Bulletin No. T-69/V-5

भा.कृ.अनु.प.
I.C.A.R.

Status of Community Based Water Storage Structures in Gujarat

V.C. PANDE | G.L. BAGDI | D.R. SENA

ICAR - INDIAN INSTITUTE OF SOIL & WATER CONSERVATION
RESEARCH CENTRE, VASAD - 388 306 (GUJARAT)

Bulletin No. T-69/V-5

STATUS OF COMMUNITY BASED WATER STORAGE STRUCTURES IN GUJARAT

V.C. PANDE

G.L. BAGDI

D.R. SENA

ICAR - INDIAN INSTITUTE OF SOIL & WATER CONSERVATION
RESEARCH CENTRE, VASAD - 388 306 (GUJARAT)

Citation
Pande, V.C., Bagdi, G.L. and Sena, D.R. (2015). Status of Community Based Water Storage Structures in Gujarat. ICAR-IISWC Research Centre, Vasad (Gujarat): 38pp.

Prepared by
V.C. Pande
G.L. Bagdi
D.R. Sena

Published by
Director
ICAR-Indian Institute of Soil and Water Conservation
218, Kaulagarh Road,
Dehradun-248195, Uttrakhand, India

Design, Layout & Production by
Nirmal Kumar

Editorial Touches by
Sangeeta N. Sharma

Year of Publication
2015

Printed at
Allied Printers, Dehradun
Ph.: 2654505, 3290845

Preface

Water has been regarded as a gift of nature to fulfill the basic needs for survival in the rural localities, irrespective of the existing social diversities. Common property water resources are water bodies which are managed by rural community for distribution of water benefits to the locals. These water resources, historically, were well managed as a part of the traditional socio-cultural wisdom of the local people as a significant section of the rural poor depended on these common resources for their traditional livelihood activities and domestic uses. Over time, due to several demographic and economic reasons, while alternative water sources gained importance, the common property water resources suffered neglect. Since these water resources still form an important component of the socio-ecological systems in rural India, their sustainable management not only addresses livelihood concerns of the rural people but also environmental issues as these are part of integrated water resource regime. It is under this backdrop that the present study was undertaken by authors to examine the community based water storage structures in Gujarat.

The study has covered a wide range of issues beginning with present status and historical change, to equity issues in benefits drawn and share of the resources in various livelihood activities of local people. Study of present institutional arrangement revealed that despite resource management institutions in place, there was apathy of local stakeholders in their management. This was drawn largely from local governance issues and financial resource crunch faced by the local management body. A set of recommendations have been given, based on the field observations, to strengthen the management of these community based water storage structures.

I hope these recommendations would draw the attention of the policy makers, state agencies implementing the water sectors programmes and policies, the development professionals and NGOs working in this area.

(P.K. Mishra)
Director, IISWC, Dehradun

Acknowledgement

Community Owned Water Storage Structures form an important component of the socio-ecological systems in rural India. A significant section of the rural poor, particularly the landless labourers and marginal farmers, continue to depend on these common resources for their traditional livelihood activities and domestic usages. The management of water resources by community, which prevailed before independence and had looked after the Common Property Water Resources, has almost vanished. Increasing demand for water has led to focus on new water resources development such as Narmada water supply in Gujarat state, further neglecting the traditional resource along the way. These alternative sources have addressed the problem of water availability both qualitatively and quantitatively but at a certain cost. The village economies yet to benefit from such sources are still reeling under water resource constraints. Small and marginal farmers, in particular, are the victims of depleting water resources as they largely depend on community water resource such as open wells and ponds/ tanks. There is need to rejuvenate the traditional community owned water storage structures such as surface water bodies, locally called *Kund* or *Talab*, as these are less capital intensive, have wider geographical distribution and are potent in areas with low rainfall making them relevant to rainfed agricultural economy of the country.

Over time, these resources have suffered neglect due to apathy of local stakeholders for institutional and financial reasons, individually as well as in tandem. Issues like equity, together with benefits drawn from community resource affect people's motivation in resource management. This has relevance in the present changing paradigm of participatory resource management. Strengthened institutions with sound technical interventions for water resource maintenance could go a long way in community resource management. The present study attempted to addresses these issues in village pond and community check dam management in Dhanduka *taluka* of Ahmedabad districts and Jamnagar *taluka* of Jamnagar district in Gujarat.

The authors wish to express their gratitude to the then Director, Dr. V.N. Sharda whose invaluable guidance, support and encouragement nourished this research. The support and technical inputs provided by the Director, Dr. P.K. Mishra are acknowledged. Our deep gratitude to the then Head of the centre Dr. R.S. Kurothe for his valuable suggestions for improvement of the methodology of the research. Our sincere thanks to colleagues at the institute and the centers, for shaping the idea in developing a core project. Thanks are also due to Sh. C.N. Damor, Sh. Anand Kumar, and Sh. D.G. Damor, Technical Officers, for their assistance in data collection.

Authors

Contents

List of Tables

List of Figures

List of Plates

Summary

With the government's initiatives, about resolving water issues, over time the community water storage structures have been losing their due importance. Nonetheless, these still play a role in meeting water demand of rural people. This is particularly so in villages where government source such as Narmada water supply has not yet over taken the community resource on a large scale. These community sources not only meet animal water and supplementary irrigation needs but also some non-cooking non-drinking water needs of the poor segment of rural society. Field surveys were conducted to assess the people's dependency, benefits drawn and their distribution across the socio-economic strata of rural society. The average household benefit drawn from these sources was estimated to be varying between ₹ 1,122 to ₹1,559 Hh^{-1} $annum^{-1}$ (2010-11 prices). The direct contribution of CPWR on agricultural returns varied from 30% to 60% in some villages. Similarly, the water productivity in crop and livestock production varied between ₹ 1.3 to ₹ 9.5 m^{-3} and ₹ 1.6 to ₹ 14.3 m^{-3}, respectively in different villages surveyed. The gross benefits was estimated to be between ₹ 0.08 million to ₹ 3.34 million across the community water storage structures surveyed.

An attempt was made to examine the institutions managing the community owned water storage structures. Poor representation of weaker sections in water management bodies and gender discrimination in community water resources decision making observed to have weakened the institutional mechanism. The panchayat/ water user associations need to be revived with bigger roles for these groups as the latter largely bear the brunt of water constraints. Strengthened institutions being a panacea for efficient resource management, technical design and scientific planning in creating/maintaining water resources, nevertheless, would go a long way in serving the rural community efficiently as these factors not only affected the ponds' functionality and financial viability but also people's perception about resource utility and efficiency in service delivery.

There is, therefore, a need to create management systems where the formal decision-makers such as PRI/ water user association interact with relevant members of the scientific community, users and other stakeholders for a coordinated approach that successfully orchestrates water uses towards hydro-geological and socio-cultural compatibility. Water resources management in the 21st century requires a radical reorientation and an effective dialogue between decision-makers, stakeholders and the scientific water community.

In view of the observations made during the course of the study, some of the interventions in the management of community water storage structures are as under:

1 Emphasis on pond siltation through utilization of state government's de-siltation scheme managed by Gujarat State Land Development Corporation on regular basis.

2 Allowing surplus water in ponds, where available, for limited irrigation use.

3 Strengthening community resource governance to avoid over exploitation of resource in such cases.

4 Community ponds with sufficient water for a longer period during the year may be encouraged for commercial enterprises such as fishery to improve financial condition of panchayat managing them.

5 Improving participation of women and weaker section of rural community in the management of community water resource as these groups were observed to have high stake but poor representation in resource management.

6 Motivation of elected body's members, who manage Community Based Water Storage Structures, through sustained campaign to manage the community resources, is strongly emphasized. A lack of interest among executive members of Panchayati Raj Institutions (PRI)/Water User Association (WUA) towards community water resource was observed during survey.

7 Involvement of Panchayat administration at higher levels, such as taluka and district, may be emphasized to ensure regular working of community water management bodies, sound fund availability and its management.

Chapter 1

Introduction

Common Property Water Resources (CPWRs) are water bodies which are managed by rural community for distribution of water benefits to locals. These village surface water bodies are small water-storing structures, with rain water accumulating in low lying areas of various depths, having a catchment and slope where water is collected during the monsoon period and are basically meant for catering to the domestic water needs of the village community. These are good source of water, particularly in areas that receive low rainfall and where livelihood is mainly based on rain-fed agriculture.

These resources play a vital role in providing income and employment to rural people in many different ways. The degradation of these resources has a direct negative impact on the livelihoods of the poor. At the same time their degradation also poses serious environmental problems to the society and country at large in the long run. Preserving these resources, therefore, paves the way for long lasting local solutions to livelihood issues. Equity and management aspects of utilization of CPWR have considerable social relevance in the changing paradigm of people's participation in the management of common property resources. While the problem of equity is common to all common property resources, this is more so in case of water, particularly groundwater. In the case of groundwater the emerging technology-driven scenario, such as Tube Wells, in the agriculture sector contains altogether different challenges and implications for the traditional institutional arrangements for sharing of and caring for the CPWRs. Being innumerable and variable in size, they lend themselves to decentralized management.

Water Management Traditions in India

Water has been regarded as a gift of nature to fulfill the basic needs for survival in the rural localities, irrespective of the existing social diversities. Water needs in villages are common and, therefore, water is seen as a common resource with universal rights to users. The water management traditions in rural India are followed within small-scale village communities. While certain needs such as drinking, cooking, washing, cleaning and bathing are common to all, those pertaining to certain productive purposes have traditionally been defined by ownership of assets. The land owning agricultural community uses water for irrigation, others like potters, washer men and cattle herders use it for specialized livelihoods.

Historically, the common property resources have been well managed as a part of the traditional socio-cultural wisdom of the local people. Village surface water bodies, locally known as *Johad, Poker, Kund, or Talab*, are small water-storing structures basically meant for catering to the domestic water needs of the village community. These water bodies are the common property resource (CPR) with the basic philosophy of water for everybody in the rural setting. Tanks, similarly, are one of the oldest sources of irrigation in India. There are many

benefits associated with tank irrigation. For example, tank irrigation systems are less capital-intensive and have wider geographical distribution than large irrigation projects.

The water management organized within small-scale village communities fulfils the water-related needs of the members through management of the resource and the sources through which it is harnessed. These include the community of water users and the managers of the system. These, in the village, are stratified into different groups and guided by the principle of social/ economic dominance. The dominant one generally leads in regulating water management affairs and tend to reside closer to the centre of the village. Others settle towards the periphery in decreasing order of their position, so that those placed lowest generally reside on the village outskirts. Economic and social dominance principles influence the various livelihood elements in a complex manner. These generally govern the beliefs and practices about rights and responsibilities, powers and privileges with respect to the different water management activities. Since water is a common need for all members of the community and water itself is conceived as a common pool resource, collective responsibility for managing it rests with the community that encompasses the entire village community.

Water Challenges and the Management of Water Resources in Gujarat

Gujarat has just 2.3% of India's water resources and 6.4% of country's geographical area. The State has an average annual rainfall of 80 cm with a high coefficient of variance over time and space and as a result droughts have been frequent. The State has only eight perennial rivers and all of them are located in southern part. Around 80% of the State's surface water resources are concentrated in central and southern Gujarat, whereas the remaining three-quarters of the State have only 20%. On average, three years in a cycle of 10 years have been drought years (Gupta, 2004).

The state government took steps to promote local water systems during mid 1990 through setting up a state level Recharge Committee to promote rainwater harvesting. During the year 1996-97, the government decided to promote two rainwater harvesting schemes, namely, Roof Water Collection *Tankas* for households and the scheme of Recharging Groundwater through local rainwater harvesting structures at the community level. In 1998-99 the state government launched Sardar Patel Participatory *Sahbhagi Jal Sanchay Yojana* (SPPWCP) to promote the ongoing check dam movement in the state, particularly in Saurashtra, which was a suitable area for check dams, with the rapidly flowing 70 rivers in the region. For drinking water supply, creation of the Water and Sanitation Management Organization (WASMO) was a significant shift in the role of governance from provider to facilitator by empowering village level institutions through extensive capacity building and pro-active facilitation. Since its inception, WASMO, through facilitating successful community led water supply programme, has, in fact, brought about effective citizens' engagement throughout the State of Gujarat.

With the increasing water crisis in the state, the government moved more and more towards crisis management. The increased frequency and intensity of droughts, which were accompanied by shortages of drinking water, pushed the state to look for quick solutions to the problem. The major components of the crisis management included fixing new pipelines for Regional Water Supply Scheme to reach problem areas, lifting Narmada water to feed new and old drying pipelines, feeding new and old pipelines (where sources have dried up) by drilling emergency bores and tube wells. To address severe water scarcity, even transferring water to problem areas by water tankers, water trains and even ships and drilling bores, tube wells etc to access water from deeper aquifers for local population were also resorted to whenever possible.

Community Based Water Storage Structures

Community's efforts in water collection, storage and management, through traditional water harvesting systems, have been in vogue for a long time. Apart from being devised in consonance with the local environment (including, hydrology and topography) and socio-cultural specificities, these systems have helped recharge groundwater and fulfilled local demand for the resource. These sources are also used for irrigating the cultivated land. About 23% of the Indian households use water resources like tank, wells and tube wells owned by village *panchayat* or a community of the village or those provided by the government and government canals, rivers and springs, for irrigating their land (NSSO, 1999). As most of these traditional water sources are in the hydrological and socio-cultural domain of rural areas, these are best managed by the local communities. These community based water storage structures, however, have not been able to serve these purposes efficiently for the reasons such as neglect emphasis on alternate source (Das, 2005) and construction far from the settlement (Hirway, 2005).

It is a general belief that the various reform initiatives in water resources management are compatible with the existing hydrological and social structures, the socio-economic divisions among users and the dominant cultural ethos. These are the very reasons which govern their success or failure. The issues have been properly dealt with in literature. Majority of the studies, however, have focused on the utilization of community water resources for non-domestic livelihood-related purposes such as, irrigation, livestock rearing, fishing, etc. Little is discussed about the degree and nature of dependency of different social and economic sections of the rural population on these resources for other basic life-sustaining activities such as drinking and domestic usage. Further, while models of participatory management of irrigation systems such as *Pani Panchayats*, Water Users Societies, etc. have been studied, technological aspects in designing and execution of water harvesting structures are few in literature. It is in the above context that a study was conducted with respect to community based water storage structures in Gujarat. The study examined the status of water storage structures, both social and hydrological, their usage and institutional arrangements, dependence of different socio-

economic groups on them, benefits accrued and water supply-demand gaps in respect of community based local water storage structures and methods/policy prescriptions for their sustainable management.

Location of Study, Profile and Demography

The potential of fresh water availability in Gujarat reveals its intensity to be on higher side in Saurashtra, Kutch and north Gujarat (Patel, 2007). Dhanduka taluka in Ahmedabad district and Jamnagar taluka in Jamnagar districts were, therefore, selected based on high number of community water storage structures (Fig.1). Engineering survey of community village ponds (16 nos.) and community farm ponds (8 nos.) in Ahmedabad district and community check dams (5 nos.) in Jamnagar district were undertaken. Village ponds largely serve the domestic purpose of cloth washing, utensil washing, animal drinking and hygiene purposes; while farm ponds are meant to serve irrigation requirement. Both these structures also help groundwater recharge. Community check dams serve the purpose of groundwater recharge benefitting the tube wells in the vicinity. Personal surveys of 142 farm households (92 Nos. for

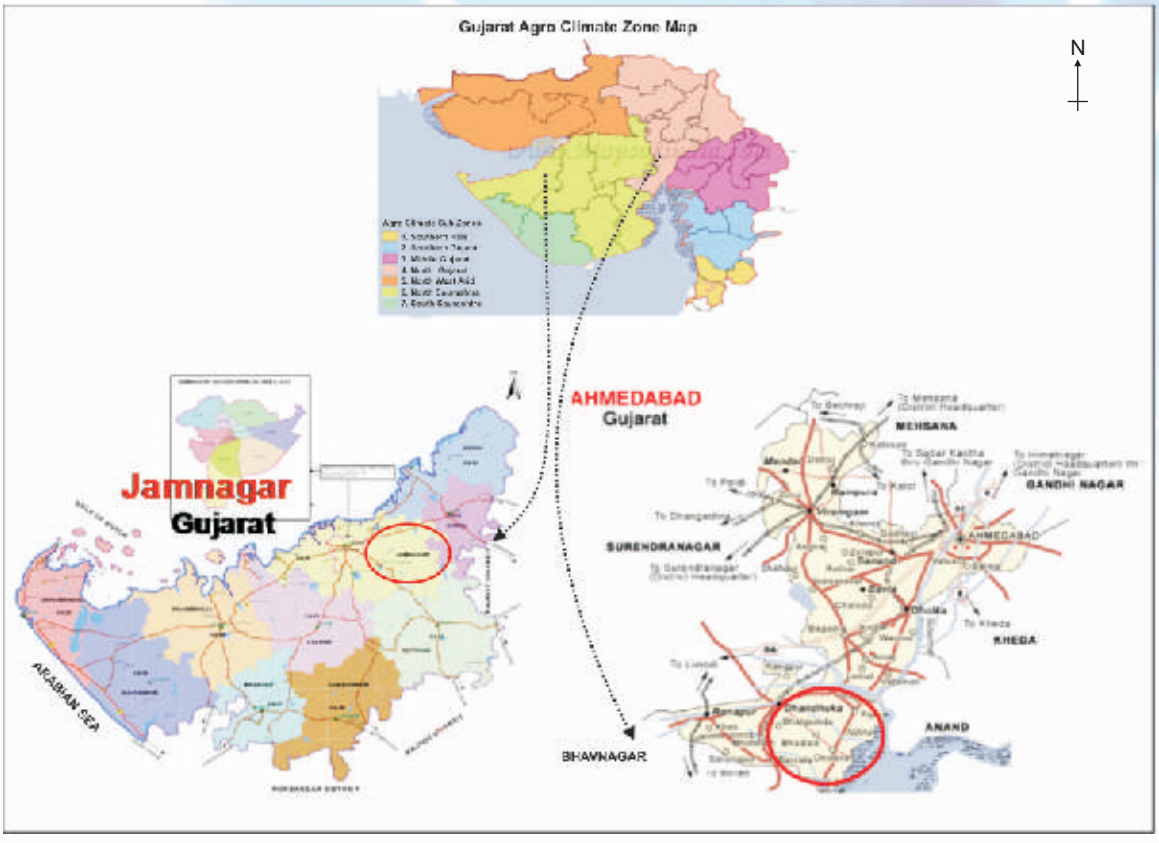

Fig. 1: Location of the study

community ponds and 50 Nos. for community check dams) were done. Data was collected on details of technical design and catchment characteristics of village ponds/ check dams, existing community structure and institutional set up, water uses, water demand and supply gap, productivity and other socio-economic variables.

Village profile

The villages surveyed varied from 50 ha to 7500 ha in geographical extent (Fig. 2). The agricultural land in the villages varied from 40 ha to 6700 ha. However, the irrigated land existed in only 60% villages, others being rainfed. The share of irrigated land varied from 1 to 97% in different villages. However, the land irrigated directly by pond was very small as the ponds are meant primarily for animal uses.

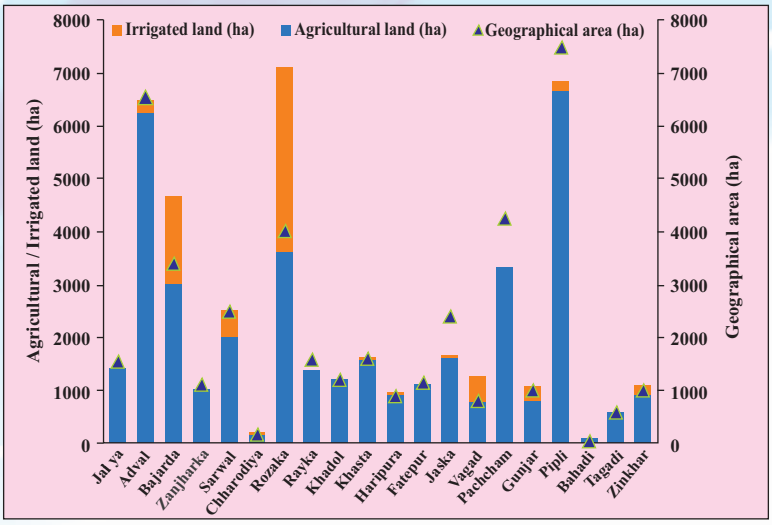

Fig. 2: Profile of villagers surveyed

Profile of beneficiaries

Majority of the farmers had small to medium holdings. About 70% of them owned *pucca* houses. Ownership of livestock is high. Cow and buffalo constituted the highest number (Fig. 3). The average ownership of bullock, cow and buffalo is 2, 2 and 3, respectively. This has implications for community water storage structures, on which the livestock depend for drinking water and for animal cleanliness.

Average family size worked out to be 4.5, with the average adult age being 39 years. Agriculture was the main occupation, though off farm employment was also reported by 20% of them.

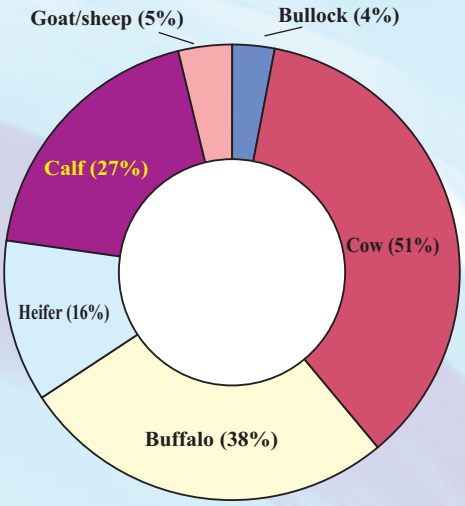

Fig. 3: Livestock ownership of farmers

While ownership of consumer durables like telephone, television and moto cycle was high, farm asset like diesel motors were also possesed by farmers (Fig. 4). Again ownership of groundwater extraction device reflected that there were substantial number of wells in the villages.

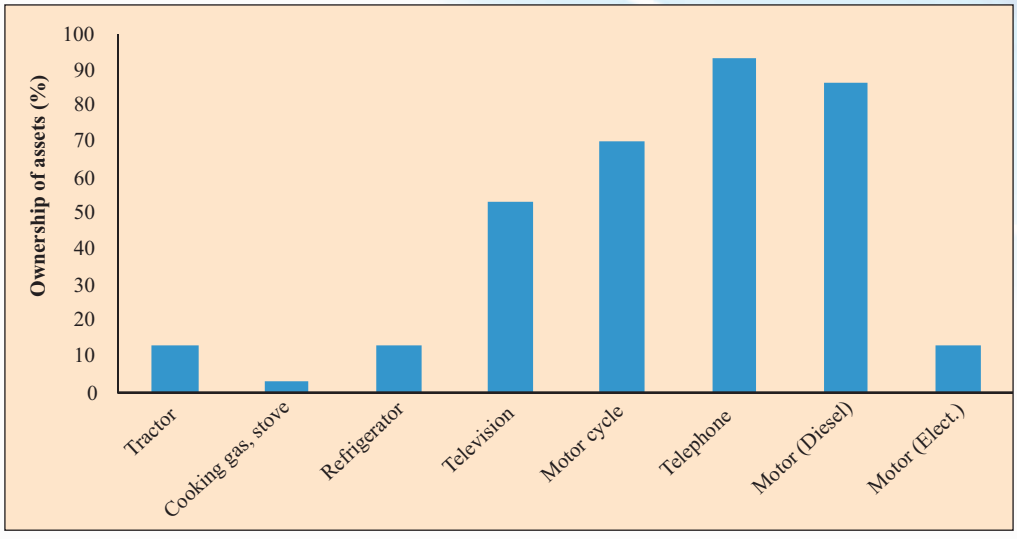

Fig. 4: Ownership of farm assets and consumer durables

Chapter 2

Survey Design and Sample Distribution

Extensive primary surveys and focus group discussions at the household levels formed the empirical core of this study. Socio-economic data were elicited through structured questionnaires prepared and finalized after pre-testing. Hydrological and engineering enquiries were also envisaged, apart from the socio-economic surveys, as an integral component of the study. The hydrological data gathered through field trips (and supplemented by secondary information) were useful in establishing the potential sustainability of the individual systems.

The entire survey exercise involved finalization of the sample sites and the systems; collection of basic village level information including community owned ponds; household survey covering socio-economic characteristics and pattern of water use; focus group discussions to elicit villagers views and perceptions about pond related issues. This was followed by hydrological and structural surveys of the structures.

Selection of Systems and Sites

Community *talavs* (ponds) and check dams, widely prevalent in these regions, were selected after discussions with different stakeholders, including concerned government and NGO officials. Ponds included both village pond and *sim talav* (Plate 1).

Village Pond

Sim Talav

Plate 1: Village pond and *Sim Talav*

Sampling of Households

The guiding factor in the selection of households was the fact that the households were using the selected ponds. The proportion of sample households selected from each village varied depending on the number of households using the pond water in a particular village. The sample size was influenced by the factors, *viz*; topography, distance between the pond and the houses.

Survey Instruments

Elaborate survey instruments were prepared for the purpose of collection of both quantitative and qualitative data from the primary source. The survey was carried out to collect information through (i) village level and household level survey instruments and (ii) hydrological and engineering survey instrument.

Village level questionnaire

This had two parts. Part A was used to collect information on area, broad socio-economic characteristics of village population, access to public utilities and basic amenities. Part B was meant for eliciting detailed information on existence of public and private sources of water supply, groundwater levels, irrigation sources, and other relevant water related issues.

Household level questionnaire

This survey schedule had been designed to collect household level information on demographic profile of the family, social status, occupation, sources of income, housing details, land holding and also variety of information on domestic water collection and use.

Hydrological and engineering survey questionnaire

The schedule was used to collect information on location, design, hydro-climatic data and catchment characteristics of the structures.

The triangulation approach was followed to cross-examine responses to ensure similar result to a question with different methods to ascertain reliability of data collected.

The community based water storage structures selected for study, *viz*; village pond, *sim talav* and community check dams (Plate 2) are given in Tables 1 and 2. Table 3 gives the distribution of sample beneficiaries surveyed.

Table 1: Details of village pond and *sim talav* surveyed

Name of structure and location	Year of construction	Catchment area (ha)*	Purpose served	Managing agency
Jaliya village pond, village outskirt	1985	40 - 50	Animal drinking, domestic (cloth washing), groundwater recharge	Village *gram panchayat*
Adval village pond No. 1, village outskirt	Very old village pond	50 - 100	Animal drinking, domestic (cloth bathing) groundwater recharge	Village *gram panchayat*
Adval village pond No. 2, village outskirt	Very old village pond	50 - 100	Animal drinking, domestic (cloth washing, bathing) groundwater recharge	Village *gram panchayat*
Adval Sim Talav No. 1	2006-07	20-30	Irrigation purpose, groundwater recharge	Village *gram panchayat*
Adval Sim Talav No. 2	2007-08	20-25	Irrigation purpose groundwater recharge	Village *gram panchayat*
Adval Sim Talav No. 3	2008-09	20-25	Irrigation purpose groundwater recharge	Village *gram panchayat*
Bajarda village pond No. 1	1987-88	30-40	Animal drinking, domestic (cloth washing, bathing) groundwater recharge	Village *gram panchayat*
Bajarda village pond No. 2	1987-88	20-30	Animal drinking, domestic (cloth washing, bathing) groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 1	1987-88	10-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 2	1987-88	10-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 3	1987-88	15-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 4	1987-88	15-20	Animal drinking, irrigation, ground water recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 5	1987-88	15-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 6	1987-88	15-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 7	1987-88	15-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 8	1987-88	10-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 9	1987-88	10-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 10	1987-88	10-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Bajarda *Sim Talav* No. 11	1987-88	10-20	Animal drinking, irrigation, groundwater recharge	Village *gram panchayat*
Zanjarka village pond No. 1	Very old village pond	15-20	Animal drinking, domestic (drinking, cloth washing, bathing), groundwater recharge	Village *gram panchayat*
Zanjarka village pond No. 2	2006-07	5-10	Animal drinking, domestic (drinking, cloth washing, bathing)	Village *gram panchayat*
Zanjarka village *Sim Talav*	2007-08	3-4	Irrigation, animal drinking, groundwater recharge	Village *gram panchayat*
Sarval village pond	Very old village pond	8-10	Animal drinking, domestic (drinking, cloth washing, bathing), groundwater recharge	Village *gram panchayat*

Name of structure and location	Year of construction	Catchment area (ha)*	Purpose served	Managing agency
Sarval *Sim Talav* No. 1	2000-2001	15-20	Animal drinking, some life saving irrigation	Village *gram panchayat*
Sarval *Sim Talav* No. 2	2005-2006	15-20	Animal drinking, some life saving irrigation	Village *gram panchayat*
Chharodia village pond	Very old village pond	25-30	Animal drinking, domestic (drinking, cloth washing, bathing), groundwater recharge	Village *gram panchayat*
Rojaka village pond No. 1	Very old village pond	100-150	Animal drinking, domestic(drinking, cloth washing, bathing), groundwater recharge	Village *gram panchayat*
Rojaka village pond No. 2	Very old village pond	20-25	Animal drinking, groundwater recharge	Village *gram panchayat*
Rojaka *Sim Talav* No. 1	Very old village pond	5-10	Supplementary irrigation, groundwater recharge	Village *gram panchayat*
Rojaka *Sim Talav* No. 2	Very old village pond	5-10	Supplementary irrigation, groundwater recharge	Village *gram panchayat*
Rojaka *Sim Talav* No. 3	Very old village pond	5-10	Supplementary irrigation, groundwater recharge	Village *gram panchayat*

Source: Data collected through personal surveys,
* Approximation.

Table 2: Details of village community check dams surveyed

Name of structure location	Year of construction	Catchment area (ha)*	Purpose served	Managing agency	No. of open/ tube well benefitted	Area benefitted (ha)*
Vibhapar check dam	1965	900-1000	Irrigation, Groundwater recharge	Gram panchayat	22	55
Dhunvav check dam 1	1985	400-500	Irrigation, Ground-water recharge	Gram panchayat	7	25
Dhunvav check dam 2	1966	500-600	Groundwater recharge[$]	Gram panchayat	8	50
Khimrana check dam	2001	900-1000	Groundwater recharge[$]	Gram panchayat	18	51
Morkanda check dam	2002	700-800	Groundwater recharge[$]	Gram panchayat	20	50
Hapa check dam 1	1995	200-300	Groundwater recharge[$]	Gram panchayat	23	104
Hapa check dam 2	2010	200-300	Groundwater recharge[$]	Irrigation Deptt.	10	50
Khimaliya check dam 1	1990	900-1000	Groundwater recharge[$]	Irrigation Deptt.	40	133
Khimaliya check dam 2	2001	100-200	Groundwater recharge[$]	Irrigation Deptt.	23	58
Theba check dam 1	2000	400-500	Groundwater recharge[$]	Gram panchayat	30	133
Theba check dam 2	2001	400-500	Groundwater recharge[$]	Gram panchayat	20	50

Source: Data collected through personal surveys
* Approximation; [$] No direct irrigation from the stored water was reported during survey.

Table 3: Sample distribution

Land holding	No. of sampled beneficiary households	Total cultivated area of sampled beneficiary households (ha)	Total irrigated area of sampled beneficiary households (ha)*	Average size of holding (ha)
Marginal (≤ 1.0 ha)	11	8.0	-	0.7
Small (> 1.0 to ≤ 2.0 ha)	45	69.3	-	1.5
Semi-Medium (> 2.0 to ≤ 4.0 ha)	35	103.3	47.1 (6.2)	3.0
Medium (> 4.0 to ≤ 10.0 ha)	34	204.4	44.7 (8.2)	6.0
Large (> 10.0 ha)	17	509.2	54.2 (16)	30
Average	142	157.9	47.5 (8.9)	6.29

* Figures in parentheses are percent of the total irrigated area that is irrigated by the CPWRs.

Plate 2: A profile of community based water storage structures (community ponds and check dams) studied

Socio-economics of Community Water Storage Structures

Among the sampled beneficiary, majority (49%) were medium farmers. This was followed by small holder farmers (39%) and large farmers (12%). The cultivated area with small holders farmers surveyed was 77.3 ha and none of this was irrigated. The sampled semi-medium farmers had 103.3 ha and only 47.1 ha was irrigated. Among medium farmers surveyed, out of the total cultivated area of 204.4 ha, only 44.7 ha was irrigated. Similarly, the large farmers' surveyed owned total 509.2 ha, out of which 54.2 ha was irrigated. In irrigated holdings, the share of community based water resource structures varied from 6.2% on semi-medium holdings to 16% in large holdings. The average employment from crop production varied between 88 man-days household^{-1} year^{-1} on marginal holdings to 807 man-days household^{-1} year^{-1}, and share of community water storage structures was about 10%. The community water storage structures also contributed to the livestock production, affecting the overall village livelihood. Ownership of milch animals was higher than draught animals and small farmers owned more buffaloes, while medium farmers owned more cows among the sampled beneficiaries. The average water

use for livestock production varied from 43 litres household^{-1} day^{-1} on marginal farms to 54 litres household^{-1} day^{-1} on small farms. Among medium and large farms, it varied between 23 litres household^{-1} day^{-1} to 32 litres household^{-1} day^{-1}. The share of community water resource in livestock production varied from 25% on marginal farms to 87% on large farms in the sample farms surveyed. The variation in livestock units owned by households explained the average water use and share of community water resource. The average employment for livestock production worked out to be 380 man-days household^{-1} annum^{-1} to 450 man-days household^{-1} annum^{-1} and the share of community water resource was estimated to be an average of 40% across the holdings in the sampled household surveyed. Apart from these, farmers also drew water from community source for various other uses such as drinking, cooking, personal hygiene and other uses including animal use (Plate 3).

Plate 3: Animal dependence on community village pond

The share of community water resources in various uses varied across the farm holding size. Community water resources had minimal share in drinking and cooking water uses ranging from 6 to 9% share in drinking water and 6 to 12% share in cooking water used by villagers. The non-drinking non-cooking water requirement met from community water resources was quite high. For personal hygiene, community water resources met 56% of the total requirement in case of large farmers to 100% water requirement in case of marginal farmers. The community resources met water requirement for washing clothes from 76% in case of small farmers to 100% in case of marginal farmers. For other uses including animal uses, similarly, the contribution of community water resource ranged between 80% in case of semi-medium farmers to 91% in case of marginal farmers (Plate 4). Across the village ponds surveyed, the average domestic water consumption from community source varied from 48 litres capita^{-1} day^{-1} (lpcd) in Khimaliya village to 205 lpcd in Bahadi village.

Plate 4: Water lifted from community check dam for supplementary irrigation

Chapter 3

Benefits, Water Productivity and Demand - Supply Gap

Pond benefit for diferent uses was estimated in terms of water uses such as washing clothes, utencils etc valued at the cost of supplying water through Narmada pipe line by the State Government. This was based on the notion that in absence of community water resources, the water supplied by government source would cost equivalent to this. Community water resources, thus, save this cost to rural society. The average household benefit was worth ₹ 1,432 Hh^{-1} $annum^{-1}$, ranging between ₹ 1,122 Hh^{-1} $annum^{-1}$ and ₹ 1,559 Hh^{-1} $annum^{-1}$. The distribution of benefits from pond across different farm category was not significantly different implying that there was social equity in distribution of CPWR benefits. The gross benefits varied from ₹ 0.08 Million to ₹ 3.34 Million (Table 4).

Table 4: Gross financial benefits from ponds across the villages

S.No.	Village name	Gross financial benefits (₹ million)		
		Total	Range	
			Low	High
1	Adval	0.67	0.61	0.73
2	Rozka	0.53	0.50	0.57
3	Chharodiya	0.83	0.76	0.90
4	Bazarda	1.07	1.01	1.19
5	Zanzarka	0.31	0.30	0.32
6	Sarwal	0.23	0.21	0.24
7	Jaliya	0.20	0.18	0.21
8	Rayka	0.24	0.23	0.25
9	Khasta	0.59	0.56	0.61
10	Khadol	0.27	0.26	0.28
11	Haripura	0.07	0.06	0.07
12	Fatepur	0.21	0.20	0.23
13	Paccham	0.68	0.66	0.71
14	Vagad	0.61	0.58	0.64
15	Gunjar	3.34	3.07	3.54
16	Bahadi	0.27	0.24	0.26
17	Zinkhar	0.34	0.32	0.35
18	Tagadi	0.13	0.13	0.14
19	Jaska	0.08	0.07	0.09

At 2010-11 prices.

The gross benefits distribution across household category (Fig. 5) revealed that the samll and medium farms realized almost similar benefits, ranging from ₹ 1,372 Hh^{-1} $annum^{-1}$ to ₹ 1,442 Hh^{-1} $annum^{-1}$. The farming category in the other two extremes, viz; marginal and large farmers, though, differed in terms of the benefits realized. This can partly be explained in terms of the household size and animal units maintained. The water drawn for various non-drinking uses depended on the daily water uses for cloth and utensil washing, animal consumption and hygiene purposes and these don't differ substantially among household.

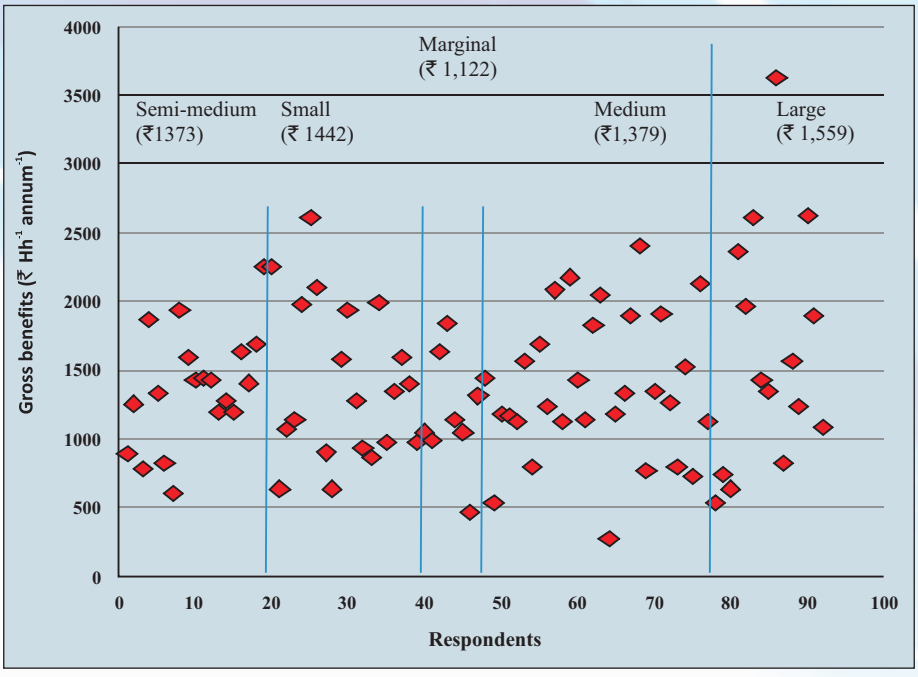

Fig. 5: Distribution of returns across farms

Area Irrigated and Water Productivity

While the village ponds were meant primarily for domestic and animal uses, field ponds (*Sim Talav*) were used for supplementary irrigation. Similarly, the community check dams helped ground water recharge and direct irrigation to crops through lift irrigation in some cases. The cultivated area with small holders farmers surveyed was 77.3 ha and none of this was irrigated. The sampled semi-medium farmers had 103.3 ha and only 47.1 ha were irrigated. Among medium farmers surveyed, similarly, out of the total cultivated area of 204.4 ha, only 44.7 ha were irrigated. Similarly, the large farmers surveyed owned total 509.2 ha, out of which 54.2 ha was irrigated. The crop productivity in these structures varied depending upon crops irrigated and use of inputs. The average crop productivity worked out to be ₹ 3.3 m^{-3}, varying

from ₹ 1.3 m^{-3} in Khasta village (wheat, *jowar* crops) to ₹ 9.5 m^{-3} in Morasiya village (cotton, cumin crops). Livestock productivity, similarly, was estimated as ₹ 6.4 m^{-3} varying from ₹ 1.6 m^{-3} in Vagad village to ₹ 14.3 m^{-3} in Vibhapar (Fig. 6). The variation in livestock productivity was mainly accounted for by the concentrate feed to milking animals, breed and care of milking animal.

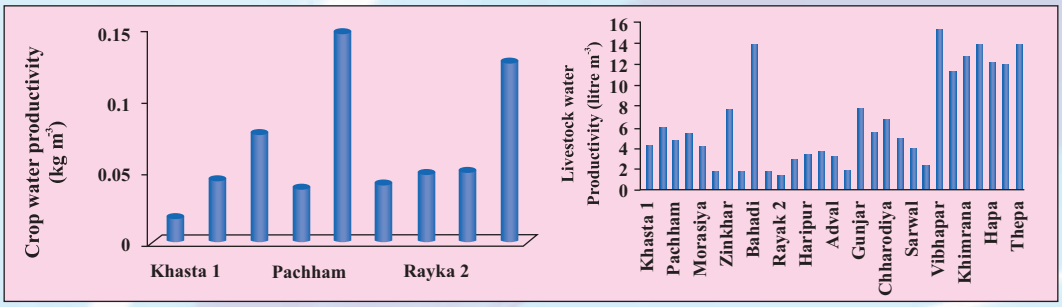

Fig. 6: Crop and livestock productivity in selected villages

Effect on Groundwater Recharge

Information was collected on number of wells in the vicinity of the community water source and water fluctuations during pre- and post-monsoon periods. The number of wells varied from 1 in Khasta, Vagad and Bahadi villages to 40 in Khimaliya village. The water table depth in the wells varied from 2.0 m in Pachham village to 20 m in Theba village during post monsoon period (Plate 5). This variation during pre-monsoon period was 3.0 m in Zinkhar village to 70 m in Khimaliya and Theba villages. The high water table was observed in wells situated within the village ponds. The water table fluctuation worked out to be 2 m in wells situated within village pond to 50 m in wells situated in the vicinity of community check dams.

Plate 5: Water table in open well in the pond vicinity

Returns from Crop Production

The returns from crop production varied from ₹ 7,436 ha^{-1} $annum^{-1}$ to ₹ 27,794 ha^{-1} $annum^{-1}$ on different farms (Table 5). Expenditure on water drawn from pond, efficient utilization of inputs and overall farm management partly explained this. The returns from livestock, however, was not markedly different among the different farm categories. The direct contribution of CPWR on agricultural returns varied from as low as 6% in Morasiya to as high as

17% in Pachham village. The remaining agricultural water use is met either from Narmada canal or private irrigation sources. On the other hand, there is a complete dependence of livestock on pond.

Table 5: Distribution of returns in crop production from pond water use across different holding size

Category	Returns (₹ annum^{-1})	Holding size (ha)	Return (₹ ha^{-1} annum^{-1})
Marginal	4957	0.67	7436
Small	40811	1.47	27794
Semi medium	45267	3.17	14280
Medium	86121	6.06	14207
Large	289205	16.39	17645

At 2010-11 prices.

Share of Water Demand met from Village Pond

The demand for village pond water arose from domestic uses apart from supplementary irrigation. Depending upon private water resource such as tube wells owned by the household or Narmada water supply, farmers depended on these community resources for major non- drinking and non-cooking water uses. This dependence on village pond varied from 86 % in Haripura village to 100% in villages like Sarwal and Bahadi (Fig. 7).

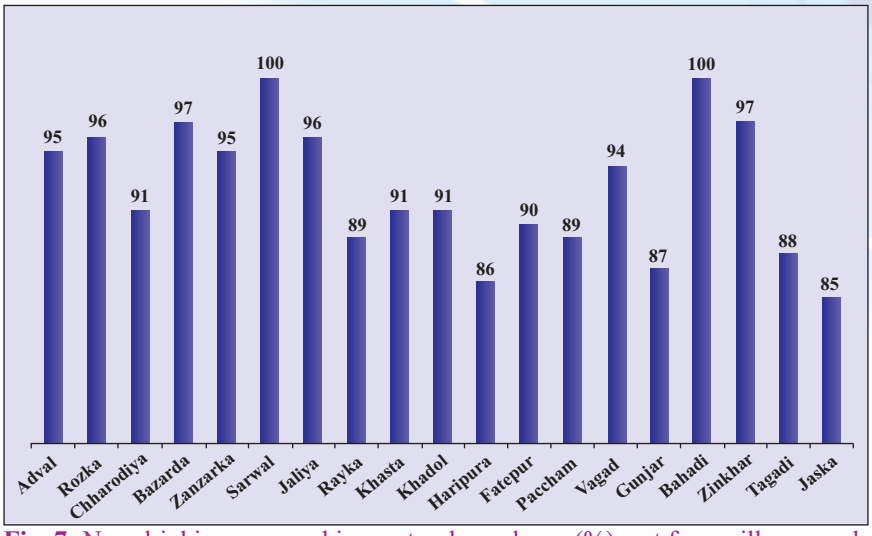

Fig. 7: Non-drinking non-cooking water dependence (%) met from village ponds

Demand and Supply of Water

Demand of water from village pond was estimated from water drawn from pond for cloth washing, utensil washing, animal drinking and bathing (Plate 6). Similarly, water demand from sim talav was estimated from water used for crop production. The supply status of ponds was

Plate 6: Domestic usage - Community check dam

examined through capacity surveys. Based on the aggregate annual demand and supply, status of gap in various ponds surveyed was estimated. During normal rainfall years, the demand was largely met from supply. In poor rainfall condition, however, the ponds remained deficit in water availability for 5 to 6 months in a year. Considering the water demand for different uses and water supply from pond on full capacity (Fig. 8), it was revealed that except for Khadol village other villages met their water requirements as revealed during survey. Khadol village pond was reported to have higher water demand for supplementary irrigation, in addition to other water demands as compared to the water available in pond.

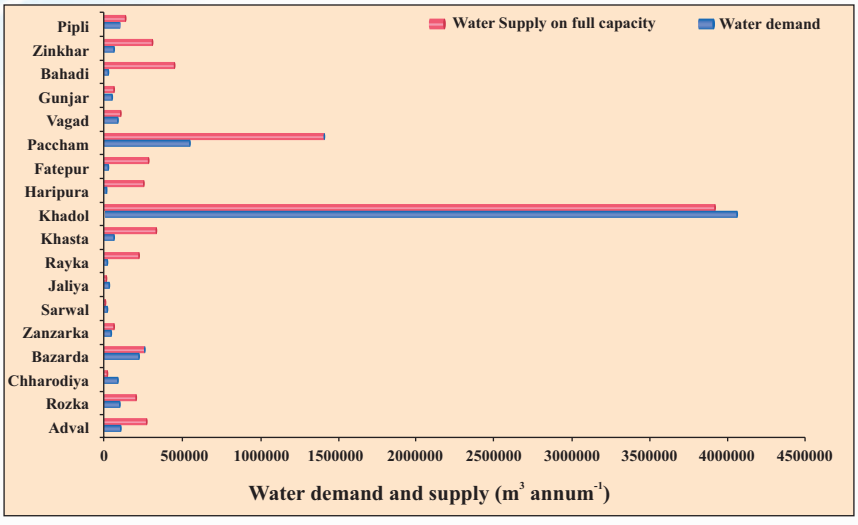

Fig. 8: Profile of demand and supply of water from community resource

Chapter 4

Engineering Survey of Community Based Water Resource Structures

Engineering surveys were conducted for different parameters such as catchment area and type, storage capacity, live storage, height, top length of dam, submergence area & command area and seepage behaviour (Plate 7). Surveys revealed that most of the structures were quite old. Only a few structures surveyed were recently constructed by state departments. Catchment in most of the ponds was non-forest type, either arable land or community land devoid of vegetation. The storage capacity of ponds varied from 0.5 ha-m to 82 ha-m and live storage, from 0.3 ha-m to 81 ha-m. The height varied from 1.5 m to 6.0 m. The submergence area of ponds varied from 0.5 ha to 26 ha and the submergence area of community check dams varied from 25 ha to 100 ha. The catchment area varied from as low as 7 ha to as high as 600 ha (Table 6). Some of the ponds were observed silted at the time of survey, the silt deposition varying from 0.3 m to 1.0 m.

The ratio of catchment to submergence/ storage varied from 1.07 to as high as 40.0. Seepage was moderate (41%) in majority of the structures surveyed. 31% of the structures surveyed had poor seepage and 28% reservoirs had good seepage. The soil of catchment was clay to clay loam, with average slope varying from 2.5 to 4.0%. A few structures (10%) were reported to have over flown twice during the recent past. The number of tube wells surrounding the structures varied from 02 to 22

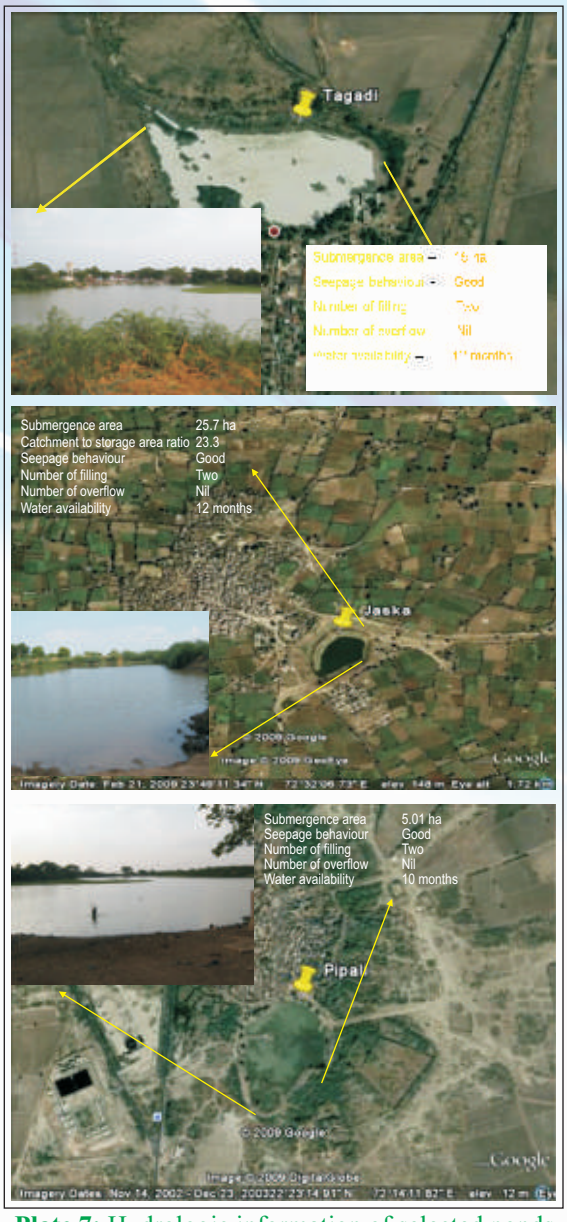

Plate 7: Hydrologic information of selected ponds

Table 6: Hydrologic characteristics of selected ponds

Name of Pond	Catchment area (ha)	Catchment type	Pond area (m^2)	Pond depth (m)	Silt deposition (m)
Pipli	530	Non-forest	56121	2	0.5
Zinkhar	400	Non-forest	120000	3	0.6
Tagadi	600	Non-forest	150000	3	1.0
Bahadi	200	Non-forest	26000	3	0.5
Jaska 1	600	Non-forest	257300	6	1.0
Jaska 2	40	Non-forest	25000	2	0.2
Khasta	525	Non-forest	114100	4	1.0
Pachham	600	Non-forest	200000	6	0.5
Fatepur	600	Non-forest	77700	3	0.4
Haripur	300	Non-forest	41490	5	0.5
Khadol	500	Non-forest	305100	4	1.0
Vagad 1	100	Non-forest	9000	2.3	0.2
Vagad 2	50	Non-forest	6375	2.5	0.3
Vagad 3	17	Non-forest	6715	2	0.3
Gunjar	150	Non-forest	24399	2	0.5
Morasiya	200	Non-forest	14653	3	0.5
Rayka	200	Non-forest	30000	3	0.5
Khasta 1	15	Non-forest	10000	3	0.5
Khasta 2	24	Non-forest	12500	1.5	0.3
Pachham	25	Non-forest	233628	2.5	1.0
Rayka 1	7	Non-forest	5625	3	0.3
Rayka 2	15	Non-forest	30000	3	0.5

benefitting from groundwater recharge, with water table fluctuations varying from 1.5 m to 5.0 m during the season.

The major crops benefitting from supplementary irrigation in case of ponds included wheat, cumin and cotton. The number of supplementary irrigations in wheat crop varied between 2 to 3, with irrigation depth varying from 4 to 5 cm. In cumin crop, the number of irrigations varied between 2 to 4 and the irrigation depth, between 3 cm to 4 cm. In cotton crop, the irrigation numbers varied between 3 to 7 and irrigation depth, between 4 cm to 5 cm. On the other hand, the number of crops benefitting from community check dams was higher. This included cotton, wheat, castor, *jowar*, groundnut and vegetables such as cabbage and brinjal. The number of irrigation and irrigation depth were also reported to be higher. In cotton, for example, number of irrigations varied from 8 to 10 with irrigation depth varying from 4 to 5. The irrigation number in wheat varied between 7 and 8 and the irrigation depth was 4 to 5 cm. The structures were not used for fishery, though in a few cases some attempts to capture were reported. The siltation problem was reported to be minor to moderate in majority of the structures.

Chapter 5

Institutional Mechanism and Factors Affecting Resource Management

Although most of the village ponds in Gujarat were the responsibility of government, in practice these were being managed as common property resource under the supervision of *gram panchayat*. Two types of ponds existed, village pond which served the domestic purpose, animal drinking and hygiene. Ponds with large storage capacity also supplied water for supplementary irrigations, though such ponds were in minority. The domestic use mainly included washing cloth, and in some cases utensils. In most of the villages water from Narmada canal was also supplied, and pond water use included only cloth washing. Animal drinking and hygiene was mainly dependent on these ponds. The farm pond, called '*Sim Talav*' locally served the purpose of irrigation and animal drinking source. Another community based water storage structure was community check dams. These served the purpose of groundwater recharge and were used for irrigation through tube wells.

Institutional Arrangement

The water storage structures were managed, in most of the cases, by village *panchayat* in the sample villages surveyed. The strength of the *panchayat* body varied from 7 to 10 executive body members (Fig. 9).

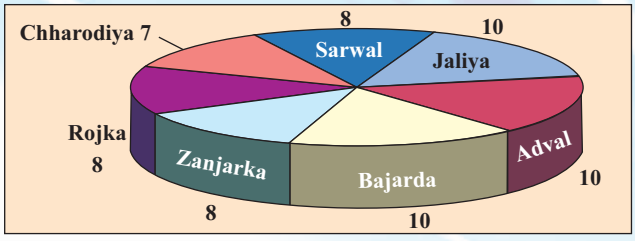

Fig. 9: Members in the executive body

The participation of female members in the executive body meetings varied from 20% to 45% in different villages (Fig. 10). Except for Jaliya village, the number of meetings held to

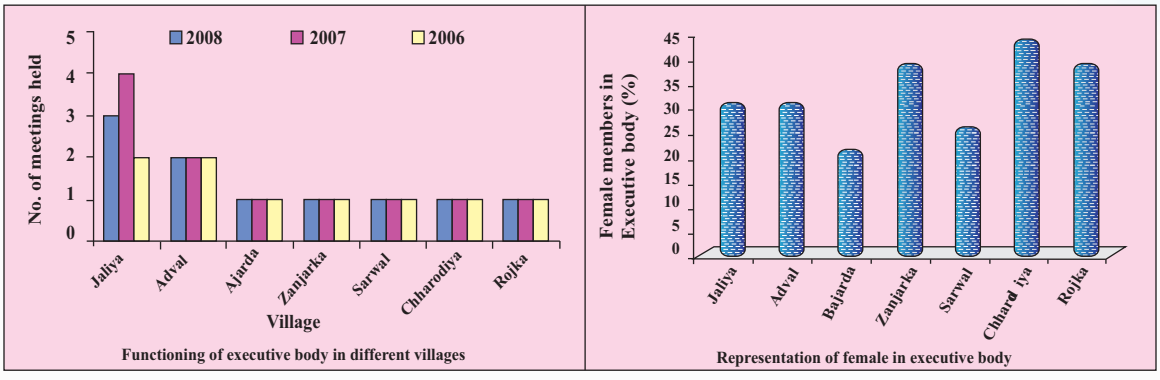

Fig. 10: Strength of *Panchayati Raj* Institution in surveyed villages

discuss about water resource was 2 or less in the other villages. This indicated poor status of affair as regards the common property water resource was concerned.

Majority were not aware of discussions related to CPWR in the management body (village *Panchayat*) in some of the villages, which again reflected a pathetic situation regarding resource management (Fig. 11). While the accessibility of the resource was not different among the different social and economic classes, this was limited because of low availability of water and, therefore, their uses were different as explained elsewhere in the report.

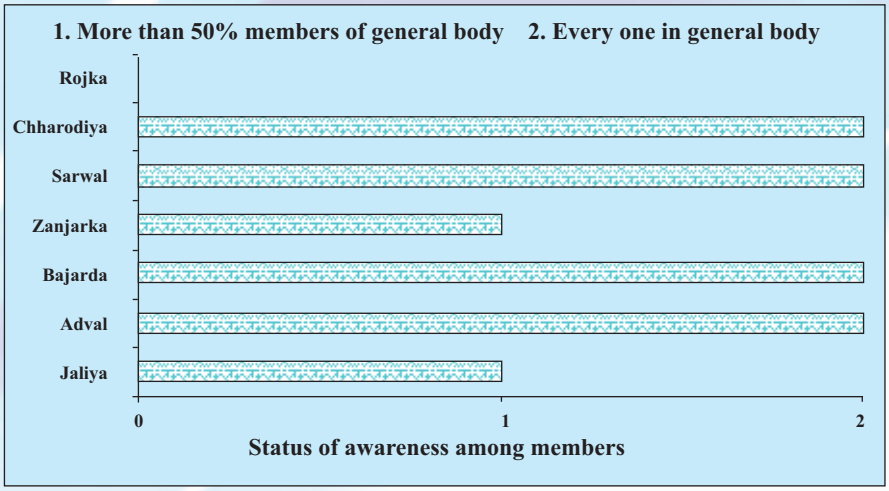

Fig. 11: Awareness among general body members about issues related to CPWR

Institutional set up was examined in terms of technical and physical attribute of community water resource, decision making arrangement, operational rules, external arrangement, pattern of interaction and outcome.

Technical and Physical Attributes of Pond

The technical and physical constraints were analyzed against three concepts drawn from economic literature, (1) jointness of consumption and supply (2) exclusion, and (3) indivisibility (Oakerson, 1986). The relevant conditions were the factors that govern the pond water demand and supply. The boundary of the pond water demand was defined, on the physical side, by soil, hydrology and the construction of the pond. The pond command area was situated in the down side and at a distance from the pond. On the supply side, the resource was defined by the capacity of the pond and the source (catchment) of the pond water (Table 7). The capacity of water distribution pipe and its maintenance decided distribution of water during the peak irrigation times. Some ponds frequently suffered water shortages and water use for all purposes, *viz*;

Table 7: Physical and technical attributes of village ponds

Pond Number	Pond name	Surface area (m^2)	Depth at mid point (m)	Shape	Catchment area (ha)*
1	Pipli	56121	2.0	Irregular	530.0
2	Zinkhar	360000	3.0	Irregular	400.0
3	Tagadi	450000	3.0	Irregular	600.0
4	Bahadi	78000	3.0	Irregular	200.0
5	Jaska talav 1	257300	6.0	Irregular	600.0
6	Jaska talav 2	50000	2.0	Irregular	40.0
7	Khasta talav 1	10000	3.0	Rectangular	15.0
8	Khasta talav 2	12500	2.0	Rectangular	24.0
9	Khasta talav 3	114100	4.0	Irregular	530.0
10	Paccham talav 1	233628	2.5	Rectangular	25.0
11	Paccham talav 2	200000	6.0	Irregular	600.0
12	Fatehpur	77700	3.0	Irregular	600.0
13	Haripur	41490	5.0	Irregular	300.0
14	Khadol	305100	4.0	Irregular	500.0
15	Rayaka talav 1	5625	3.0	Rectangular	7.0
16	Rayaka talav 2	8590	4.0	Irregular	150.0
17	Rayaka talav 3	30000	3.0	Irregular	200.0
18	Morasiya	14653	3.0	Irregular	200.0
19	Vagad talav 1	9000	2.5	Rectangular	100.0
20	Vagad talav 2	6375	2.5	Rectangular	50.0
21	Vagad talav 3	6715	2.0	Rectangular	17.0
22	Gunjar	24399	2.0	Irregular	150.0

*Approximation through observation and discussion with villagers.

domestic, animal and irrigation use was a problem. While jointness was not a problem in the use of pond water *per se*, irrigation pipe laid for supplementary irrigation was a limitation in water use.

Since, the rights to water in the pond could be subdivided; the indivisibility aspect did not necessarily pose any problem for their management once the pond investment was made. Each villager was eligible to draw water from village pond for any domestic use as per the requirement. The water supply was usually enough to serve the intended purpose; though in some ponds it remained scarce during the summer season. Further the supply was limited by the pond's storage capacity and the quantity of water available to fill the tank, which was dependent on catchment characteristics. Some ponds retained water for the major part of the year during normal rainfall, while others became dry in five to six months. Similarly some ponds (60% of the sample surveyed) were filled more than once a year while others were filled only once in a year. Some ponds (22%) also had water over flown during the season. Siltation and seepage problems (41%) had reduced the storage capacity of many ponds. The surplus arrangement (inlet and outlets) in the pond also affected the amount of water stored and thus, its availability to the beneficiaries. Though majority of the ponds (86%) had proper inlet and outlets, others either have breached or are in defective condition. Absence of maintenance had reduced the water storage capacity of some ponds.

About 59% village ponds had tube wells in their command and directly benefited through groundwater recharge. The farm pond (*Sim Talav*) were not only used for irrigation but also helped recharging the wells. The rise in their water table was reported in the range of 1 to 3 m as a result of pond water during post monsoon season period. The area irrigated varied from 2 ha in case of small pond to 100 ha in case of bigger ponds. The Narmada canal provided water to some of the villages; as a result, the farmers' dependency on village ponds for drinking and cooking use had reduced in majority of the villages.

Decision Making Arrangements

The decision making arrangements and rules resulted mainly from the nature of technical and physical constraints and the goal of the water users about their share of water from pond. The conditions for collective use arose when the scarcity of pond water forced farmers to compete for their share of water. Pond which was the responsibility of village *panchayat* suffered from poor management. However, the *panchayat* did not meet regularly to discuss water management issues. The meetings to discuss the water management issues were held either once or no meeting held in majority of the cases (90%). In half of the ponds studied, most of the members of management body were aware of the rules regulating pond water use but did not meet to discuss as they had little interest. The members of *panchayat* could propose a change in rule in only few ponds studied, in the remaining management bodies only executive body members could do the same. Some of the *panchayat* bodies had less than 30% women participation. The problem, by and large, was identified as poor representation of weaker section of community and gender participation in the management. Only few of the *panchayat* bodies had small and marginal farmers as the member. These two groups largely depended on community pond for water uses but had poor say in pond management.

Operational Rules

The operational rules in case of village ponds pertained to domestic and animal uses of the pond water, and avoiding the irrigation use in most cases. Only some village ponds (18%) where the pond storage capacity and catchment characteristics were favourable and water remained throughout the year in sufficient quantity, limited irrigation was permitted through pipe lines. In majority of the remaining village ponds, water was not allowed for irrigation use. Irrigation was done through *sim talav*.

Panchayati Raj Institution/Water User Association members were aware of pond management rules in 35% ponds studied. More than half PRI members were aware of the rules in only 20% cases. In the remaining cases, either less than 25% members were aware or none. Apart from PRI members' awareness about rules, the strength of democratic process in bringing

about modification in rules governs the health of the PRI. In 35% PRIs only, any member of general body could propose the change, in the remaining (65%) PRIs only executive body embers could propose change/ modification. However, in none of these PRIs any change had been proposed so far. The members of general body could unanimously effect the proposed change in 40% cases. In 25% PRIs, the change could be effected unanimously by executive member through voting; in remaining cases, it could be done through voting by members of general body.

The rules and restrictions for pond water distribution did not exist in cases where the pond water supply was in excess of the demand of water from the pond. In addition, in majority of the cases the executive body of the institution comprised of more number of the medium and large farmers with own water sources.

External Arrangements

Only few ponds (less than 10%) were managed by state department. Other ponds, managed by *panchayat*, did not have sufficient funds for maintenance. The fee collected for use of pond water was very nominal. The fee was decided by the government where *panchayat* did not have any jurisdiction. There is a provision of state assistance in the maintenance of pond. State department such as Gujarat State land Development Corporation (GSLDC) has a scheme of de-silting of pond in 10 districts of the state. Government provides 90% subsidy; the other 10% is contributed by beneficiary gram *panchayat*. All villages of the districts under watershed can submit application along with *Gram Panchayat* (PRI) resolution. However, the PRIs in some villages could not avail the benefits of the scheme. As a result, these ponds had silted up reducing the storage capacity.

Patterns of Interaction

In majority of the cases (55% PRIs examined), the executive body did not hold meetings to discuss about water related issues. Gender discrimination in PRI was identified as one of the reasons. Women, who mostly bore the burden of arranging water for domestic and animal use, were not well represented in the management of community resource. Among the members of executive body, women members (one third of the total members) as stipulated, were in only few cases (45%). In these bodies, women as *sarpanch*, head of the executive body, was observed in only a few cases (15%). The other members did not bother to take up the issues related to water from pond. Similarly, in majority of the cases executive body members of PRI largely had own private source or depended on government source like Narmada canal. Hence, no set pattern of interaction was observed related to pond water issues.

Outcome

Pond with high demand for water against poor supply experienced water conflict in terms of use for irrigation apart from domestic and animal uses (Table 8). The conflict management in some villages was governed by the strength of the institution. De-silting of ponds, maintaining the earthen bank of the ponds and cleaning of ponds turned out to be the major responsibilities of the executive body in majority of the cases; however, financial constraint was reported to be the problem by 43% PRI at the time of survey. This, along with the technical and physical constraints, affected the maintenance of the ponds (Table 9). Further, the capacity utilization of the ponds revealed in-efficiency in water use as there was either under or over utilization. The distribution of benefits from water use was, by and large, not much different across farmers of different land category. This might be due to use of water for, by and large, domestic and animal use in most of the ponds. Only a few pond supplied water for agricultural use. The domestic water use was washing cloths and utensils in homes of mostly poor and small farmers, the big farmers managed to purchase water through tankers in some villages. People in a few villages drew water from these ponds for drinking use also. These were the villages where farmers were mostly poor who could not afford to purchase water and the Narmada canal pipe lines for supply of water has not yet reached.

Table 8: Pond management in relation to population, water supply

Pond No.	Village name	Village population	Animal population	Pond storage volume (m^3)	Pond water usage	Pond Maintenance	Social conflict management
1	Pipli	760	750	100200	Domestic, animal, irrigation	Poor	Poor
2	Zinkhar	823	1520	240000	Domestic, animal	Good	Good
3	Tagadi	336	106	450000	Domestic, animal	Good	Good
4	Bahadi	45	23	52000	Domestic, animal	Good	Poor
5	Jaska	384	487	1029200	Domestic, animal, irrigation	Poor	Good
6	Khasta	3885	382	55000	Domestic, animal	Poor	Poor
7	Paccham	2250	1270	349200	Domestic, animal	Poor	Good
8	Fatehpur	574	180	225000	Domestic, animal	Good	Good
9	Haripur	282	50	207460	Domestic, animal	Good	Good
10	Khadol	747	445	1220400	Domestic, animal, irrigation	Poor	No conflict
11	Rayaka	784	193	124360	Domestic, animal, irrigation	Poor	No conflict
12	Morasiya	750	150	49590	Domestic, animal, irrigation	Good	No conflict
13	Vagad	2100	1119	46015	Domestic, animal	Good	No conflict
14	Gunjar	12590	913	58000	Domestic, animal	Good	No conflict

* Sum of more than one pond volume; Domestic use includes cloth washing.

Table 9: Pond performance and the level of management

Pond name	Physical/ technical constraint	Maintenance Agency	Decision making arrangement	Pattern of interaction	Pond performance (water availability in a year)
Pipli	Leakage, siltation	*Panchayati* Raj Institution	Voting in general body	Once in month	Six month
Zinkhar	Minor siltation	*Panchayati* Raj Institution	Unanimously by executive body	Nil	Nine month
Tagadi	Siltation	*Panchayati* Raj Institution	Unanimously by executive body	Nil	Ten month
Bahadi	Minor siltation	*Panchayati* Raj Institution	Unanimously by executive body	Nil	Nine month
Jaska talav 1	Leakage, siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Ten month
Jaska talav 2	Bund breach, minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Khasta talav 1	Leakage, minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Eight month
Khasta talav 2	Leakage, minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Khasta talav 3	Siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Ten month
Paccham talav 1	Leakage, minor siltation	*Panchayati* Raj Institution	Unanimously by executive body	Nil	Ten month
Paccham talav 2	Minor siltation	*Panchayati* Raj Institution	Unanimously by executive body	Nil	Ten month
Fatehpur	Minor leakage and siltation	*Panchayati* Raj Institution	Unanimously by general body	Once in month	Nine month
Haripur	Minor leakage and siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Khadol	Minor leakage, siltation	*Panchayati* Raj Institution	Unanimously by general body	Twice a month	Ten month
Rayaka talav 1	Minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Rayaka talav 2	Minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Rayaka talav 3	Siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Eight month
Morasiya	Minor siltation	*Panchayati* Raj Institution	Voting in general body	Once in month	Seven month
Vagad talav 1	Minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Eleven month
Vagad talav 2	Minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Vagad talav 3	Minor siltation	*Panchayati* Raj Institution	Unanimously by general body	Nil	Nine month
Gunjar	Minor siltation	*Panchayati* Raj Institution	Voting in general body	Nil	Eleven month

Factors Affecting Resource Management

A successful community based water storage structure is one that is able to reliably deliver services to the target community, through physical and financial support from the community, with little intervention from external sources. This institutional status was examined as factor of two components, *viz*; financial viability of the community structures and functionality of the structure (Pande *et al*., 2013). The finances generated from pond water use sustain the structure through regular maintenance, thereby, improving efficiency of the water delivery system, while a functional pond would ensure reliable service on sustainable basis. These two, in tandem, would strength the local institution in the management of community water storage structure. To examine financial viability of the ponds, a Financial Viability Index (FVI) was computed in terms of charges collected for domestic water use, charges collected for livestock water use, frequency of collection, utilization of collected saving (pond maintenance), and mode of water charge collection. This was hypothesized to be affected by household characteristics such as perception about change in water collection time, *Panchayati Raj* Institutions (PRI)/WUA functionality and number of household drawing water from resource and population below poverty line. An empirical relationship of FVI with these factors was estimated to understand their relationship. Pond functionality was measured in terms of operationality (number of days the structure has water in a year) and pond status. Factors affecting the operationality included the physical and technical design factors associated with the pond. Pond status was examined in terms of perception of beneficiaries about the status of community pond. This was verified with physical surveys in the field. The factors affecting this included distance of pond from the settlement, accessibility and the water use restrictions. PRI/WUA functionality in pond management was measured in terms of meeting and participation in decision making, amenability/ capability to resolve water management issues, social representation in the PRI executive body (resolving social conflict) and benefits perceived from community water source.

A relationship of pond status perception as dependent variable with relevant independent variables was examined. It was hypothesized that pond status perception affected beneficiaries' involvement with the management issues of the community owned water storage structures (Tyson *et al*., 2011). A positive perception motivated beneficiaries to participate in pond management. This was regressed over factors such as pond distance from village, pond accessibility and water use restriction. It was hypothesized that resource with less distance, un-restricted use and within village premises would receive better involvement of the beneficiaries and would have good status. Ponds within village premises were better looked after and were, therefore, perceived to have good status. A pond outside the village premises but less than one kilometre was hypothesized to affect people's perception positively. This draws from the concept of 'no source village' to identify villages with inadequate water supply. This concept was

introduced in the Fourth Five Year Plan of the state, wherein, one of the conditions, for a village to be no source village, was the source of water supply being more than one kilometre away (Hirway, 2005). It was hypothesized that a pond less than one kilometre from the village would be perceived with good status positively as beneficiaries would draw the benefits with ease. Similarly, ponds with accessibility to all beneficiaries were hypothesized to have good status. Ponds with all domestic and irrigation uses were perceived to have good status, in the same manner.

A pond was hypothesized to be financially viable if more fees was collected on regular basis and was utilized with unanimous decisions of the members of the PRI on pond management. It was hypothesized that a functional PRI/WUA would positively motivate the members to contribute to the finances for the maintenance and up keep of the pond (Kumar and Vashist, 2005). PRI/WUA functionality was computed from factors, *viz*; meeting and participation in decision making, amenability to resolve water management issues, social and gender representation in decision making body and benefits perceived by members and non-members of the body assigning equal weightage to each of them. A positive perception about change brought about by the pond would induce the beneficiaries to contribute to the finances. In the same manner, while higher number of beneficiary was positively related to financial viability of the community structure, the effect of a higher number of beneficiary household below poverty line would be contrary to that. Further, it was hypothesized that with higher benefits accruing from the pond, fee charged for water use would be higher, as more beneficiaries would be willing to pay, as compared to those water storage structures with lower benefits. A PRI/WUA with members owing their private water resources would not be much concerned about its maintenance and thereby, affecting the finances collected for the community structure. The perception about change in water quality available from the community structure would, similarly, play a role in beneficiaries' decision about contribution to finances for that pond.

The perception about current status of pond was found to be affected by factors like distance of pond from settlement and water use restriction. These factors significantly affected the current status of the resource at 10% and 2% level of significance, respectively. Examination of relationship of financial viability index with explanatory variables revealed that PRI/WUA functionality, gross benefit from pond and perception about water quality change were related with dependent variable. Perception about change in water collection time was closely related with location of the source from village. Resources closer to village periphery positively changed water collection time and affected financial resource of the PRI.

It was observed that PRI/WUA functionality, perception about change in water collection time and number of households served by the pond were responsible for financial

viability of the ponds. Perception about change in water collection time was closely related with location of the source from village. Resources closer to village periphery did perceive change in water collection time, quality and got regularly paid for water charges. PRI/WUA functioned with poor representation of weaker section of community and was observed to have poor gender sensitivity. Women as *sarpanch*, head of the body, was observed in only a few cases and these bodies incidentally held executive body meeting at least once in a year. In other cases, the other executive body did not hold meetings about water issues. The importance of women's involvement in water resource management has been well recognized (Whittington *et al.*, 2009). Women do most of the work of collecting water in Indian villages as elsewhere. They must be empowered to manage water related conflicts. Representation of weaker section of community was also observed to be poor. Except for a couple of cases (10% PRIs), in other bodies the members were medium and large farmers, and had own private source of water such as tube wells. They drew least benefits from pond and hence, did not bother to take up water issues in general and pond maintenance in particular. Paradoxically, the marginal and small farmers fully depended on pond for various water uses but had at least say in their management. PRI functionality can, therefore, be strengthened by motivating and sensitizing PRI members to water governance issues by enhancing representation of women, who manage water uses at household level and weaker sections of farmers who did not have private water source and, primarily depended on these community resource. The weak sensitivity of PRI towards these community based natural resources can also be partly explained in terms of network of Narmada Canal and pipeline to villages to meet largely domestic uses as reported elsewhere (Das, 2005). Yet considering their importance in the livelihood of poor and weaker sections, management of community pond must be improved by strengthening the institutions created locally for the purpose.

Distance of the water resource and use restriction influenced beneficiaries' perception about present status of community based natural resources. Ponds which were closer to settlement were perceived to have served the community in better way as compared to those which were at a distance. Such ponds were considered with good status and positively influenced people to contribute financially and physically for their maintenance. Similarly, few ponds had unrestricted use for domestic, livestock and agricultural purposes and these ponds had least conflict in terms of financial contribution. These were the pond with sufficient water for a longer period of time in the year. The ponds being located in the outskirt of village, only a few were observed to have easy access. Ponds with low storage volume in relation to demand from stakeholders were primarily meant for domestic and livestock use alone. Irrigation use was completely debarred in such ponds. Technical design in terms of size and place of pond construction partly explained this. Incidentally, storage to catchment ratio turned out to be one of the factors affecting operationality of the pond. The technical design and planning of the pond in relation to catchment characteristics and size in the vicinity of the village settlement might not only affect the services provided by the resource but also

overcome use restrictions. This would positively induce the local stakeholders in regular management of the resource.

Perception about Change in Status

Information was collected from beneficiaries on change in people's perceptions about source of drinking water, water quality and water availability change over a period of 20 years across the villages (Fig. 12).

Change was observed with respect to perception about water resources. In some villages such as Gunjar, Vagad, Pachham, Fatepura, Haripura, Khadol, Kahsta, Rayka etc the major source of water dominated by community pond was over taken by government source such as Narmada water. In others such as Sarwal, Zalia, Zinkar, Bahadi etc villages, community water source such as pond was still dominant source as 20 years back. In the remaining, private source were being used more as compared to community resource. People's perception about water quality was observed to have followed this trend. The villages with village pond as dominant water source reported water to be not potable as compared to the village where major water source had been overtaken by Narmada water supply. Overall, people's perception about impact and changing status of community water source revealed a positive change towards increase in income/ employment, water availability during scarcity months and accessibility to the community water storage structures.

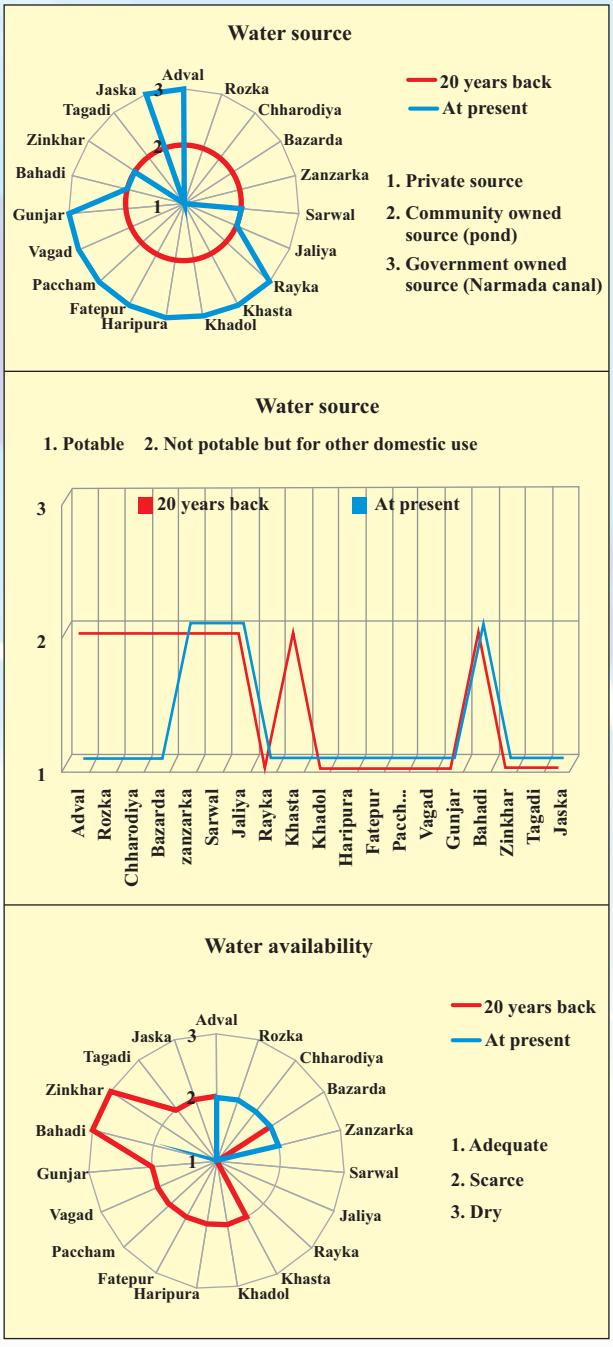

Fig. 12: Perception of beneficiaries about status of pond water over the period

Chapter 6

Conclusions

With the government's initiatives about resolving water issues, the community water storage structures have been losing their due importance over time. Nonetheless, these still play a role in meeting water demand of rural people. This is particularly so in villages where government source such as Narmada water supply has not yet over taken the community resource on a large scale. These sources not only meet animal water and supplementary irrigation needs but also some non-cooking non-drinking water needs of the poor segment of rural society. The average household benefit drawn from these sources was estimated to be varying between ₹ 1,122 Hh^{-1} $annum^{-1}$ and ₹ 1,559 Hh^{-1} $annum^{-1}$ (2010-11 prices). The direct contribution of CPWR on agricultural returns varied from 6% to 16% axcross the villages surveyed. With respect to non-agricultural uses such as personal hygiene, washing and animal uses the contribution varied from 56% to 91% and in case of marginal farmers, 100%. Similarly, the water productivity in crop and livestock production varied between ₹ 1.3 - 9.5 m^{-3} and 1.6 - 14.3 m^{-3}, respectively in different villages surveyed. The gross benefits was estimated to be between ₹ 0.08 million to ₹ 3.34 million across the community water storage structures. The distribution of benefits from CPWR across different farm categories reflected social equity in distribution of CPWR benefits.

The technical and physical attributes of pond revealed that while majority of the ponds (86%) had proper inlet and outlets at the time of survey, others were either breached or had defective system. Siltation and seepage problems (41%) with poor maintenance had reduced the storage capacity of some ponds. The installation of private and community wells in the pond irrigated area had helped overcome some of the water supply constraints. In addition, the Narmada canal provided water to some of the villages; as a result, the farmers' dependency on village ponds for domestic use had reduced drastically over time. Institutional arrangement of community based water storage structures was found poor. The pattern of interaction among the *Panchayati Raj* Institution/Water User Association members revealed that in majority of the cases (55% PRIs examined), the executive body did not hold meetings to discuss about water related issues. Gender discrimination in management was observed. Women, who mostly bore the burden of arranging water for domestic and animal use, were found to have poor say in the deliberations about water issues. In *panchayat*/ water user bodies, women as *sarpanch*/head of the executive body, was observed in only a few cases (15%). The other members, who mostly included medium or semi-medium farmers and had their own private water source, did not bother to take up the issues related to water from pond. In some cases executive body members of PRI largely had own private tube well or access to government source like Narmada canal, hence, they least bothered about management issues related to community water storage structures.

Field surveys revealed that *Panchayati Raj* Institution (PRI)/Water User Association (WUA) functionality, perception about change in water collection time and number of households served by the water resource significantly affected financial status of the bodies responsible for the management of community water resources. PRI/WUA functionality in respect of community water resource management, therefore, should be improved. Factors such as catchment land use and storage to catchment ratio, which affected operational status of the source, should be duly considered while designing location and size of the water resource such as pond.

Water resources closer to village periphery did affect perception about change in water collection time, quality and affected collection of water charges for their maintenance. Though there was government mechanism to provide financial assistance for pond de-siltation under watershed management programme, this was not utilized. Except for a couple of cases (10%), in other bodies the members were medium and large farmers, and had own private source of water such as tube wells. They drew least benefits from pond and hence, did not bother to take up water issues in general and pond maintenance in particular. PRI functionality functioned with poor representation of weaker section of community and was observed to have poor gender sensitivity. PRI functionality can, therefore, be strengthened by motivating and sensitizing PRI members to water governance issues by enhancing participation of women, who manage water uses at household level and weaker sections of farmers who did not have private water source and, primarily depended on these community resource. The weak sensitivity of these management bodies towards the community water resource management can also be partly explained in terms of network of Narmada Canal and pipeline to villages to meet largely domestic uses as reported elsewhere (Das, 2005). Yet considering their importance in the livelihood of poor and weaker sections, management of community pond must be improved by strengthening the institutions created locally for the purpose.

Accessibility to the resource and use restriction influenced beneficiaries' perception about present status of community based natural resources. Though village ponds were meant primarily for animal uses, ponds which were accessible for all different uses such as domestic, livestock and agricultural were perceived to have served the community in better way as compared to others. Such ponds were considered with good status and positively influenced people to contribute financially and physically for their maintenance. Similarly, these ponds with unrestricted use also reported least conflict in resource management. These were the pond with sufficient water for a longer period of time in the year. Similarly, distance of resource also affected perception about its current status in terms of maintenance. The ponds being located in the outskirt of village, only a few were observed to have easy access. While accessibility to pond in rural community might be rooted in the cosmology of Indian society wherein water sources are socially identified with its user caste (Singh, 2006), use restriction is governed by water

storage volume in ponds. Ponds with low storage volume in relation to demand from stakeholders are primarily meant for domestic and livestock use alone. Irrigation use is completely debarred in such ponds. Incidentally, storage to catchment ratio turned out to be one of the factors affecting operationality of the pond. The technical design and planning of the pond in relation to catchment characteristics and size (Kumar and Vashist, 2005) in the vicinity of the village settlement might not only affect the services provided by the resource but also overcome use restrictions. This would positively induce the local stakeholders in regular management of the resource.

The active participation and local governance of community resources for more efficient, effective and equitable development need promotion of equitable participation of women and weaker section of rural community. The essential assumption here is that women and poor farmer represent a marginalized group in society whose lives are entrapped in an institutional framework characterized by gross inequalities of formal power and authority in the public sphere and denied equal access to and control over resources (Singh, 2006). Observations around the world suggest that institutional structures with gender-equity based participatory models of local governance would balance out the inequalities by offering a platform or space where women (Aladuwaka and Momsen, 2010) and weaker sections of society (Barnaud *et al*, 2010) could come together and be empowered to express their opinions as well as contribute effectively in decision-making processes. With respect to the water sector in general, women's participation seek to correct imbalances perceived in terms of access to water resources and benefits from water development projects as well as exercise of decision-making powers with respect to the management of these resources (UNDP 2003; GWA 2003). Strengthened institutions being a panacea for efficient resource management, technical design and scientific planning in creating water resources, nevertheless, would go a long way in serving the rural community efficiently as these factor not only affected the ponds' functionality and financial viability but also people's perception about resource utility and efficiency in service delivery. Storage to catchment ratio of more than 0.1 or more has been suggested appropriate (Kovari, 1984) for pond utility such as aquaculture. Such ponds with water for sufficiently longer period of time would also serve other purposes of rural livelihood.

There is need to create management systems where the formal decision-makers such as PRI interact with relevant members of the scientific community (Kumar and Vashist, 2005; Kurian, 2000), users and other stakeholders for a coordinated approach that successfully orchestrates water uses towards hydro geological and socio-cultural compatibility. Water resources management in the 21st century requires a radical reorientation and an effective dialogue between decision makers, stakeholders and the scientific water community (Falkenmark, *et al*., 2004).

In view of the observations made during the course of the study, some of the interventions in the management of community water storage structures are as under:

1. Emphasis on pond siltation through utilization of state government's de-siltation scheme managed by Gujarat State Land Development Corporation on regular basis.
2. Allowing surplus water in ponds, where available, for limited irrigation use.
3. Strengthening community resource governance to avoid over exploitation of resource in such cases.
4. Community ponds with sufficient water for a longer period during the year may be encouraged for commercial enterprises such as fishery (Plate 8) to improve financial condition of *panchayat* managing them.
5. Improving participation of women and weaker section of rural community in the management of community water resource as these groups were observed to have high stake but poor representation in resource management.

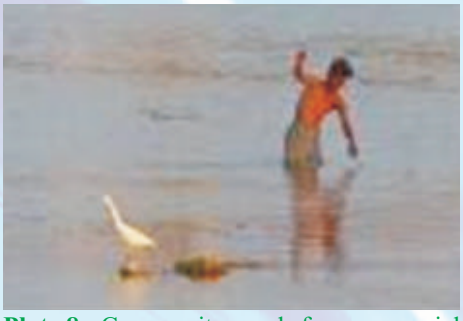

Plate 8 : Community ponds for commercial enterprises such as fishery

6. Motivation of elected body's members, who manage Community Based Water Storage Structures, through sustained campaign to manage the community resources, is strongly emphasized. A lack of interest among executive members of *Panchayati Raj* Institutions (PRI)/Water User Association (WUA) towards community water resource was observed during survey.
7. Involvement of *Panchayat a*dministration at higher levels, such as taluka and district, may be emphasized to ensure regular working of community water management bodies, sound fund availability and its management.

References

Aladuwaka, Seela & Momsen, Janet (2010). Sustainable development, water resources management and women's empowerment: the Wanaraniya Water Project in Sri Lanka. *Gender & Development*, 18(1) : 43-58.

Barnaud, Cécile; van Paassen, Annemarie; Trébuil, Guy; Promburom, Tanya and Bousquet, François (2010). Dealing with Power Games in a Companion Modelling Process: Lessons from Community Water Management in Thailand Highlands. *The Journal of Agricultural Education and Extension*, 16(1) : 55-74.

Das, Keshab (2005). *Alternative Strategies for Rural Drinking Water Supply in Gujarat : Practices, Institutions and Policy Learning*. Study sponsored by the IWMI-Tata Water Policy Program (through the Institute of Social and Economic Change, Bangalore), Gujarat Institute of Development Research, Ahmedabad. (Mimeo, unpublished).

Das, K. (2002). Reviving a water heritage: Economic and Environmental Performance of Traditional Water Harvesting Systems in Western India. Working Paper Series : WIS-1, Gujarat Institute of Development Research, Ahmedabad.

Falkenmark, Malin; Gottschalk, Lars; Lundqvist, Jan and Wouters, Patricia (2004). Towards integrated catchment management: increasing the dialogue between scientists, policy-makers and stakeholders. International Journal of Water Resources Development, 20(3) : 297-309.

Gupta, R.K. (2004). Water Governance in Gujarat State, India. *Water Resources Development,* 20(2): 131-147.

GWA (2003). Advocacy manual for gender and water ambassadors. WEDC (for GWA), Leicestershire.

Hirway, I. (2005). Ensuring Drinking Water to all: A Study in Gujarat. Paper submitted to the 4th IWMI-TATA, Annual Partners Research Meet, 24-26 February.

Kovari, J. (1984). Considerations in the selection of sites for aquaculture. United Nations Development Programme, food and agriculture organization of the United Nations, Rome. http://www.fao.org/docrep/X5744E/X5744E00.htm.

Kumar, Chetan and Vashisht, Umar Shankar (2005). Redefining communitystate partnership in natural resource management: a case from India. Development in Practice, 15(1) : 28-38.

Kurian, M. (2000). CPR design principles - A response. *Common Property Resource Digest*, 53: 6-7.

NSSO (1999). Report Common Property Resources in India, Jan.-June 1998. NSS 54 Round: pp 452.

Oakerson R.J. (1986). A Model for the Analysis of Common Property Problems. In: National Research Council, *Proceedings of the Conference on Common Property Resource Management.* Washington : National Academy Press.

Pande, V.C., Bagdi, G.L., Sena, D.R. (2013). Physical and Social Factors in Management of Community Based Water Storage Structures in Gujarat: An Institutional Analysis of Local Governance. *Irrigat Drainage Sys Eng.,* 2 : 108.

Patel, Vithalbhai Becharbhai (2007). Water Resource of Gujarat Compared to India & World: An Overview. Paper presented at the Conference on Gujarat: Water Resources Management for a Better Tomorrow, Ahmedabad, January 12-13.

Singh, Nandita (2006). Indigenous Water Management Systems: Interpreting Symbolic Dimensions in Common Property Resource Regimes. Society & Natural Resources, 19(4) : 357-366.

Tyson, Ben; Edgar, Nick & Robertson, Gretchen (2011). Facilitating Collaborative Efforts to Redesign Community Managed Water Systems. *Applied Environmental Education and Communication*, 10(4) : 211-218.

UNDP (2003). Mainstreaming gender in water management: a practical journey to sustainability. UNDP/BDP Energy and Environment Group, New York.

Whittington, D., Davis, J., Prokopy, L., Komives, K., Thorsten, R., & Lukacs, H. (2009). How well is the demand-driven, community management model for rural water supply systems doing? Evidence from Bolivia, Peru and Ghana. *Water Policy*, 11(6) : 696-718.

Photographs

Apathy towards proper maintenance of community based water storage structures was observed (plate 9), though these structures are still very much relevant to the livelihood of the local stakeholders (plate 10). The resource managing institution needs to be motivated to address the issues.

Plate 9: Maintenance status of community check dams at the time of survey

Plate 10: Different uses of community Water Storage Structures

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

संरक्षित मिट्टी–सुरक्षित प्रकृति
Conserve Soil-Protect Nature

2015
International
Year of Soils

Healthy Soils for a Healthy Life

Printed at **Allied Printers**, Dehradun. 0135-2654505