

COMPETITION AND CONFLICTS AMONG MULTIPLE USERS OF TANK IRRIGATION SYSTEMS

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ABSTRACT

Social interactions among multiple user groups of tank irrigation systems were studied to propose policies for sustainable management of tanks. Crop growers are the major competitors for water besides encroachers, fish and duck farmers. Existence of weak property rights remained as the reason for the competition among users that subsequently led to conflicts. Conflicts aroused among user groups during water scarcity conditions and were settled by the community leaders and water users association (WUA). It is suggested that WUA must play major role in promoting the collective actions among user groups to use the tank resources sustainably.

Keywords: Tank irrigation, Multiple users, Competition, Conflicts

1. INTRODUCTION

Irrigation systems are generally viewed in terms of their ability to provide water for crop production thus concentrating on the development of agriculture and farming communities. However, irrigation systems also support a host of other non-agricultural and domestic activities to satisfy the needs of a number of user groups which are often overlooked. Meinzen-Dick and Bakker [1] reported other uses of irrigation systems as supporting home gardens, livestock, fishing, aquatic products, brick-making, domestic uses such as drinking, cooking, bathing, washing, recreation, and environmental uses, including recharging groundwater, flushing contaminants, and supporting wildlife. Tanks would also be useful in reducing floods, recharging wells and providing drainage in high rainfall periods (Walter [2]). The importance of non-agricultural uses of irrigation water in livelihood strategies of communities in irrigation systems has implications for irrigation management and water rights, especially as increasing scarcity challenges existing water allocation mechanisms. Systems of formalized individual water rights are developing in response to increased competition for water. In the process of allocating formal rights, secondary water uses such as livestock, gardens, and other domestic micro-enterprises are often ignored and those who use water for such purposes lose access.

The range of stakeholders with an interest in water resources of an irrigation system goes far beyond the owners and cultivators of irrigated fields. While the amounts used by these other uses may be small relative to irrigation, they can have a very high value, both in quantifiable economic terms, and especially in terms of livelihoods for the rural poor (Chambers [3]). Hence it is important to consider other uses and user groups of an irrigation system in order to work out effective water management policies to satisfy all the users and uses of an irrigation system.

Many of the demands for water are increasing; or at least are perceived as increasing; with the result that there appears to be growing stress on the available water resources. The main driver in this process is the increasing population in the catchment, along with other socio-economic forces such as government liberalization policies, resulting in greater demand for water and other natural resources in the catchment. Franks et al. [4] stated that demand for water in the Usangu Basin is driven by a number of competing and sometimes conflicting uses. These include domestic supplies, irrigated agriculture, livestock, fishing, maintenance of the Usangu wetland, a National Park and major hydroelectric system downstream. As a result of a number of driving forces including the growing population, the water resources of the basin are becoming increasingly stressed, and downstream flows have now reduced to zero during the dry season. This indicates that whenever a resource base is shared by multiple user groups, naturally there will be social interactions among the user groups that may lead to expression of competition and conflicts.

Many farmer- managed irrigation systems have been in operation for centuries (and have been the subject of study for decades—see Ostrom [5], Wade [6]). However, the survival of such systems is challenged by changing property rights regimes, livelihood strategies, and growing scarcity and competition over water resources. Conflict resolution measures examined included negotiation, arbitration, judicial processes, water pricing, quotas and conditional permits.

In India, an irrigation tank is a small reservoir constructed across the slope of a valley to catch and store water. In rural areas of India, a 'tank' is typically used for multiple purposes such as irrigation, forestry, fodder, livestock drinking, fisheries, duck rearing, brick making, collection of silt, washing and bathing. Before Independence, most irrigation tanks in India were owned privately by Zamindars, Jagirdars, or Talukdars*, or jointly by closely related families. After the abolition of Zamindari and Talukdari following independence, however, ownership rights in private tanks were abolished and vested in the state governments (Palanisami et al. [7]). For all practical purposes, tanks became Common Property Resource (CPR); all farmers who owned land in the command area of a tank had access to the tank water. From a legal perspective, common property refers to the distribution of property rights in a resource where a well-defined set of users has a set of well-defined but not necessarily equal-rights to

* Titles conferred earlier by Indian rulers and later by the British government on big landlords authorized them to collect land revenue from farmers and remit part of that to the government.

use the resource, while all potential users not belonging to the group are excluded (Howe [8]).

Many policy research studies on tank irrigation systems considered the use of water for agricultural purpose only neglecting other uses/user groups of water namely non-agricultural and domestic uses. Recognizing the multiple uses of water in tank irrigation systems and the social interactions among the users is critical for arriving at sustainable water management policy. Research is needed on how to move from a sense of competition to win-win cooperation among multiple users of water resource. The perception of irrigation water has to be changed from being water to sustain agricultural production; to water that sustains the livelihood of people living in irrigation schemes. The objective of this paper is to examine the social interaction processes in terms of competition and conflicts among the multiple users of tank irrigation systems in India and draw implications for sustainable management of the tank system.

2. THE CONTEXT

Tank irrigation contributes significantly to agricultural production in parts of South and Southeast Asia. Tank irrigation as a socio-economic activity in India dates back to 5th century. In the semi-arid regions of India there are around 120,000 small-scale tanks, irrigating about 4.12 million ha. (Anbumozhi et al. [9]). Tank systems mainly served irrigation and other needs such as domestic, livestock, poultry, social forestry, fish production, silt collection and brick making. In India, the largest concentration of irrigation Tanks are found in the three southern states namely Andhra Pradesh, Karnataka and Tamil Nadu, which account for nearly 60 per cent of India's tank-irrigated area. Tanks account for approximately one-third of the total irrigated area in these three states of South India (Palanisami et al. [7]). Tanks also have many positive attributes such as providing ecological benefits ranging from recharging ground water and moderating floods to serving as habitat to birds and wild life.

In Tamil Nadu state of south India, there were 39,000 tanks with varying sizes and types. The non-system tanks (that depended on the rainfall in their own catchment area and are not connected to major streams or reservoirs) accounted for 85 percent of the total tanks in the state. The system tanks (which receive supplemental water from major streams or reservoirs in addition to the yield of their own catchment area) accounted for about 15 percent of the total. The recent decades have recorded the declining trend in the contribution of tanks to irrigation from about 40 percent in Tamil Nadu in 1955 to less than 25 percent in 2000 (Balasubramanian and Selvaraj [10]). This indicates that there is an urgent need to sustain the contribution of tanks to irrigation and to provide better solution to the tank user communities which largely depended on the tank systems to earn their livelihood.

Specifically, the tank irrigation system in the state has special significance to the marginal and small scale farmers who make a very large number (two-third of the tank

irrigators) essentially depending on tank irrigation as these systems are less capital-intensive and have wider geographical distribution than large irrigation projects. Since the farmers belonging to marginal and small size group are mostly poor, they couldn't afford for cost intensive irrigation sources like groundwater/pressurised irrigation system as in the case of medium and large farmers and hence tank irrigation continues to play a crucial role in sustaining the livelihood of small and marginal farmers. Appropriate policies are needed to sustain the tank irrigation scenario in the state. One of the perspectives to work out the needed policy is to examine the existing competition and conflicts in sharing the tank resources equitably among the tank users leading to the sustainable management of the tank systems.

3. METHODOLOGY

The scientific methods adopted to conduct the research are detailed below:

3.1 Selection of tanks

Tank-chain approach was followed to select the tank samples since most of the tanks in the state falls in chains and not in isolation. Sample tanks were considered to be drawn from chains covering both head and tail end. Four tank-chains were selected randomly from each of the two tank intensive districts of Tamil Nadu state, thus making a total of eight tank-chains. From each tank-chain, four tanks were selected which included two from head end and two located at tail end of the tank-chain. Considering the presence of maximum number of tank uses and maximum number of users who depended on tanks as the criteria, a sample of 32 non-system type of tanks was drawn randomly from the selected tank-chains. However, based on the completeness and precision of data collected, 31 tanks were considered for analysis.

3.2 Selection of respondents (tank users)

A group of 12-15 tank users (key informants) comprising agricultural, non-agricultural and domestic users were drawn purposively from each of the selected tank villages. In selecting the key informants, representation was given to include all user groups/category of users of a tank such as: older farmers/farm women, village head man, WUA office bearers, SHG women member, Village Panchayat leader, caste group representative, silt users, brick makers, domestic user, tree user, fish right holders, livestock farmer etc. so that adequate data about the research issue could be collected precisely.

3.3 Data collection

Participatory Rural Appraisal (PRA) was conducted in each of the 31 selected tank villages with the group of selected key informants ranging between 12-15 per group to

collect the data for the research. Transect walk, rapport building, group discussion and triangulation were the techniques of PRA handled to gather data regarding the key research questions on social interaction processes among tank users. Hence a semi-structured interview schedule covering questions on the aspects namely, pattern of competition and conflicts among and between various user groups was developed and administered during the conduct of PRA to the group of respondents in each of the selected tanks to gather the data for the study. Percentage analysis was done to understand the distribution regarding the pattern of social interactions observed in the sample tanks.

4. FINDINGS AND DISCUSSION

4.1 Social Interactions among users in tank system

As the tanks in the state supported agricultural, non-agricultural and domestic uses there existed various user groups exhibiting different patterns of social interaction processes among them. Two major types of social interactions namely, competition and conflict were documented and the results on this aspect is presented as follows:

4.1.1 Pattern of competition among the farmers of tank system

Competition existed among the multiple users of the tank system for utilizing the tank water to satisfy their respective uses. The major competitor for tank water being the farmers, the pattern of competition that existed among the farmers group for utilizing the tank water was analyzed. An overview of the results presented in Table 1 reveals that seven types of competition existed among and between farmers group.

Table 1 Competition among farmers to use water for irrigation purpose

Pattern of competition	Total (n=31)	
	Number	%
Among Head end or within Tail end farmers	23	74.19
Between Head Vs Tail end farmers	22	70.97
Encroachers Vs Farmers	21	67.74
Upper Vs Lower sluice farmers	17	54.84
Between command area farmers of two villages	15	48.39
Well owners Vs Non-well owned farmers	09	29.03
Day irrigators Vs Night irrigators	09	29.03

The most common pattern of competition recorded in nearly three-fourth of the sampled tanks was among and within the head or tail end farmers of the tank command area for the use of tank water to irrigate their paddy crop. The other two popular types of competition noted were between head and tail end farmers (70.97%)

and between the encroachers who had occupied the common property resource for cultivating paddy crop with the command area farmers (67.74%). In about 55% tanks there existed competition between those farmers who depended on water from upper sluice with that of their counterparts namely the lower sluice farmers followed by competition between the farmers whose command area was spread over more than one village (48.39%). More than one-fourth of the tanks (29%) recorded competition between well owned farmers and those who depended solely on tanks for irrigation and between day v/s night irrigators.

It is a common practice that not all the farmers of the tank command area did transplanting of paddy crop uniformly on a particular day for want of labour and other resources to perform various operations in the field. So the stage of the crop in the field varied for few farmers and this difference created competition among the farmers of either within the head or at the tail end to acquire their share of water ahead of other farmers and this leads to competition among farmers. Likewise the farmers between the head and tail ends also compete for water to get it on priority basis. Tail end farmers feel that the water available in the tank might not be sufficient enough to feed their fields if it has to reach their fields after irrigating the head end in the order that was normally followed in some tanks. Hence there existed competition between head and tail end farmers for water.

Encroachers are those individuals who illegally utilized a portion of the common property lands such as tank foreshore, supply channels etc. for crop cultivation using the tank water. They also claim the tank water to irrigate their fields and competed with the command area farmers for water to raise crop. These encroachers support the local village leaders and gain influence to occupy the common property lands belonging to the tank.

Whenever the tank gets filled with water, it is a normal practice to open the upper sluice first followed by other sluices depending on the water level in the tank to irrigate the fields down the slope. However when the water in the tank was not found to be sufficient to irrigate the entire command, then there existed competition between those farmers who depended on upper sluice and other sluices to get the water on priority basis.

There existed cases wherein one tank feeds the command area spread over more than one village. In that case, it is a convention that the village in which the tank was located gets the preference to irrigate first followed by other villages in an order. This convention was followed during normal period or whenever water is sufficiently available in the tank. However there existed competition among the different villagers whenever the water in the tank was found to be scarce.

Using 40 years rainfall data, it was estimated that in 5 out of 10 years the tanks will be experiencing deficient supply; in 3 years the tanks will fail; in one year the tanks will have surplus storage, and in one year the tanks will be getting full supply. For example, during the eighties, in four years (i.e., 1980-81, 1982-83, 1986-87 and 1988-

89), the tanks had failed. The effect will be more pronounced in the case of non-system tanks than in system tanks resulting in reduction in area irrigated over years (Palanisami et al. [11]). This fact has indirectly remained as one of the reason for the growth of wells in the tank command areas. Whenever there is water scarcity, the non-well owners of the tank command feel that their fields need priority irrigation as compared to that of their counterparts.

It can be inferred that competitions among and between farmers aroused particularly during water scarcity period. Although there existed norms and rules to share water conventionally, these rules were not strictly followed by the farmers at the time of water scarcity conditions. Stronger water rights will apply even during periods of scarcity—dry seasons and drought years, while weaker rights may be denied when water is scarce (MeinZen-Dick and Bakker [1]). Hence it is inferred that the existence of weak water rights (rights not enforced strictly) in majority of the tanks remained as the reason for the competition that may even lead to conflict among users.

4.1.2 Pattern of competition existing between the multiple uses of tank system

Apart from farmers, competition for using the tank water was recorded between the various tank user groups. These patterns of competitions were studied and the results are given in Table 2. The results revealed three patterns of competition and the most predominant one was noted between agriculture and fishery use in 52% of the tanks. Agricultural use was also found to compete with duck rearing to an extent of 19% of the tanks. In about 13% of the tanks the uses namely fishery and duck rearing competed with each other. These patterns of competition were observed during water scarcity period in the tanks.

Table 2 Competition between user groups for tank water

Pattern of competition	Total (n=31)	
	Number	%
Agriculture Vs Fishery	16	51.61
Agriculture Vs Duck	6	19.35
Fishery Vs Duck	4	12.90

The competition between agricultural and fishery uses aroused due to the reason that fishermen wanted to retain water in the tank unto certain level to rear fish successfully whereas the farmers in the command area wanted to use the water from the tank beyond the specified limit to irrigate and harvest a good crop in their fields. Hence there was conflicting interest between the two user groups in sharing the tank water for productive purposes.

In the case of the well owned farmers (agricultural use) and duck farmers, the competition arose due to the conflicting interests of the well owners to retain the water

below sluice level as reserve for recharge of wells present in the tank command, whereas the duck farmers needed the water to feed their ducks. Hence both user groups competed for the tank water. This case was observed to an extent of one-fifth of the tanks.

It could be concluded that competition to share tank water aroused during scarcity conditions only. Farmers were found to be the major competitors for tank water. Other competing user groups for tank water include fish and duck growers. Competition for tank water among domestic use(r) s was not observed in any of the tanks.

4.2 Pattern of conflict among the multi-users of tank system

Conflicts exist in a relationship when tank users believe that their aspirations cannot be achieved simultaneously or perceive a divergence in their values, needs or interests and purposefully employ their power in an effort to defeat, neutralize or avoid each other to protect or further their interests in the interaction. Indeed, conflicts in tank resources management can be understood to entail strategic planning by one user as a means of out-competing other interested users.

The ultimate cause for conflict is a perceived (or) real scarcity of the natural resources, which is driven by a number of factors, including increasing consumption patterns, pursuance of economic development paths and possible exploitation of economic potentials, changing ecological and environmental conditions and unjustified "greed". The fundamental cause of conflicts over tank resources founded on actual or perceived scarcity of the resource at issue seems to be the differing goals of the parties. The main factors which have fueled the various conflicts being experienced include increasing economic needs which impinge on resource conservation and management; non adoption of mutually agreed mechanisms for promoting equity and fairness in sharing benefits arising from the use of tank resources; and ineffective functioning of informal/formal institutional arrangements that would promote equitable distribution and use. These conflicts have been aggravated by rapidly changing climatic conditions.

As the origin of such conflicts was predominantly at the local level, their escalation depends on the absence or presence of mechanisms for conflict resolution and management. Various measures have been taken to resolve or manage resource conflicts at different levels. Indeed the provisions for use rights ought to be understood in the context of resolving community based tank resource based conflicts.

In the context of the multiple users of tank system, four major patterns of conflicts were observed. They were conflicts among farmers, conflicts between user groups, conflicts between controlling authority and user group and inter-village conflicts. The results are presented as follows.

4.2.1 Conflicts among farmers

It was observed that competition that existed either among or between users for tank water remained as a major cause for the conflicts. Hence the pattern of conflicts among farmers was observed in the same proportion of tanks as it was analyzed for competition and the results are presented in Table 3.

Table 3 Pattern of conflict among farmers for tank water

Pattern of conflict	Total (n=31)	
	Number	%
Among Head end / Tail end farmers	18	58.06
Between Head Vs Tail end farmers	17	54.84
Encroachers Vs farmers	11	35.48
Upper Vs lower sluice farmers	10	32.25
Between command area farmers of two villages	8	25.80
Well owners Vs non well owned farmers	3	9.67
Day irrigators Vs night irrigators	3	9.67

The results reveal that the conflicts among and/or between head end and tail end farmers for the use of water was found to be the most popular type of conflict that prevailed among farmers in more than half of the tanks studied. The main reason for the conflict being the priority to use water for agriculture between head and tail end farmers involved. Other types of conflicts observed among farmers at scarcity period, in about one-third of the tanks include encroachers Vs farmers (35.48%), upper sluice Vs lower sluice farmers to follow the simultaneous release of water in both upper and lower sluice of tank (32.25%), between the command area farmers of two villages (25.80%) to share water for irrigation. Other minor conflicts observed among farmers were between well owners and non-well owners (9.67%) and between day and night irrigators (9.67%) due to overuse of water without giving due respect to the customary rules/rights of their tank command for sharing the water for agriculture.

Conflicts among farmers occurred mostly between adjacent farmers due to overuse of water by few individuals as against their allotted share of water at the time of scarcity. Encroachment of tank was seen at different parts of a tank system namely supply channel, catchment's area, foreshore area, tank bed etc. Due to the encroachment of the common lands in these locations, water filling in the tank gets reduced which in turn affected the availability of water for the farmers in the command area. Apart from this the encroachers in the foreshore area break open the tank bund thus avoiding the water to get filled unto full tank level. These facts remained as the cause for the conflict between encroachers and farmers in the tank command. The reasons attributed for the different patterns of competition among and between farmers holds good for various types of conflicts also.

4.2.2 Conflicts between user groups

Seven types of conflicts were observed between the multiple users of tank system. The results are presented in the Table 4. At the time of water scarcity the farmers and fish rearers competed for the water that was present just above the lower sluice level to satisfy their economic interest which resulted in conflict between them. Conflict aroused between agricultural use and fishery use in 32 per cent of the tanks. Fish rearer felt that the water just above the lower sluice level is needed for the successful growth of fish, whereas some farmers felt that even that amount of water should also be used to raise their crop. Hence the conflict between these two uses.

In order to protect the crop from livestock that approached the tank either for drinking or grazing purpose, the encroachers in tank bed prevented the entry of livestock resulting in conflict with the live stock owners. This type of conflict was observed in 25.80 % of the tanks.

Among these, about one-fifth of the tanks recorded conflict between social forestry and live stock grazing (19.36%). In order to promote the initial growth of the tree seedlings for a period of three years from planting, the Department of social forestry prevented the entry of livestock for the purpose of grazing into the tree plantation area (created in the tank bed). Hence conflicts aroused between the forest guards appointed by the department of social forestry and the live stock owners if they made their illegal entry into tank bed area to graze their animals.

Table 4 Pattern of conflict between use(r) s of tank

Pattern of conflict	Total (n=31)	
	Number	%
Agriculture Vs Fish	10	32.25
Encroachers Vs LSG	8	25.80
Social forestry Vs LSG	6	19.36
Agriculture Vs Duck	4	13.00
Social Forestry Vs Silt	4	13.00
Fish Vs Duck	3	9.70
Tail end farmers Vs Silt users	3	9.70

About one-tenth of the tanks had recorded the conflict between farmers and duck owners due to various reasons. The major cause being, the ducks destroyed the standing crops of second season planted by well owners at the time of consuming the harvested remains of first season crop in the tank command. Other perceptions of farmers such as loss of beneficial insects due to consumption by the ducks leading to increased pest prevalence, the excreta of duck caused irritation to the walkers in the field during inter-cultural operation were the causes for such conflict between farmers and duck rearers.

The villagers felt that the existence of tree plantation in the tank bed remained as a source for the presence of thorns in the silt which affected during the collection of silt by the farmers. Besides this the existence of tree plantation increased the harboring of silt in the tank bed which again affected the water storing capacity of the tank. As only few farmers collected silt, the collective action process by all users for desilting was negligible. Hence conflicts aroused between the social forestry and agricultural uses.

Duck rearing in tank command area needed some amount of water to wet the harvested field to facilitate the easy consumption of paddy remains by the ducks. But in some tanks the fish rearers objected the release of water for duck feeding purpose in order to enhance the growth of fish in the tank. Hence conflicts aroused between fish and duck rearers in less than one-tenth of the tanks studied.

The collection of silt by some farmers to fertilize their lands or by the doll makers and others in random pockets from the tank left the tank bed with pits and undulated surface. This in fact facilitated enhanced water storage capacity in the tank. However, the tail end farmers objected the actions of desilters stating that their share of water was not made easily available as most of the water gets stagnated (in the pits) below sluice level due to desilting. This situation had resulted in conflict between tail end farmers and desilters in less than one tenth of the tanks studied.

It can be concluded that conflicts aroused among different users due to the vested interests of few users to overlook the rules and tried to grab their share of water early than their fellow users. Although different patterns of conflicts existed among multiple users of the tank system, such conflicts aroused only during water scarcity conditions and were mostly settled by the community leaders and water users association functioning in the area. However the effectiveness of these associations to enforce the rules for sharing the tank resources at the time of water scarce conditions was not found to be well pronounced.

4.2.3 Conflict between management authority and user group

In Tamil nadu the tanks were managed by two organizations depending on the size of the command area covered by the tanks for irrigation. Those tanks with a command area of less than 40Ha are owned and managed by the Panchayat Union (PU) officials and if the area is more than 40 Ha then it was managed by the Water Resources Organisation (WRO). The results reveal that there existed conflict between farmers and the management authority of the tanks namely either the officials of PU or the WRO in 50 per cent of the tanks. The major reason for such conflicts was due to the long pending demands of the farmers to attend the repair and maintenance works of the tanks.

Another case of conflict of this type was observed between the Irrigation Functionary (IF) and farmers. The IF was locally called as 'neerkatti' or 'neerpaichi' or 'kambukatti'. IF were appointed by the Water Users Association (WUA) and one of their

responsibilities was to distribute water in the tank command for irrigation proportionate to the ayacut farmers as per the norms fixed by the WUA. In few cases, these IF had done their job in biased manner to favour some farmers by violating the fixed norms for want of satisfying their personal gains. Hence conflicts between IF and farmers were observed in about one-fifth of the tanks.

4.2.4 Inter-village conflicts

Inter-village conflicts were observed in one-third of the tanks due to various reasons such as encroachment of supply channel and main channel for crop cultivation by neighboring village farmers, overflow of water from tank due to lack of surplus weir or broken bunds, fish theft by neighboring villagers, arresting the water flow to neighboring tank by some individuals and diverting/grabbing of water directly from supply channel.

Apart from competition and conflicts, there were also a few complementarities observed among some uses. Well owners and fisheries in the tank both benefit from the stored water left after the tank season is over. Similarly brick making and desilting have some complementarities, as the silt may be used for making bricks.

4.3 Resolution of conflicts

All patterns of conflicts among or between the multiple user groups of tank irrigation system were settled down by the process of counseling or mediation lead by the office bearers of the WUA or jointly with the help of the elderly and respectable persons of the village who had adequate influence over the people living in the village for his words of judgment over the tank management issues. In some villages the mediation was led by the village head man or the President of the village Panchayat, who is an elected member of the local self government. The issues were almost settled locally by the process of counseling ending up with win-win situation. In some deserving cases, the WUA collected fine amount from the users who deviated the water sharing norms that were laid by the WUA for adoption by all farmers in the tank command. In the past say two decades back, the norms laid by the WUA for sharing water and other tank benefits like fish and fodder were strictly adhered by the user groups and the benefits were shared equitably among the user groups. However in recent years these WUA have lost their importance and they were almost disappearing due to the various reasons such as growth of wells in the tank command, poor maintenance of tank structures, lack of cooperation by users, frequent monsoon failure etc.

5. CONCLUSION AND IMPLICATIONS

The head and tail end farmers of the tank command competed for the use of tank water for irrigation. Other competing user groups include encroachers, fish and duck rearers. Conflicts in sharing water among farmers occurred mostly between adjacent farmers due to overuse of water as against their allotted share. Existence of weak property rights (rights not properly defined and enforced) in majority of the tanks remained as the major reason for the competition among tank users that led to conflicts among users. It is important that the conflicts should be minimized and complementarities increased in order to achieve the optimal use of the tank potential. Some uses are complimentary and some are competitive, resulting in conflicts. Conflicts existed when tank users believed that their aspirations cannot be achieved simultaneously or perceive a divergence in their values, needs or interests and purposefully employ their power in an effort to protect or further their interests at the expense of other uses or users.

The extent of use clearly makes certain uses competitive. Conflicts aroused due to the conflicting interests of different user groups on tank resources and lack of maintenance of tank structures. It is needed that the use and control rights should be well structured, defined and enforced strictly in such a way that maximum benefits will be obtained by all user groups. For example, specification of the level and duration of water storage in the tank for specified months will help the fish as well as irrigation uses effectively. It could be concluded that one or other type of conflicts were observed in almost all the tanks. Damaged condition of the tank structures and presence of conflicting interests to satisfy their respective needs by the multiple users remained as the major cause for the conflicts among the multiple users. Tank rehabilitation and modernization programs need to be taken up in tank systems of the state in a phased manner to renovate the existing physical structures and restore the effective utilization of the tank by all users without competition and conflicts. It was also reported that farmers were willing to pay for the irrigation water from tanks even considerably higher than the average operation and maintenance expenditure incurred by the state Government on the tanks (Karthikeyan et al. [12]). Hence the WUA need to be empowered to fix and collect charges for the operation and maintenance of the tanks besides enforcing sharing rules to promote collective action for the use of tank resources effectively.

Encroachers of common property remained as a source of conflict in sharing the tank benefits. Tendency to encroach catchment area was noted for residential purpose. In conjunction with siltation, the farmers in the last two decades have slowly started encroaching on the tank bed. Crops were cultivated by the encroachers in the water storage area (whenever the tank is not filled with water) since the tank beds produced higher crop yield due to heavy silt deposits which are fertile in nature. In many cases the government issued rights to farmers for such unauthorized cultivation, resulting in reduction of the storage capacity of the tanks. The encroachers also reduced the water level in the tanks by illegally opening the sluices / damaging the surplus weirs to avoid submergence of their crops cultivated in the tank bed. Reduced storage capacity together with weak bunds resulted in breaching of tanks during excess / normal rainfall

years, incurring heavy loss to crops and other property. Considering these serious consequences the practice of encroachment in tanks needs to be pruned completely through enactment and enforcement of strict rules and it should be enforced within the framework of socioeconomic and environmental perspectives. It was reported that presence of a strong WUA would ensure eviction of encroachments which is also understood as a source for conflicts in the tank system (Palanisami et al. [7]). Strengthening and empowering the WUA to manage the tanks and control the tank resources could be an innovation in the institutional arrangement to facilitate the following strategic actions: collective action of the tank users, intensify the property rights over the tank resources, reduce the competition and conflicts among users, evict the encroachments in the tank effectively, coordinate with various other institutions managing the tanks thereby promoting effective conservation of tank resources and sustainable management of tank irrigation system in south India.

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