CHAPTER - II

REVIEW OF LITERATURE
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2.0 REVIEW OF LITERATURE

This chapter, which presents a review of the literature on tank irrigation system, is divided into three sections.

The first section deals with the structures of tank irrigation system. The second section presents studies on the water management in the tank irrigation system. The third and last section analyzes the water users' association and its functions.

Extensive literature on scientific aspects of tank irrigation management is available. But very few studies of this type of the present work are available.

2.1 TANK STRUCTURES AND PHYSICAL PARTICULARS OF THE TANK IRRIGATION SYSTEM

Adequate maintenance and operation of an irrigation system is a prerequisite for irrigation management. Structures of the tank system are to be maintained properly to reap the benefits for long. If these are all allowed to fall into disrepair then the replacement cost would be far heavy. Therefore, regular maintenance and operation become quite important in any irrigation system. In this chapter some of the books are reviewed on tank structures, physical particulars and command area in the tank irrigation system related studies.

Mohanakrishnan, A. (1999) has stated that irrigation system maintenance is a continuous process. The irrigation channels are to be maintained season after season so that dependable water supply can be delivered to the command area. Repairs of physical structures such as sluices, tank bunds and de-silting of channels come under maintenance phase. Equitable distribution of water supply is very important to ensure supply to the
tail ends and also to reap the benefit of the system. Farmers are not usually consulted in design, construction, operation and maintenance.

In an overview of the IMTI Seminar Proceedings, (1998) in some tank systems, the modernization work has been entrusted to the tank farmers' organization. This type of execution work is done by the farmers' organization of the Kannangudi tank in Pudukkottai district at a cost of 25 lakhs. This modernization work has been carried out successfully with the full involvement and co-operation of members of the farmers' organization. They have the confidence in the structure limit since the quality was ensured. They felt the sense of responsibility maintaining the structures by realizing that they executed the work.

Michaelm, A.M. (1985) has stated that several structures are used to convey, divert and control irrigation water on the farm. Good irrigation structures are an essential part of an irrigation lay out. Efficient structures will save labour, land and water. Earthen channels are lined with impervious materials to prevent excessive seepage and growth of weeds in channels. Severe erosion will occur in earth channels if structures to control the slope are not provided. Drop structures and chute drops are used to prevent erosion in field channels. When water is to be taken from a lateral channel into a field distribution channel or from a channel into a field, a turn out is used. Flumes are used to carry irrigation water across canals. The discharge capacity of pipe flumes may be determined using the equation.

Vasudeva Rao, D. (1987), In a study on rural development through irrigation the author has stressed that the canal system should be improved with lining to avoid wastage due to seepage and to improve the distributory efficiency. Along with adequate irrigation, farmers should be properly trained
to adopt package practice and modern agricultural implements to reap the benefits quickly and continuously.

**Arthur Hazlewood and Ian Livingstone. (1982)** In their study on irrigation economics in poor countries they have indicated that the unpredictable rainfall makes agricultural planning difficult, but once water is available all the year round the farmers are protected from the vagaries of the climate, which is the most important single measure to encourage them to adopt improved farming techniques. The choices in irrigation policy and in the design of irrigation system are complex and the consequences of decisions, particularly in small, poor communities, widespread and large wrong decisions have grave and irreversible effects, and at the very least involve heavy losses of scarce resources.

They have also stated that efficiency requires that water cannot be conveyed to the system and distributed with minimum losses in such a way as to secure maximum efficiency of water use as determined by the ratio of the amount of water used by plants to the amount of water withdrawn from the system.

**Dikshit, G.S., et.al. (1993)** have concluded in their study that till the middle of the sixteenth century tanks were built and maintained by the people and their rulers satisfactorily. The irrigation works constructed by the Vijayanagar kings on the Tungabhadra and Kaveri are still in use. Thereafter the decline began and the British later paid some attention to the restoration of big and productive tanks, while the small village tanks were grossly neglected because village community lost much of their old strength and self-reliance as traditional practices fell into disuse including de-silting of tanks. Watershed development to shape land and conserve every drop of water is the current restatement of a vital need, assisted by modern developments such as satellite
2.1 Photo – view of a **sluice in the tank system** from which water delivered to irrigation through *screw type shuttering* arrangements.
images and scientific advances. But the scope to absorb all this to strengthen institutions, programmes and population participation is immense.

According to Gudihalli inscription of 1527 AD in Krishnaraya region one Timmarasa under the orders of his superior Nagarasaya had the damaged sluices of the tank in the village Arasikere rebuilt. The inscription gives full details of reconstruction. It appears that the sluice was damaged and unworkable due to the use of inferior materials in construction. The inscription says that Timmarasa got the sluice opened and its different parts removed and replaced them by strong stones and rebuilt it firmly with mortar.

**Satpathy, T. (1984)** the author has advocated that to make possible optimal utilisation of scarce irrigation potential already created at huge cost to other public exchequer, field channels need to be provided to all irrigated areas at an early date on priority basis. Government should play a more meaningful and positive role in respect of construction of field channels.

**Muthuvijayan, V. (2001)** In a study on irrigated agriculture intensification programme has advocated that the irrigation project design, operation and maintenance and canal lining require accurate measurement of seepage loss. The possible benefits from canal lining are saving in water, elimination of water logging and reduction in maintenance cost. The following are the measures to reduce the seepage losses, lining channels, proper maintenance of channels, water management practices and awareness to farmers.

The water losses in the unlined channel system are usually high. The losses will depend upon sectional area of the channel and its total length. By knowing the water requirement of the command area at root zone depth, one will be able to determine the requirement of water at project head works or any other point in the system by taking into account all the losses in the system.
from the project head works up to the field. These losses include evaporation and seepage losses.

**Kallapiran, S. N. (1993)** carried out a study in operation, maintenance and control of tanks and says that a better system operation is possible only if an acceptable operational plan is designed and carried-out. As the success of the system operation depends on group decision and group action of local community, an operational plan can be evolved better only through organized water users' association.

**Srinivasa Brahmanand, P. et al., (2000)** emphasizes that the research efforts must develop suitable Integrated Water Management (IWM) technology which should be economically viable, socially acceptable and technologically feasible. Unfortunately canal water use efficiency has been poor in our country due to neglected attention to canal lining and severe incidence of aquatic weeds like water hyacinth (Eichornia crassipes). Appropriate scheduling technique and methods of irrigation have to be followed under efficient canal water management. Recently many Indian states including Rajasthan, Gujarat and Andhra Pradesh experienced drought because of lack of proper water management practices. One of the main reasons for this is non implementation of proper methods for recharge of ground water. One must not forget the fact that the traditional tank structures followed by our ancestors helped a lot in recharging of ground water. These tanks have been neglected for a long time which led to drought situation. IWM would concentrate on uniform development of tank structures and prevention of indiscriminate exploitation of groundwater and hence leads to better crop production.

**Indradeo Sharma. (1985)** the author indicates that the reservoirs act as artificial recharges of groundwater and thus augment groundwater in the area. While conserving the rain run-off the check dams conserve the silt which flows
with the water and they act as a soil conservation measure. It will promote the
development of fishery and thereby augment the supply of fishes in the region.
The reservoirs add to the scenic beauty of the surrounding areas and serve as picnic and tourist spots.

The author also states that too much growth of lift irrigation schemes will make these resources dry during summer, creating drinking water problem for animals and human population.

Kraatz, D.B. (1977) the author stated that the conveyance and distribution of water are an integral part of an irrigation project. Water obtained from natural streams and reservoirs must often be conveyed through canals. Conservation of water supplied is becoming increasingly important all over the world as the demand for this vital commodity continues to rise rapidly and new sources of supply become scarce.

He also stated that, one of the most important ways in which full use of natural water supplies for agriculture can be achieved is through a reduction in the amount of water lost by seepage during transportation to farmers' fields and through weed control. An ever-increasing number of canals and ditches are being lined in order to save valuable water and land, to minimize deterioration of the environment through seepage and to obtain other benefits.

Palanisami, K. (1994) has analyzed that the strategies of structural improvements are inadequate as they confine the nature and scope of the tank modernization to existing conditions. The following strategies are grouped for tank modernization, de-silting the tanks, de-silting the supply channel, curtailing encroachment, afforestation programs, tank water management, redefining the water demand, conjunctive use of tank and well water, farmer involvement in tank modernisation, crop management, tank administration etc.
Mukundan, T.M. (1988) explains in his study of tank irrigation in Tamil Nadu that there are instances, where, when the public works department was not able to undertake the repairs to the tanks the association undertook the mobilization of resources and carried out the repair works. A study has estimated that one association managed to mobilize as much as Rs.250/- to 300/- per hectare per year locally through voluntary contribution.

Shanmuganathan, K. et al. (1998) found that most of the tanks were infested with Ipomoea weeds. The weeds apart from reducing the water holding capacity of the tanks also infest the other low-lying ponds and drainage channels. This leads to reduction in total storage capacity of tanks and the carrying capacity of drainage channels. Contour grid survey was conducted in Andaman tank to assess the present capacity of the tank and the physical loss in the capacity of the tank due to weeds.

Ramaswami, P. P. (1998) in his article on sustainable management of tanks and watersheds says that the river and the tanks are to be linked together by suitable canal formation. All the tanks should be de-silted regularly and the tank bunds strengthened by the silt and planting suitable tree species in the bunds and also in the catchment areas. About 50 per cent of the crop area in the country will always depend on rain, which is very erratic, unpredictable and distributed over a period of 3 to 4 months. At all stages involvement of people in the planning and execution of field program with a community endeavor is suggested.

Shankar, R. and K. Viswanathan. (1998) conducted a study on the Modernization of existing irrigation systems and found that the Kannangudi tank Water users' association achieved a lot of benefits in agriculture through their co-operative efforts. The modernization work of the tank has been carried out successfully with full involvement and co-operation of the members
2.2 Photo – view of weirs (Kalingu) for speedy discharge of tank water during the flood surpluses.
of the association. They have the confidence in the life of the canal structure, since the farmers themselves built it the quality was ensured. They distribute the available tank water uniformly to their crop. By this way they have increased their socio-economic position.
2.2 IRRIGATION, WATER MANAGEMENT AND AGRICULTURE IN THE TANK IRRIGATION SYSTEM

A tank may be defined as a small storage reservoir to impound the run off from the monsoon rains and to regulate supply of water through net work of main and field channels for irrigated agriculture. Irrigation management is nothing but an artificial supply of water to a plant at a particular place, in a particular quantity and at a particular time.

In certain areas the farmers themselves join together and appoint a person to irrigate the field under the command of a particular sluice or appoints persons for a whole village. They are called neerkatti, nirranikans, or kavalkaran. These neerkattis systematically irrigate the lands according to the needs of the crop stages, since he is considered an expert in irrigation. They are paid according to the land they irrigate.

In this chapter, books are reviewed in the aspects of irrigation, agriculture, water management and general profile.

Souvik Ghosh and Kannan, K. (2001) state that in collective participation, there are ample possibilities available to reduce the existing use of groundwater by taking simple works such as removing grass and weed from water conveying channels. There is also a need for constant monitoring and evaluation of the performance of WUAs for the success of the programme and for its replication in other areas.

Sivanappan, R.K. (2001) found out that the present allocation of water for house hold, industry and irrigation sectors are about 4, 14 and 84 per cent respectively. It is estimated that in another 20 years, the allocation of water for irrigation will be reduced from 84 per cent to 71 per cent.

Anil Bhardwaj and Narda, N.K. (2001) the authors explain that in rainfed areas, women play an important role in farming system. They are
usually involved in feeding livestock and agricultural operations such as sowing, weeding, harvesting etc. Watershed management projects should plan and provide development to benefit women and also the weaker sections of society.

**Pandey, M.P. (1979)** the author states that his study of villages deals with the variables like communication, population, occupation, irrigation, markets, co-operative societies, self-based cultivation fragmentation of crop pattern, income and indebtedness. The study indicates that all over performance of the irrigated villages is far superior to that of the un-irrigated villages.

**Sachindananda. (1972)** the author found in his study that the caste composition, size and type of family, education, occupation, land holding size and socio-economic status, levels of living aspirations differed significantly between the two sets of block, one with Integrated Agricultural Development Programme (IADP) and other without it.

**Doneen, L. D., and D.W. Westcot. (1984)** the authors' discussion is concerned with the efficient of use of irrigation water and an even spread over the field in the right amount to fill the soil reservoir. In his analysis, the amount of crop produced with the water supply available determines the real efficiency of the use of water. Crops can be efficiently irrigated once or twice during the season and still fail to yield well because of the lack of irrigation during part of the growing season. Also water cannot be used efficiently unless good farming methods, as well as good irrigation practices are followed.

**Misra, G.P. and M. Vivekanandan. (1979)** the author observed an inverse relationship between the size of the holdings and the area irrigated. Allocation of area under different crops, adoption of new/HYV crops are the result of irrigation. Despite high cost per acre, the farm business income per acre is positive in irrigated lands. So, also the net income per acre. The
introduction of canal irrigation has positively affected the employment of labour per person and per acre. The annual employment per person has increased significantly in all villages including land less labour.

Alexander, K.C. (1979) the author sums up that the canal irrigation in certain parts of the command area lead to substantial increase in agriculture production, increase in income, employment opportunity, greater division of labour and occupation specilisation, increasing consumption, improved living conditions. Social and geographic mobility set in, in an otherwise static society, thus initiating a process of social change.

Kamta Prasad, B.D. Singh. (1994) says that drought is caused by deficiency of rainfall. Hence its' adverse effects on the economy of a drought prone area can be moderated if adequate irrigation facilities are provided. The effects may be demographic, agricultural, and socio-economic. Another significant variable is the quality or reliability of irrigation. Optimum result from irrigation is obtained when its availability in required doses is assured at proper time. In general, canal irrigation is more reliable than dug well irrigation since the former is fed by perennial sources which survive even during the summer while the latter depends on rainfall and usually dries up during summer or when there is drought.

Tanks are quite important in West Bengal but insignificant in the other two states. Less reliable sources like dug wells and tanks have been more important in drought prone districts. In fact, about half the irrigated area in drought prone districts of West Bengal is fed by tank irrigation as against only 16 percent in non-drought prone districts. It can be seen that the drought prone districts are worse off than the non-drought prone ones not only with respect to percentage of irrigated to total area in the three states but also with the of quality of irrigation.
The combined effect of irrigation, higher crop yield per hectare, higher cropping intensity and better cropping pattern can be initiated by crop grown and net farm returns per hectare. Thus irrigation has been a major factor in raising the economic status of drought prone areas.

**Peter Fraenkel. (1986)** the author advocates that the small holdings can be the source of a significant proportion of a community's and a country's food production and they can also be more productive and more energy efficient than large holdings. Efficient and effective irrigation of these lands can therefore have a dramatic effect on agricultural output and the heart of irrigation lies the problem of lifting or pumping water. The different methods used for water lifting are human and animal-power, internal combustion system, electrical, wind, solar and hydro-power and the use of bio-mass and coal in relation to mechanical capability costs, reliability and availability are to be taken into consideration.

**Sukhadeo Thorat. (1993)** the author states that the apparently small farmers depend more on state owned canals and tanks than the large farmers. But the position gets reversed in respect of privately owned wells, large farmers irrigate fairly larger proportion of their area through the privately owned wells than the small farmers, particularly for high value crops. To the extent that small farmers depend more on public irrigation and less on the privately owned wells.

He also advocates that the small farmers lag far behind large farmers since modern capital assets are highly expensive and hence beyond their financial capacity. With the rapid increase of capital intensity in agriculture in the near future, small farms will be pushed further down to a position of absolute disadvantage due to lack of resource. While the small farmers spend a little more on all the inputs for high value crops in the dry region, the opposite
2.3  Photo – view of an open well with energised pumpset for irrigation in the Parambur tank.
is true in partially irrigated and irrigated regions, for large farmers of these regions spend relatively more on high value commercial crops. Small farmers seem to derive a little more income per acre than large farmers.

The author also stated that Maharashtra has been one of the leading states to try all possible dry farming techniques which were developed during the successive stages of its experimentation right from the mid thirties. Yet the farm income in the dry region has remained low and highly unstable.

Johnson, A.I. and Ronald J. Finlayson. (1989) the authors states that it is possible to construct many small water impoundment's on lateral collectors on the watershed and thus store some proportion of the surface runoff for release into the stream bed later in the dry period. This would benefit the basin pumpers and the range users and would aid in sediment and flood peak management in the lower, urbanized area of the watershed.

Dhawan, B.D. (1988) the author indicates that the groundwater irrigation in the southern states, especially in Tamil Nadu, has certainly promoted the cultivation of non-food grains more than tanks and canals. Surface irrigation here is designed for supporting rice cultivation, as chiefly field-to-field irrigation is provided in many of these surface irrigation works. Since well water is very expensive, well owners find it advantageous to use it for growing more remunerative, lightly irrigated crops, for which they construct a net work of field channels that permit a lot of diversity in crop pattern also.

The author's conclusion, from the analysis of sample field data for four states of Maharashtra, Tamil Nadu, Punjab, Utter Pradesh is that on farm benefits from a unit of irrigated area need not rise with the size of a farm holding. Small farmers can gain, acre for acre, as much benefits from irrigation as do large farmers, as is sharply borne out by the survey data pertaining to Punjab and Tamil Nadu states. He also states that the composition of the
aggregate output is partly determined by the social and engineering design of a public irrigation work. The future growth of the physical product of already irrigated tracts may not be accompanied by a proportionate growth in agricultural income, unless the production function witnesses a technical change.

Ahluwalia, B.K. and Shashi Ahluwalia. (1986) the authors advocate that the nature of the land holdings affects the economic efficiency to a great extent. The most serious problem of Indian Agriculture is the existence of uneconomic land holdings of the majority of the farmers. Small farmers defined as those with land holdings up to 5 acres constitute nearly 70 per cent of the total number of farmers in the country. The tiny holdings cannot give them opportunities for full utilisation of the available human and animal power. A family holding is not a single consolidated farm. Each holding is not only small but also sub-divided into several fragments generally situated far apart.

The proportion of small farmers is gradually increasing due to partition of families. Small farmers cannot invest in agricultural or allied pursuits from their family income.

The author found that after the implementation of the irrigation projects and the adoption of improved methods, the annual average income from agriculture has increased from Rs.2,737/- to Rs.4,018/- per family. The irrigation projects confined to the adoption of improved agricultural technology has brought about rays of hope in the minds of small farmers.

Tripathy, R.N. and B. Samal. (1964) the authors have shown in their study of the integrated irrigated area of Sambalpur, Orissa that per hectare farm business income is the true index of relative income gains. It was the highest with the lowest size class of farm operators. Their study further show that the net profit was higher with small farm operators.
Bharad Waja, Krishna. (1980) the study has pointed out that while on irrigated holdings in Punjab only 50 per cent of the crop area was devoted to food crops, on un-irrigated holdings and on the other hand 73 to 94 per cent of the crop area went to food crops. Similarly in Tamil Nadu the irrigated holdings concentrate on paddy, a relatively more valuable crop, while the un-irrigated holdings mainly produce dry grains like cumbu, cholam etc. As such it may broadly be stated that, it is irrigation expansion that plays the dominant role in the context of crop pattern changes.

He also notes that the tube-wells and dug-wells particularly fit into the policy of national priority of providing irrigation facility to other weaker sections of the community. Minor irrigation development also favours the reduction of the regional divergence in distribution of irrigation facility.

Palanisami, K. and J.C. Flinn. (1988) come to the conclusion from their study that variation in the rainfall in the Northeast monsoon period heavily influences the tank filling and the tank irrigation on an average over a 10 year period, tank overflow in 1 year, adequate supply in 2 years (70 to 10 per cent), Complete failure in 2 years, Partially filled in 5 years.

Narayanmoorthy, A. (1993) explained in his study that the farmers' participation on water management works has reduced in recent past in Indian agriculture. Massive introduction of bore well irrigation reduces the farmers' participation on the tank-related works. At farm level participation water buyers use the water efficiently more than water sellers, since water buyers consider the water as costly inputs, while water sellers consider cost less as input. Because of lower participation and misuse of water the level of ground water has gone down from 12 to 45 feet in the eight-year period. Most of the farmers do not know that storage of water in tank is very important for good water recharge for bore well.
Renganathan, N. (1988) states in his article that distribution of water is always a challenging job. It should achieve productivity, equity and justice. The bureaucrats, who have only theoretical knowledge and lack of field experience, mostly do the tasks. It is noted that the end user knows what he wants and how best he could use to achieve the best. Realizing this, water users' associations have been started involving them in the distribution of water for irrigation.

Brij Raj chauhan. (1989) the author states that the arrival of the British brought modernity and caused a decline of tradition in several spheres of Indian life. The modernizing forces had both positive and negative consequences more negative than positive.

The country mainly grows food grains with over three-fourths of land under cultivation. The country was importing food grains in the early fifties of this century; now it is able to meet its normal needs. In the northern states of Punjab, Haryana and adjoining areas of Utter Pradesh, wages have gone up with the green revolution. Besides agriculture India traditionally had one-tenth of its population living in rural areas and working as artisans or rendering other services to the farmers.

Ganapathy. (1992) states that an important pre-requisite for scientific use of water, is an organization of water users. This kind of organisation was found even well over 1000 years ago, during the period of Chola kings of Thanjavur according to an inscription of Rajendra Chola found in the Siva temple at Cholamadevi. The old saying is that "The world will not form without water". Therefore the farmers of Tamil Nadu are well aware of the importance of water. They were also well versed in the technology of collecting, storing, transporting and distribution of the water for irrigation purposes
Balasubramanian, A. (1995) says that the important source of irrigation is the rain. Lakes, tanks, dams and channels are the irrigation systems used for collecting storing and distribution of rain water. Farmers are well experienced in agriculture including irrigation management.

Martin Selvaraj, S. (1995) finds in his study that the emergence of filter point irrigation not only affected the co-operation but also affected the old turn system called 'Sethi Murai'. After emergence of filter point irrigation both the turn system as well as channel maintenance got affected. The necessity of farmer's participation in irrigation management is increasingly felt and therefore encouraged by the government. The government may also strengthen farmers' organisations by encouraging them to look after the maintenance of channel and may provide the necessary financial assistance and legal powers.

Dhawan, B.D. (1989) the author advocates that the conjunctive irrigation is now the watchword of the day, more so with the planners of major surface irrigation works. They wish to promote ground water development within the commands. In the matter of spatial equity within a state and also within the command of an irrigation work, major irrigation works of Northwestern India have to be accorded a high rating. By adopting a policy of under irrigation, the spatial coverage of the benefits has been extended maximally. And by creating the institution of warabandhi (a time shared system of taking canal water by turns) in the tertiary part of the canal system (i.e. below the tank outlet) and successfully enforcing it, the farmers in the tail ends of the canal system have not suffered unduly from undue appropriations by the head reach farmers.

Swaminathan, M.S. (1982) the author advocates that productivity can be doubled or more by introducing farm level management through community action in water and soil conservation. The productivity of wheat in
2.4 Photo – view of the **paddy field** in Mangavanam tank.
irrigated area is higher than the all India average, whereas the productivity of the outside irrigated area is lower than the all India average yield rate.

**Kulkarni, A.R. (1992)** the author states that there is an increasing awareness to day of the need to involve beneficiaries in water management and distribution for optimum utilisation of the irrigation facilities in all irrigation system. The success of the study system shows that even though the holding sizes are small, it is possible for the beneficiary farmers to effectively come together and manage their irrigation system as a community asset.

**Gopalakrishnan, G.N. (1990)** the author states that another benefit conferred by tanks is that they provide scope for the development of fisheries in tank beds. Inland fisheries have an important role to play in India's economy in augmenting food supply, generating employment and raising nutritional levels. The Bangalore Rural Zilla Parishad has successfully used the tanks for developing inland fisheries. The income from the source has been used to maintain tanks in a good condition, besides earning a revenue for the Zilla Parishad.

**Yoder. (1986)** states that some of farmers-managed irrigation systems are managed well, with intensive cultivation of three crops a year giving an annual production in the range of 7,500 to 9,000 Kg./ha.

**Vaidyanathan. A and S. Janakarajan. (1989)** notes that several tanks get their supplies directly from flows drawn from the main or the branch canals, but a much larger number are fed by surplus flows from upper stream tanks. The common pattern is for water from the main or branch channel to flow into one tank. After the latter got filled up, the overflow goes over the surplus weir and flows into the next lower tank and so on. The number of tanks in such chains varies.
Reddy. (1998) Check Dams, a boom to water-starved villages (18th December 1988, The Hindu). He states that the groundwater levels have risen, on an average by four meters. This happy transformation is made possible due to the construction of 29 artificial recharge structures for harvesting rainwater. In addition, the three existing ponds in the region choked with rubble and solid wastes have been cleared and de-silted as part of the drinking water sustainability program. The bore wells in the region, which had a poor discharge rate of about 1,500 gallons per hour in the past, had dramatically risen to 4,000 gallons per hour following the construction of check dams. The micro watershed development programs for sustainability of drinking water by means of recharging groundwater through artificial recharge structures are giving encouraging results.

Kulkarni, S.N. (1990) the author states that even though water is not percolated from tanks, the stored water can be useful to the people and the cattle. The utility of these tanks for Sinnar taluk has been proved but maintenance of these tanks and de-silting after regular intervals is necessary. More percolation tanks can be planned in future. Expert opinion must be obtained on the issue whether tube wells on massive scales would lead to further depletion of groundwater level.

Tanks will solve the problem of drinking water from human beings and cattle. Irrigation facilities being scarce, shall be available to the crops with a view to obtaining maximum output per unit of water. In order to overcome the evils of droughts and scarcities the proper policy perspective above would not be enough. The policies should also be associated with active participation and an efficient administrative machinery.

Shinde, S.D. (1980) the author states that the livestock is an integral part of agriculture and consists of cattle, buffaloes, sheep, goats, pigs and
poultry. Together they contribute to a considerable extent to the rural economy. Most farmers keep cattle primarily to provide draught force, buffaloes are maintained for milk and cows are kept to provide bullocks rather than milk.

**Millican, M.F. and D. Hapgood. (1967)** the author feels that if agriculture herb, as in other underdeveloped regions elsewhere, is to be effectively modernised, it has to attract the attention of a significant number of the brightest, most imaginative, most innovative and most ambitious members of the rural countryside. This is true both in farming and in such farm related activities.

**Sundararajan, S. (1991)** the author states that the maintenance of small-scale irrigation system was the basis of the social and economic prominence of the local landed groups called the *nattar*, because much of the agriculture in the macro region depends upon this irrigation systems. Irrigation was the basis of agriculture in most part of the Coromandal plain, where the system employed was the tank irrigation. These tanks were by riverine channels. Storage in some tanks is augmented by monsoon rains. The maintenance of local systems of irrigation depends on co-operation and co-ordination among the dominant peasantry utilizing the system. Thus they are bound together by specific economic interests usually reinforced by social and ceremonial ties.

**Thangamuthu, C. (1988)** Need to involve ryots in water management:- (News published in The Hindu on 16th March 1988) Irrigation Management is a complex subject, since it is confined not only to just irrigating one's field but has serious political, socio-cultural economic implications. The farmers should be closely associated with the management of water, and the decision to supply water or power, should not be taken by politicians or bureaucrats. Farmer's
views should be taken into consideration while deciding the cropping pattern for a particular season. In years of deficient flows, farmers should be advised to restrict the command area, and adopt rainwater harvesting, recycling of wastewater and recharging groundwater avoiding over exploitation of groundwater etc.

Duraisaminathan, V. (1993) carried out a study on characteristics of tanks taken up for modernization which shows that more water spread area holds less capacity or in other words shallow depth of tanks may increase the losses due to seepage and evaporation. Ratio between number of wells and ayacut is to be given importance to know about the dependency of ayacut on tank water.
2.3 WATER USERS' ASSOCIATION (WUA) IN FARMER-MANAGED TANK IRRIGATION SYSTEM

Association here means some kind of socially structured way of working together which is acceptable to almost all water users and supported by them. It may be formal, loose or under agreed local leadership. An effective Water Users' Association can play a vital role in improving the dependability and equity in the distribution of irrigation water in a tank system.

The main tasks of the Water Users' Association are:

1. Sluice operations and water distribution in a traditional way.
2. Cleaning channels every year before the commencement of cultivation.
3. Arrange to bring the extra water to the tank by diverting the nearby flows.
4. Minor maintenance works
5. Safeguard the tank system during flood and droughts.

The farmers benefited by traditional distribution methods normally dominate the informal groups and they resist any change towards a better redistribution method. The main purpose of formal Water Users' Association is water management.

Sridharan. (1993), says the stone inscription of the Kulothunga Cholan (1202 AD) in the Uthamanathaswamy temple at Keeranur in Pudukkottai district, records that the members of all the sections of the village community had common and joint responsibility in the protection and proper maintenance of the tank, well, irrigation channels and trees in the villages even when they had differences of opinion on several other matters. Further it is found that there was a contract by the different sections of the people of the village, that
even if there was any dispute no one should cause any damage to the trees, wells or irrigation channels. If anyone violated this common code then he was forced to donate various extent of his land to the common property of the temple depending on the seriousness of his offence.

Nirmal Sengupta. (1993) in his study finds out that involving farmers in management is by now accepted strategies for performance improvement of irrigation systems. The government has been providing supports to irrigators in technical resources and legal matters. But now it is also required to provide support in institution building. An organizer is a person who has skills to convince and motivate farmer communities towards self-help and to organize themselves in appropriate groups for mutual benefit. In essence, organization building is a continuous process, with these cycles repeated.

Palaniswamy, K. (1990) states that the government authorities did not give much importance to tank irrigation. Absence of village level leadership and conflict between tail and head enders are the reasons for poor management of the tank.

Mohanakrishnan, A. (1990) in his book on "Selected Papers on Irrigation" advocates that both in operation and maintenance in the present conditions of administration and democratic rule joint formal management of the system should be well appreciated. The government agencies and the system beneficiaries should jointly participate in this endeavor to get maximum benefit.

Arumugam, A. (1988) in the study about the Peikulam agriculturist and farmers improvement society states that the organization contributes any amount which exceeds the deposits of Rs.1000/- towards the Philanthropic activities like eye camp etc. Even though many of the office bearers are active politicians, the society is free from politics.
Balasubramanian, A. (1995) explains in his article “Socio-psychology of traditional irrigation systems in Tamil Nadu from ancient time” that the farmers of Tamil Nadu are well aware of the importance of water. They were also well versed in the technology of collecting, storing, transporting and distribution of water for irrigation purposes. Tank, lake, Dam and channels are the irrigation systems used for collecting, storing and distributing of rainwater for irrigation. Tanks are considered assets by the community and the giver of food and prosperity. The kings and Zamindars provided special manyams and grants for the proper upkeep and maintenance of these tanks. At Thuvakudy village a sluice made of granite has been discovered in a tank with Chola inscription, indicating the existence of sluices constructed by the Chola kings to regulate water supply.

Athreya, V.B. et al. (1990) states that the farmers do not have enough capital to purchase the required inputs the financial institutions are generally more helpful to the large farmers. The small and medium farmers are often forced to borrow at exorbitant rates of interest from such non-institutional sources as money lenders.

Bharawadkar, R. B. (1998) says in his article “Role of Water Users’ Association in Irrigation Management” that the main role of WUA is to create a sense of ownership and right amongst the members so that the members will feel that this is “ours”.

They will use this water with more efficient economic and judicious use. Irrigation water is a common priority resource (CPR) and it is such commodity that it will be taken mainly as collective activity. Hence the association is the appropriate media for Participatory Irrigation Management (PIM). The WUA will act as a Liaison between the government and the enormous number of
2.5 Photo – view of a temple and God, located at the bund of Mangavanam tank, where the villagers pray to God for prosperity, good health and wealth.
individual farmers. The WUA will be the assisting agency for executive government policy.

**Bhogie, S.G. and V. Puranare. (1988)** explain that in India, the majority of population lives in villages with agriculture as predominant economic activity. Irrigation projects and hence irrigation management imply major technological intervention. Once the irrigation projects are constructed and irrigation facility given, it becomes necessary to assess the socio-economic impact of irrigation projects so as to justify the future investments in irrigation projects. Irrigation facility for cultivation of crops through public sector projects is a service provided to farmers. This yields benefits.

**Balasubramanian, C.N. (1993)** states in his study that the traditional irrigation institutions gradually vanished due to the changes in the socio-political environment. However the farmers were concerned about their irrigation systems. Though the institutions vanished their functions developed into a customary responsibility of ryots called "Kudimaramath". These traditional organisations in Tamil Nadu show the right circumstances on the whole (as in tanks) and part (as in channels).

**Chambers, Robert. (1988)** states that farmers maintained water-related works through village level participation, in some places it emerges spontaneously, while in some places it emerges because of their need. However most of the organisations are spontaneous in character.

**Balasundaram, C. and K. Viswanathan. (1998)** finds that turning over of maintenance works to the farmers' organisations may be increased. The conjunctive use of water should be increased in their fields.

**Devanathan, K. (1998)** in his study on Futuristic strategies for the successful functioning and sustainability Water Users' Association says that formation of water users' association is being encouraged by the government in
various commands besides providing financial support in some of the commands. The success and sustained functioning of these WUA are of paramount importance in future, for the proper management of irrigation water, since the major portion, above 70 per cent of the available water resources is being utilized by the agricultural sector. The suggested strategies have been grouped as logical support, organisational support, social support and financial support.

Narayanamoorthy, A. (1990) A study in Pudukkottai district of Tamil Nadu shows that education is not a barrier to adopt the modern inputs and to more yields. He also finds that experience and active involvement in agriculture are more important factors than education.

Ganapathy. (1992) also indicates that an important pre-requisite for scientific use of water, is an organization of water users.

Gomathinayagam, P. (1993) explains in his Joint Management of Irrigation System that the socio-economic, environment backgrounds plays an important role in deciding the crop, agronomic practices, etc. When looking at the present management of an irrigation system two distinct domains are in existence viz. 'the management' and 'the farmer'. For the management side, there are formal government organizations and the farmer's side; there are formal and informal organisations of various models. The organization will ensure equitable distribution of water to all village outlets and maintain the canal distributor. For these services, the village organisations have to give a share of their income from produce. If any special works attended in the main canal special subscription will be collected from all farmers.

IIMI Country paper-Nepal (1990) finds in Farmers-managed irrigation systems of international irrigation management institute that farmers-managed irrigation systems are an important element in the studies of irrigation
management. Systems built and managed by farmers in different environments exhibit a wide range of management capacities. Awareness of these systems and of their numbers and diversity as well as their economic and social contributions has been growing in many countries.

Iyyampillai, S. and N. Jayakumar. (1993) explain in their study of Irrigation Management in Tamil Nadu that in east Thanjavur, farmers' organisations meet on every new moon day and discuss their problems maintenance work relating to sub canals in also done by the villagers in the delta region. It is observed that a sum of Rs.20/- per acre is collected by the local leader and used for de-silting the branches of main canals in the villages closer to Grand Anicut. Mobilizing the already existing grass root level farmers organisations and making them responsible for the management could be a better method for improving the maintenance as well as the management of irrigation system.

Narayanan Leila. (1993) in her study finds out that the number of hamlets and the relationship between the ayacutdars residing in them should be understood. Social investigator has to be alert as to whether the records and the actual reality coincide. It becomes necessary for the investigator to understand the pattern of interaction between castes and assess the social climate, type and quality of leadership is being the most important variable affecting social organization.

Manuraj, M. (1988) in his article on socio-economic survey of the Sooriyur irrigation system that water is a social commodity increasing demand for various sectors insists on economic use by better management practices. When the end users are allowed to manage the available water in cases of tank irrigation system, the above objective shall be achieved.
Martin & Yoder. (1988) also indicates that the strength of farmers-managed irrigation systems is the ability of farmers to cooperate in the management of their system.

Pundarikanthan, N. V. (1993) finds that the goal of turning over, is not to abandon the systems of irrigation to the farmers but to make efficient use of water from them with cost-effectiveness as well as efficiency. It also means the better use of government resources through the encouragement of self-reliance in irrigation management. Turning over can of course restructure the balance between the government and the local roles to restore a greater role for local ownership and management of resources. While the farmers are quite eager to shoulder this responsibility they want legal and financial support in certain areas, before taking over the system from the government.

Mukundan, T.M. (1988) reports that there is a great variety in the features of irrigation depending on the supply of water to the tank as well as the particular cultural, social and political history of the area and the composition of castes that live in the village. But the general principle governing these organisations is the same. The irrigation association consists of members from a number of castes such as Vellalas, Nadars, Moopan, Konar, Asari, Maravar, Scheduled Castes as well as three religions namely the Hindu, Muslim and Christian. The office bearers of the informal associations are selected by organizing the villagers called 'Oorkootam'. In some places the 'Nattar' the leader or the 'Nattanmai' becomes head of the irrigation associations.

Niranjan Pant, and R.K. Verma. (1983) the authors advocate that as regards the utilisation of these organisations in the effective implementation of various policy decisions, there is hardly any doubt about their utility. But it has to be a two way process. The government on its part should involve local
cultivators vigorously in micro level planning, designing and construction of irrigation works. If it is done, farmers are bound to help the public authorities in bringing about order syndrome in the place of anarchy syndrome in irrigation system.

Gupta, D.P. and K.K. Shangeri. (1980) the authors state that the irrigation projects with their complex engineering and bureaucratic organisations cannot be successful without the active participation of beneficiary farmers in the management process. The findings of various scholars like Mass, Coward, Levine, Lowdermilk, Freeman, Wickham, Taylor and Abel have shown that local collective organisations have been very effective in the irrigation management process in terms of distribution of water, maintenance of water supply, structures and resolution of conflicts at the local level.

Palaniswamy, K. (1983) also indicates that the functions of irrigation associations are associated with better distribution of water and higher yield. Therefore these social organisations must be encouraged and recognized as authority for regulating water from the tank as well as within the command.

Pant. (1985) points out that some farmers-managed systems are operating far below the production level they could potentially achieve with their available water and land resources.

Poddar, R.S. (2000) reports that farmer managed small scale irrigation projects have many advantages like high rates of return, short gestation period, low investments and maintenance cost, suitability to the local conditions, no cost escalations, no silting of reservoir, minimal environmental degradation and human misery in terms of eviction of the native people. The project drew the attention of the whole country as a project conceived, constructed, owned and
maintained by the farmers and has brought about substantial changes in the socio-economic and agricultural situation in the region.

Puranik and Sharma. (1993) carried out a study of farmers' organization for irrigation management and found that without certain human activities, goals of irrigation can not be attained. So irrigation is better known as socio-technical process which combines organisational and material elements. All irrigation systems need management to be productive. All types of farmers' organisations whether formal or informal, should be involved in repairs and maintenance of the system, expansion of the system and minor construction work. Multi-disciplinary training program must be arranged for promoting farmers' management. Farmers need training to establish co-ordination among themselves and rapport with government officials.

Reidinger, R.B. (1974) advocates the farmers' organisations on each water course to organise distribution of irrigation water. Consequently the literature on irrigation management in recent years has given increasing attention to the value of organised participation by water users in the management process.

Hassab, Turapul (1980) the author contends that the sluice committees are organised on the basis of fair and free elections or by the consensus of the members under the sluice. The committee represents the beneficiary head, middle and tail end and under no circumstances any member represents more than one group.

Sinha, V.S. (1981) the disputes regarding the share of water have been amicably and informally settled. The society is able to improve the use of water by penalising waste. The society has purchased one tractor to achieve better co-ordination in ploughing operations and to supplement the work of
tractors owned by cultivators and those available from custom centers operated by Gujarat Agro Industries Corporation.

Owens, Edgar and Shawj Robert. (1972) the authors argued that the first step in development is to organize the mass of the people in autonomous local institutions. Development does not start with goods, it starts with people and their education, organisation and discipline. Without these, all resources remain latent, untapped, potential.

TNFMIS Act- 2000. (2001) the following sub committees may be constituted by a Farmers' Organisation

1. Finance and Resource sub committee
2. Works sub committee
3. Water management sub committee

The Objectives of the Farmers' Organisations

1. To function in a democratic manner through consensus respecting the rights and duties of all members.
2. To make their organisation a viable, vibrant and functioning entity.
3. To emphasize in making water available to tail end areas.
4. Optimise productivity and production consistent with the availability of water supplies, etc.

Rights of Farmers' Organisation

1. To obtain information in time about water availability and effectively participate and involve themselves in decision making process related to opening/closing of main canal, periods of supply and quantity of supply, closure of canals etc in pre-seasonal meetings.
2. To receive measured quantum of water from the WRO of PWD for distributions among water users on agreed terms of equity and social justice.

3. To levy separate fees for maintenance of the system.

4. To participate in planning and designing of micro-system.

5. To remove encroachments in canals, drains and tank *porambokes* in the area of operation.

**Responsibility of the farmers Organisations**

1. To prepare the schedule of water deliveries and communicate to the concerned.

2. To supply water to all members in the command area as per the approved terms.

3. To carry out timely maintenance and repair works to the channel system below the distributory system including drains and other properties.

4. The general body of the association may take a decision not to supply water or provide benefits to such persons.

5. The general body may take a decision to prosecute such persons in a court of law.

The farmers' organisation shall assist the government / commissioner/ government authorities in implementing the various provisions of the act and rules, and it shall abide by the directions/orders given by the government/commissioner.

**David W. Johnson and Frank P. Johnson. (1982)** the authors advocate that the groups are good for humans. The productivity of groups is higher than the productivity of individuals. Groups make more effective decisions and solve problems more effectively than individuals. The quality of
2.6 Photo – Groups are good for humans. Group makes more effective decisions and solve problems. Discussing about the problem in the farmers residence.
every day life is greater in groups due to the advantages of specialisation and
division of labour. Conflicts are managed more productively in groups. Without co-operation, social organisation and groups of various kinds, humans
would not survive.

The author points out the works of an irrigated agriculture also. The
importance of groups or organisations is realised in WUA. The group concept
is clearly shown in water management, water distribution, and conflict
settlement.

Jainulabdin, D. (2001) the author advocates that the problems of illicit
and over drawl of water in the head reaches and there by creating scarcity in the
tail reaches affecting the yield in both the cases are solely due to lack of
understanding and co-operation among the farmers. Hence bringing the
farmers together for group action, involving them in the planning of on farm
development works and accommodating all their genuine needs will make them
voluntarily work for the success of the system.

He also states that the execution of on farm development works in the
sluice command will increase water use efficiency at farm level. This in turn
will enhance productivity.

Santha Goving and Sahaya Lesey Loyans. (1998) state that as the
majority of the conflicts were resolved by the FMIS itself, the FMIS may be
given the judicial power and rights for the entire Peikulam command area,
which would pave the way for continued growth and existence of the PFMIS.
As the Peikulam FMIS was effectively functioning for well over a century, this
could be made a model FMIS by the government for implementing irrigation
projects in rural areas.

Donald, D. White. (1982) the author says, conflict is defined here as
any kind of opposition or antagonistic interaction between two or more parties.
It can be conceptualized as existing along a continuous range. At one extreme, there is no conflict. At the other extreme is the highest state of conflicts, described behaviorally as the act of destroying or annihilating the opposing party. All intensities of interpersonal, intra-group and inter-group conflicts would fall somewhere along this continuum. If there is opposition and if the parties fail to perceive it, then conflict does not exist.

Shankar, R. (1993) in his article concludes that human beings are self-centered. In intersectional situations every one wants to give away little but wants to gain more. The farmers' organization is multi-religious, multi-caste and the land holdings indicate that it is economically stratified. Water management is a socio-technic process. Hence due consideration has to be given to the human element in addition to the scientific, technical aspect. The planning for water management has to give due weightage to the human aspects for its success and it has shown that social group has been responsible for the effective implementation of the scientific model of water management.

Shaul Manor. (1990) reports that allocation of low budget for repair and maintenance results in untimely release of water further shattering their confidence under these circumstances, farmers are not committed to the systems and are unwilling to pay the charges. Farmer-managed schemes, though unsophisticated in nature, cost only nominally and constitute effective organisation and water distribution systems. The farmer-managed schemes reflect opportunity for quick returns on investment.

Farmers' participation is defined here as a transferring of decision making powers in system development and management to farmers. This participation consists of authority to take decisions and resource mobilization (e.g. ideas, money, man power and materials). The objective of farmers' participation is to develop co-operation between Government and the farmers'
which will bring fruitful results for farmer-managed irrigation system. Evidence from recent experiences in many areas indicates increasing farmer involvement and participation, in terms of achieving increased self-reliance and a sense of ownership.

The following benefits have been attained in the FMIS

a. Improved equity in water distribution.
b. Greater certainty of water delivery.
c. Cohesiveness among farmers.
d. Reduced social problems attributable to irrigation development
e. Increased capital build-up and improved self-reliance.
f. Enhanced internal resource mobilisation to sustain operation and maintenance through farmers' participation.

Sankara Kumar, P. (1995) in his article on water users' association and their role finds that the main functions for WUA are acquiring water, storing water, equitably distributing the water among all the beneficiaries without any disputes, protecting the infrastructure facilities, and finding the ways and means to uplift the socio-economic standards of the farmers and the whole village itself. For making WUA a successful one, the government agencies like irrigation department, agriculture department and non—governmental organisations have their own responsibilities.

Vasantha Kumaran,T. and L. Jayasekar. (1993) also indicate that the WUA of India is perhaps centuries old, although the earliest that is known to exist is just 125 years old in ancient India. There was a large variety of community managed irrigation systems, notably wells, tanks and even streams. The WUA has indeed produced positive impact upon the people. The people also believe in the WUA in its future viability and activity expansion. The
WUA is a sure means of doing it, because under the association, people can be made to realize the importance of the auspices of unity.

Viswanathan, K. (1995) explains in his study on Future role of farmers in the management of major irrigation tanks that the farmers themselves should involve themselves in the organisational activities and follow the decisions of the organization. The cropping pattern can also be decided by the farmers' association based on the availability of tank water. Farmers' participation is the only solution to overcome all problems in the tank irrigated agriculture.

In this chapter literature is reviewed on tank irrigation system management with regard to structures, water management, WUA and its functioning, women participation, socio-economic aspects of farmers in the irrigated agriculture. This study differs from other studies and mainly focuses on the farmer-managed tank irrigation system with reference to system and non-system tanks.