Swallow et al., 2001). The cost and benefits are unevenly distributed which results from spatial variation and multiple conflicting use of natural resource in watershed. Large

[24] Hariyali means greenery.
[25] Village panchayat is the elected village governing council.
[26] Gram Sabha is the assembly of all inhabitants of a village.

proportion of uncultivated common land is often in the upper watersheds and revegetating the landscape requires protection against erosion which in term leads to cordoning of limits on grazing and firewood collection (Farrington et al., 1999). The poor, women and landless who are heavily dependent on these lands are severely affected, whereas the water harvesting benefits are also disproportionately benefiting those, whose land are near the check dams and these are mostly wealth farmers who own most of the irrigable land. Projects are unlikely to result in conservation and productivity benefits due to uneven distribution of benefits, where conformity cannot be achieved or where downstream users and upstream users work in close harmony and cooperation (Kerr, 2002). Thus the success of watershed projects to spread beyond some cases and sustained into future as well, requires the knowledge of importance pertaining to water-sharing. Consequently village level micro watersheds with discernable hydrological linkages and established social relationship are promoted for watershed than the macro watersheds covering many villages (Kerr, 2007).

The next section deals with the pump irrigation economy of India with the mechanized groundwater development in the post independence era.

4.2.2 Groundwater Revolution – Taming the Anarchy

The mechanized lift irrigation from groundwater started in mid 1960s with the advent of new pumping technology, which made possible to bore deep wells and extract water in large quantities. At the same time with the advent of Green Revolution a voracious demand for water was created for the high-yielding hybrid crop varieties (Hardiman, 2007). Green Revolution agrarian technology and the institutions of groundwater revolution played a significant role in transforming the productivity of India's irrigated agriculture. The Green Revolution and Tubewell Revolution went hand-in-hand. In India, mechanized pump irrigated area has tremendously increased from 6 million hectare in 1950-51 to 33.3 million hectare in 2000 (GoI, 2006a).

In the prosperous canal irrigated areas of the North-west where the revolution began and in other alluvial areas with easily accessible aquifers, small-capacity shallow tubewells (STWs) under individual ownership were given preference since the beginning. Whereas promising aspects of deep borewells in water scarce hard rock areas made the groundwater technology quite popular. This was due to its capacity to provide water on demand, having good impact on production about twice as high as canals, per unit of water provided and three times higher than tanks (Chambers et al., 1989). Various public agencies provided support in the form of credits and subsidies for well installation and the supply of electricity (Bottrall, 1992). This again benefited the rich farmers, 'once again, like the canal and dam technology, affluent sections of society benefited from the tubewells' (Singh, 1997:53).

Although the well were individually-owned and direct government involvement in tubewell management was through incentives and disincentives, only with the exceptional cases of Eastern Floodplains, like Eastern Uttar Pradesh, Bihar, West Bengal where State Irrigation Department (SID) were actively engaged in installing deep tubewells. For example in Uttar Pradesh which had the largest public tubewell program among all the Indian states, World Bank introduced two technological improvements during early 1970s: a) power line to insulate public tubewells from power outages; and b) an 8-shaped buried distribution system with pucca (concrete) outlets for blocks of eight hectares of the command area (Shah, 2009:28).

These developments benefitted already prosperous canal irrigation regions, especially in North-West of India. Moreover, private shallow tubewells (STWs) which were dependent on groundwater recharge from canal seepage were able to offer complementary flexibility which rigid canal supplies lacked, due to the availability of water on demand from the wells at time at will (Bottrall, 1992). The spread of tubewell technology went hand-in-hand with the Green Revolution technology in the NorthWest region of India and projected the region's experience as the best model for rest of India.

Whereas the spread of private shallow tubewells (STWs) were slow and erratic in the groundwater abundant Eastern Plains, which led the policy makers believe that unequal and fragmented landholdings were acting as hindrance in the promotion of tubewell technology. Therefore in many states of India, large capacity tube wells run by government corporation were introduced which were serving areas of 50 to 150 hectares (Shah, 2009) from the support of World Bank in states like Uttar Pradesh and Bihar. The main objective behind public tubewell projects was to encourage the use of tubewell and modern

mechanical pump irrigation, and promote equity to bring irrigation benefits to poor farmers. Furthermore tubewell technology was capital intensive and required large farms to make it economically viable, but majority of the Indian farms were small. In order to avoid the situation where the larger farmers having tubewell technology become exploitative water lords, and to maintain the parity with canal irrigation, public tubewell projects supplied water for irrigation at heavily subsidized rates (Ibid).

On the one hand there has been limited evidence of public tubewells projects being superior to private shallow tubewells (STWs) on equity forum, as tubewells were manipulative in their operation by larger farmers (Ballabh and Shah, 1989; Shah, 2009). On the other hand despite all these, the projects demonstrated the ability of the productive value of the modern tubewell irrigation. Private shallow tubewells (STWs) in 1980s began to get widespread in many parts of India especially in Eastern UP and West Bengal, and in areas where shallow tubewells (STWs) came up in large numbers competitive groundwater market developed (Chambers, 1989). Private markets in pump irrigation service soon emerged and started competing with the public tubewells (Shah, 1993, 2001). Studies of Ballabh (1987) in Uttar Pradesh, Pant (1984, 1991), Singh and Satish (1988) found the private tubewell owners offering far more superior irrigation services to their neighbors in and around the public tubewells. In fact groundwater development in the water-scarce hard rock upland region has been biased towards larger farmers' due to high investment costs and absence of surplus water for selling.

The expansion of groundwater irrigation has been largely due to improved drilling and lifting technologies along with liberal credit provision; lower per unit cost of water pumping, enormous rural electricity program with subsidized supply of electricity (Marothia, 2003). Therefore with the absence of effective institutional control measures and checks have led to severe over-exploitation of the groundwater. Farmers with adequate resources have constructed deep tubewells with submersible pumps and in the process have been more interested with their private gains and ignoring the social cost of over-exploitation of groundwater (Joshi and Tyagi, 1991; Dhawan, 1995; Vaidyanathan, 1996).

This in turn has led to gross over-exploitation of groundwater resource in the form of phenomenon which seems to provide justifiable evidence Garett Hardin's thesis of 'tragedy of the commons—that uncontrolled access to a Common Property Resource (CPR) leads inevitably to its degradation (Hardin, 1968, 1977). However there is no 'tragedy for the time being for those who have the resources to drill the wells and purchase water, as it puts them in an excellent position to benefit from the wider scarcity (Hardiman, 2007: 41). Further under private property regime, water markets have developed in many parts of India (Shah, 1993). As groundwater is neither a true open access resource, because its ability to extract water is limited by well ownership, nor it is a Common Property Resource (CPR) because it lacks an identifiable group of users having co-equal user rights (Ciriacy-Wantrup and Bishop, 1975).

In order to prevent over-exploitation of groundwater, Government of India drafted a Model Bill in 1970 for adoption by the State Governments for groundwater regulation. Although water management is the overall responsibility of the State Government as per the constitutional provision of India, it falls under the State subject (Dhiman, 2007). The Model Bill empowered the State Governments to tackle the drinking water situation and the bill was further revised subsequently in 1972, 1992 and in 1996. The latest version unveiled in 2005[27] has more influence on legislative activity because groundwater regulation has become priority in many states. Model Bill gives the State Government, the power and the authority over groundwater control by imposing the registration of all groundwater infrastructure and; providing a basis for intruding permits for groundwater extraction in region where groundwater is over exploited (Phansalkar and Kher, 2006; Cullet and Gupta, 2009). Some states have adopted the groundwater acts over the past decades[28]. The Model Bill included the constitution of State Ground Water Authority (SGWA) and the modalities for regulation of groundwater resources. Central Ground Water Authority (CGWA) was constituted under sub section (3) of the environment (Protection) Act, 1986 on 14.01.1997 for the purpose of groundwater development and management[29]. The authority has

[27] For detail see 'Model Bill to Regulate and Control the Development and Management of Groundwater 2005', available at http://www.ielrc.org/content/e0506.pdf.

[28] Andhra Pradesh, Goa, Tamil Nadu, Kerala, West Bengal, Himachal Pradesh and Union Territories Lakshadweep and Pondicherry have enacted and implemented groundwater legislation.

[29]For detail see 'Groundwater Management and Ownership - Report of the Expert Group (Planning Commission, 2007, Government of India, New Delhi).

the mandate to notify 'over-exploited'[30] and 'critical'[31] areas and the regulation of groundwater withdrawal in those areas. But the authority does not have a broad mandate to regulate groundwater in general and have not been able to make much difference in the groundwater management (Shah, 2008). Apart from the legislative activity to manage groundwater, control measures such as electricity reforms like Jyotirgram[32] scheme ("Lighted Village") have been introduced. As a silver line, community based mass movement for rainwater harvesting and recharge has been quite successful in Rajasthan, Saurashtra of Gujarat, Madhya Pradesh and Andhra Pradesh.

To summarize, the groundwater institutions which we find today in India were embryonic in the early years of the nineteenth century and are fully operational in contemporary India. The jointly owned wells in nineteenth century Punjab (Islam, 1997) operated like the tube well companies of North Gujarat (Shah and Bhattacharya, 1993) and Punjab (Tiwari, 2007) of today. In 2003 India's National Sample Survey organization conducted a study on the source of irrigation used by cultivators in Kharif (rainy season crops) and Rabi (winter crops), by asking 51,770 cultivators from 6,770 villages. The study found out that 69 percent of kharif acreage and 76 rabi acreage were irrigated with wells or tubewells (Shah, 2009). Therefore mechanized tubewells with small pumps have transformed irrigated agriculture in India thereby giving a whole new meaning and dimension to the water management. The process of groundwater development has been institutionally (not hydrologically) independent from surface water development. The surface water development technology's management has been Common Property Resource (CPR) or under state agencies, whereas groundwater is governed by minimal legislation as it remained open – access, and provides the pump owners with unlimited right to extract water from aquifers under their land.

5 Discussion

Water management related policies, laws and programmes in postcolonial India have been largely shaped by the legacy of the colonial times, constitutional developments, with specific rules on surface and groundwater irrigation and management. This has resulted in different programmes for large-scale irrigation across community based water management and groundwater development at different spatial and temporal scale.

The existing institutional arrangement for water resource management in the country is fragmented (see Fig. 1 in Appendix) with a number of independent organizations dealing with water at the centre and state levels. At the union level, the water affairs are run by Ministry of Water Resources (MoWR), agriculture is under the rubric of Ministry of Agriculture (MoA); rural development is conducted through Ministry of Rural Development (MoRD) and forest affairs being managed by Ministry of Environment and Forest (MoEF). Each of these ministries has their own research and development sections and policies to guide their programmes. Interestingly, the MoWR only lays down policy guidelines and programmes for the development and regulation of country's water resources[33] (GoI, 2003) and has no institutional structure to support the implementation of the water resources development programmes at the state level. Thus creating a vacuum at the level of policy implementation between center and state. The

[30]Over-exploited in the context of groundwater means 'annual groundwater extraction exceeds the annual replenishable resource and significant decline in long term groundwater levels has been observed either in pre or post monsoon or both'(Dhiman, 2007).

[31]Critical in the context of groundwater means 'stage of groundwater development is above 90% and within 100% of annual replenishable resource and significant decline is observed in trend of long term water levels in both pre and post monsoon periods'(Dhiman, 2007).

[32]In 2003, Gujarat government introduced Jyotirgram Scheme, in which villages get 24 hours three-phase power supply for domestic uses, schools, hospitals and village industries and; farmers get 8 hours of full voltage three phase power on a announced scheduled, and by 2006 around 18,000 villages have been successfully covered under this scheme (Shah, 2009).

[33] Though the MoWR has about 8 federal-level organizations performing different functions along with 10 ad hoc boards and commissions having responsibilities for the execution of specific engineering objectives within river basins (Pitman, 2002:5).

exception to this lies with regard to inter-state and international water issues. While the ministry of water resources remains mainly as an advisory and monitoring role, other ministries related to water (agriculture, forest and rural development) and agencies (state irrigation departments) play an additional regulatory role with delegated structures. The vacuum created illustrates the drawbacks and void in the mechanism of the Ministry of Water Resources, which does not have any validity beyond making policies and generating information.

State agencies play a major role in development and management of water resources under their jurisdiction through water related sectoral units (agriculture, forest, rural development, urban development), other than the Ministry of Water Resources. Though there are diverse departments and agencies involved over water resource management but their role remains fragmented (World Bank, 1998). Irrigation is the largest user of water in all states. Interestingly, there is no separate department for irrigation; rather it comes under the state department of public works (PWD). The PWD is mainly entrusted with constructing roads and governmental buildings, and providing material requirements and construction of infrastructure for drinking water and irrigation water needs. In a way there is strong orientation of the PWD towards civil works construction resulting in limited attention to water planning and management. Though a few states have created a Water Resources Organization (WRO), like Tamil Nadu and Orissa, they have merely remained in renaming the existing PWD with specialist function of irrigation management (Thakkar, 1998). Interestingly, in Tamil Nadu the WRO is mainly concerned with formulating and implementing major, medium and minor irrigation schemes (GoTN, 2005). While Maharashtra went for a gradual irrigation reform through participation, Andhra Pradesh went ahead with a 'Big Bang' approach driven by political will to reform the state. As a result over 10,000 water users association were elected throughout the state in June 1997 (Pitman, 2002:10). With strong sectoral interest among various departments, there is inadequate institutional mechanism for handling inter-sectoral water issues.

The legal component assumes importance in providing operational backing and enforcement towards water resources management. India does not have any separate water legislation, but has water-related legislation dispersed across various sectors between central and state provisions (Saleth, 2004). The legislation governing water issues fails to recognize the structural system and process for providing secure, defensible and enforceable surface water rights. The Indian legal system accepts the riparian rights of the individual to extract surface water from natural systems without disturbing similar benefits of other riparians, as natural rights[34]. With the Indian legal system recognizing statutory means of governing water, socially embedded rules are left in legal limbo with individuals seeking the time-consuming and expensive Indian court system for their grievances. The problem is further compounded with increasing demand from new water resources, such as industrial and environmental needs.

Groundwater, on the contrary, is purely a private good having rights linked with land ownership. All groundwater existing and found beneath private property (that is land) is fully under the control of the owner, who is free to extract and use it as he or she sees fit. Regulation of groundwater is limited[35] to a few states and metropolitan cities. However, regulations through indirect means via the National Bank for Agricultural and Rural Development (NABARD) and State Electricity Boards have been adopted while providing electric connections and credit for investments in wells and pump sets. However, such acts have been frequently by-passed, many times affecting the poor. For instance, Jyotirgram scheme has shrunk the water markets in Gujarat affecting the livelihood of many people[36]. To sum-up, groundwater is largely governed by farm size, the depth and number of wells, pumping capacity and economic power (Saleth, 2004:11). In recent years, the advent of rainwater harvesting gives overwhelming rights to owners having rooftops and open space. There are a number of institutions prescribing water quality

[34] This does not apply to waters flowing in irrigation canals and stored in man-made reservoirs, in which case water can be drawn only with a governance-issued permit.

[35] Only Chennai Metropolitan area, state of Maharashtra, Karnataka and Gujarat have enacted ground water regulation acts (Saleth, 2004).

[36] For detail see 'Groundwater Governance through Electricity Supply Management: Assessing an Innovative Intervention in Gujarat, Western India (Shah et al., 2008).

standards.[37] Unfortunately, there is no coordination among these agencies and more important is the need to operationalise these standards through monitoring and enforcements. In addition to these, there are legislations that have indirect influence on water resources, such as those related to land, forest and environment. The applicability of these legalities often takes the route of conflicts that are conducted and decided in terms of law. Mosse (1997) provides a clear illustration in the existence of socially embedded rules in accessing water from tank-irrigated agriculture in South India.

The incongruence in the conceptualization of legally defined institutions (especially government) and the concrete manifestation of these with socio-and economic life of actors, not only leads to mismatches in the way these legislations are perceived by statutory Acts, but also represents a struggle in establishing and protecting existing socially embedded rules over water. Von Benda-Beckman et al., (1997) illustrate this incongruence in terms of the definition of water, construction and in the complexities involved in understanding water rights. Firstly, formal institutions especially the state, should define water in terms of legally defined rules of 'one water complex', such as lakes, rivers, streams, well and water for irrigation. In addition, it can also refer to specific volume or quality. However, water is conceived among people in terms of its actual use and normatively defined functions. This mismatch in defining water very often leads people to invest these normative definitions with a specific legal status. Secondly, in the legal context there are two broad distinctions of water rights; public and private water rights. Though most rights at the local level have a complex mix of both public and private rights over access to water. Finally, legally defined rights are very often seen as established ones. Nevertheless, the conditions under which actor's access water resources are rarely defined rules.

In view of these complexities, the legislations and regulations made by the national government are only one part of the motivation for the actors' behavior. These conventional forms of legislation co-exist and interact with multiple legal orders such as customary, religious, project and local laws. All of which provide basis for actors to claim access to water (Von Benda-Beckman et al., 1997), especially in countries like India that have centuries old archaic management practices. These multiple legal institutions existing at various levels in the social spectrum help actors in "forum shopping" to one or another of these legal frameworks to access water (Spiertz, 2000:191). Institutions through which these legal forms are negotiated and renegotiated are crucial for water resource management (Bruns and Meinzen Dick, 2000).

6 Conclusion

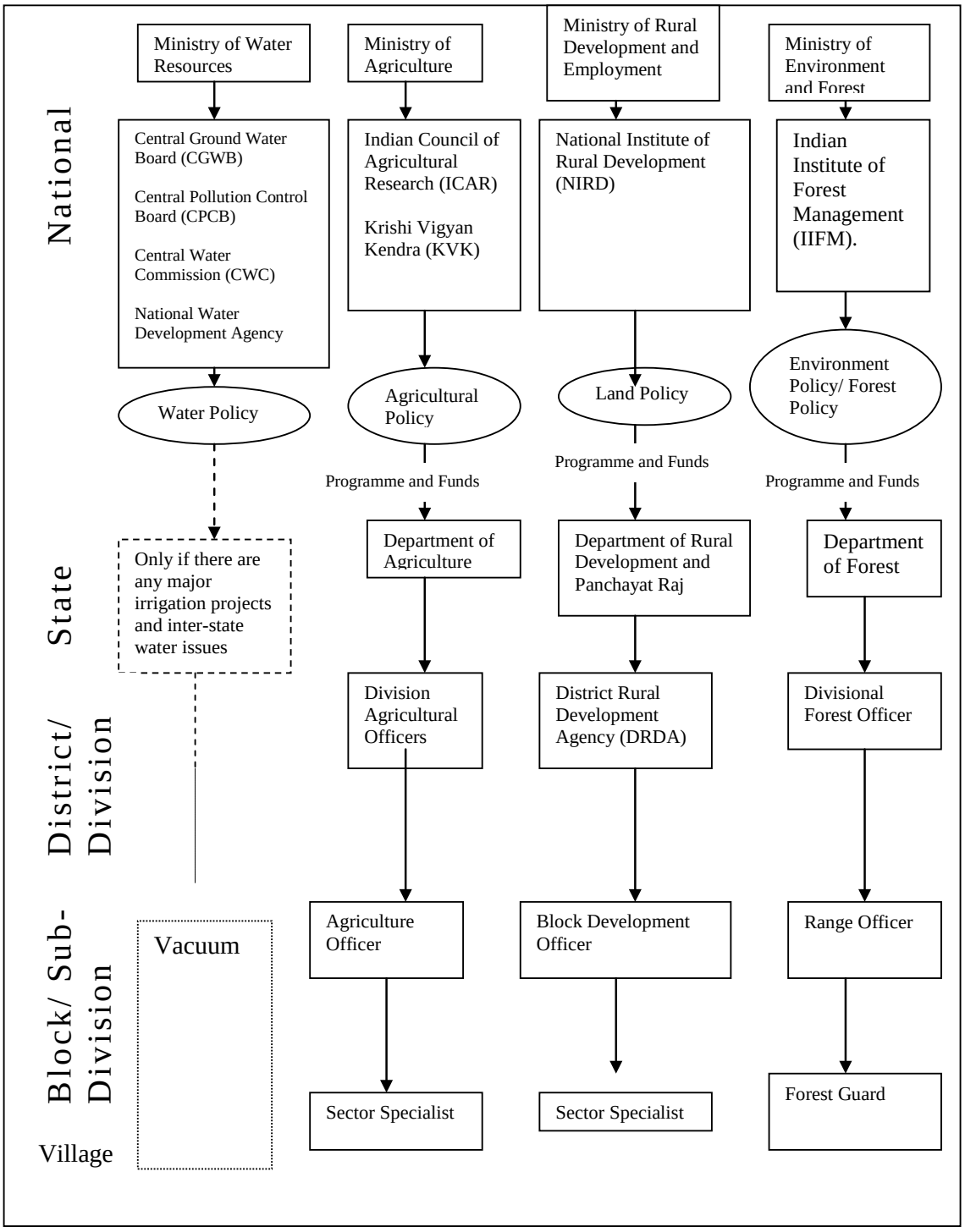
Water management has been a contentious and tricky affair in India due to socio-economic-political and ecological reasons. Factors like caste-class differences, heterogeneity of farmers, rural–urban dichotomy, and extreme different ecological conditions have influenced the water management. To complicate further, vote bank politics, lack of coordination between irrigation bureaucracy, policy making and various sectoral departments carrying out their own water programmes, have affected water management in a diverse manner to people. In this diverse regime, India has been embracing water management in its water policies, but they remain a mere proposition. The Ministries seize the opportunity presented by the all-encompassing concept of 'integrated' and 'community-based water resource management' to push their ministerial objectives and to overcome financial deficit, together with their proclaimed adherence to democratic commitment. The state governments have exploited the concept to remain forefront in ecological and social transformation using a vehicle of centralized single focus technology mission. While collective action is transformed into private collaboration for local elites in their continuous search for acquiring power to control. These actors exploit the incongruence presented by the complex rules and administrative red tapism to achieve their social goal of survival by exploiting water management technologies. Understanding how these different policies and programs

[37] Central Pollution Control Board (CPCB) defines water quality for five different categories of inland and fresh water that is being followed by the States. The Bureau of Indian Standards establishes drinking water quality under the Indian Standards Institution (ISI). World Health Organization (WHO) provides guidelines not covered by ISI standards. In addition, the Environmental Protection Act 1986, Hazardous Waste Rules 1989 and State Pollution Control Boards (SPCB) have their own regulatory regime.

influence water management at the community level is one of the unexplored issues. Its further examining will offer insights on the ability of the community to integrate different programs and policies by default given their complex livelihood requirements. The co existence of static and dynamic elements in the society along with organic and inorganic linkages would pervade through paradox and ambiguities perturbing the debate. Thus it would invite and stimulate new inquiries emanating from policy makers, civil society, academia and institutional apparatus of state.

Appendix

Fig. 1 ADMINISTRATIVE STRUCTURE OF MAJOR MINISTRIES CONCERNED WITH WATER RESOURCE



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