Commission on Agriculture as 1,953 km$^3$. The Commission has estimated the annual ‘usable’ water resources of the country as 1,086 km$^3$ (690 km$^3$ of surface water plus 396 km$^3$ of groundwater). The present quantum of use is put at around 600 km$^3$. However, the continuing trends in growth of population and urbanization will require 973 to 1,180 km$^3$ by 2025. Iyer cautions, “the precarious balance between supply and demand can of course tip over into a crisis, if the actual developments fail to conform to the assumptions”.

**The Technological Issues**

Vaidyanathan (1999)\(^2\) is of the opinion that one of the factors that arrested the growth of irrigation in India is that the technology of storage - based system did not develop indigenously in the country. T.M.Srinivasan (1991)\(^3\) says something different on the standard of ancient indigenous technology. South India is recognized to be among the oldest areas in the world where artificial irrigation was practiced on a large scale. He brings out the technological aspect of strengthening the embanks of the river Kaveri and cutting inundation canals (done by King Karikala of the Sangam Age) as high order control measures, not only to divert
flood waters, but also to prevent silting of adjoining lands under cultivation. The innumerable tanks of South India bear testimony to the storage based system that was in vogue from time immemorial. Srinivasan mentions about a treatise on water by the sage Garga and also a 1369 A.D. inscription that gives an account of the method of construction of tanks and dams in medieval South India.

Iyer (1998) criticizes the craze for western engineering models of large dams – the so called ‘temples of modern India’. The basic syllogism in the modern engineering approach to water resources development, proceeds from the spatial and temporal variability in the availability of water, through a view of rivers as ‘surface water resources’ to be ‘harnessed’ and ‘exploited’ for human use, with the instrumentality of science and technology. [(Boulding (1966) also refers to this inclination of modern engineers to wage a ‘war against nature’)]. Iyer laments that the era of large dams has resulted in a decline of traditional forms of small scale, local, community-managed systems of water-harvesting and management. This lends credence to the Wittfrogel hypothesis
concerning the inherent tendency of hydraulic societies to become centralized despotic states.  

Modern Technology helps in the development of water resources, in augmenting, especially ground water, through pumpsets and tubewells. Kurien (1981)\textsuperscript{7} is of the opinion that it is the pump set revolution that preceded the Green Revolution in Tamil Nadu, that has set the pace for the latter. Sinha (1995)\textsuperscript{8} also says that, in districts like Bihar Sheriff, Samastipur, Begusarai and others, the Green Revolution has taken off only because of the growth of tube well irrigation.

Dhawan’s study of tube wells in Uttar Pradesh (1973)\textsuperscript{9} finds that, “the level of utilization of tube wells is more sensitive to the level of agricultural prices rather than the price of tubewell water. Another finding of the study is that irrigation water is underpriced and the raising of tube well tariff (by 66\%) is in order. Such a rise need not cut back the demand for tube-well water” as the demand is not found to be elastic with respect to the price of tube well water. On the premises that the ground water makers are seen concentrated mostly in scarce water regimes, Saleth (1994)\textsuperscript{10}
concludes that the Ricardian rent, which the water – sellers enjoy at present, will dissipate with increasing competition and hence is essentially a transitional phenomena.

Sarma et al (1995) analyse the consequences of over exploitation of ground water and incidence of salinity in Haryana, resulting in land degradation, which led to decline in farm production and income, unemployment and migration, disparities and ecological imbalance. The study shows that with a fall in the water table, consequent upon over exploitation of ground water, the farmers are abandoning agriculture itself and becoming agricultural and non-agricultural labourers. Mistry (1992) in this context, suggests the following techniques for artificial recharge of ground water storage:- (a) water spreading (b) sub-surface dams (c) injection wells and (d) induced recharge.

Dam technology for irrigation has also led to serious ecological problems like loss of forest area, land degradation, migration of people, water logging or soil salinity. Nathan et al (2001) point out that in Indira Gandhi Irrigation project, 83 percent of the area is water-logged and 53 percent area is salt-
affected. In Haryana also 450000 hectare are affected by salt and water logging: wheat and rice yields have declined by 22 percent and 49 percent respectively.

**The Economic Issues**

Literature on the economic issues of water resources development are available in plenty. They can be grouped under five headings:

- On revenue productivity,
- On agricultural production/productivity
- On stability of production
- On equity and
- On economic well-being and development.

That the colonial administration took to irrigation development, only with a financial motive is well documented by Ratna Reddy (1990).\(^\text{14}\) Mohanakrishnan (1977)\(^\text{15}\) also provides an evidence to the thesis. The Select Committee of the House of Commons in 1879, stated that the financial results of works of irrigation are the best tests of their utility. This principle was followed since then, and the rate of return required before a project
could be considered as financially productive was fixed variously from time to time. The rate was gradually increased from an initial level of four per cent to six percent, at which level it remained till 1949,\textsuperscript{16} when it was reduced to 3.5 percent.

According to one estimate, the share of irrigation related investments averaged 91 percent of the official estimate of fixed capital formation in agriculture on public sector account.\textsuperscript{17}

Naturally, such huge amounts of expenditure prompted evaluation of its costs versus benefits as well. As the objective was increased agricultural production, the principal criterion for appraisal was a rise in production.

In 1958, the Research Programmes Committee of the Planning Commission, Government of India, arranged for investigating the benefits and costs of six (primary) irrigation projects which have been in operation for not less than 20 years, namely

1) Cauvery Mettur reservoir, Tamil Nadu (by K.S.Sonachalam)

2) Damodar Canals, West Bengal (by S.K.Basu and S.O. Mukherjee),
3) Saradha Canal, U.P., (by Singh and Misra),

4) Ganga Canal, Rajasthan (by Research Programmes Committee),

5) Tribeni Canal, Bihar (by Dhivakar Jha) and

6) Nizam Sagar Canal, Andhra Pradesh (by M.F.Jassawala)

These studies show that large benefits accrued from irrigation in terms of double cropping, diversification and better quality crops, higher yields, larger income and greater employment opportunities for hired labour. It was also made clear that the total benefits from irrigation were far larger than the direct financial returns accruing to the government from irrigation rates. The Committee of Direction, therefore, recommended that, in future, the benefit-cost ratio should be used for assessing the feasibility of new projects.

These studies are not perfect, because, they employ for their ex-post appraisal, the techniques of cost-benefit analysis that are devised for ex-ante appraisal; further, they paid little attention to the distributional-equity-aspects of the benefits.
Thangapandi, in his doctoral dissertation (1988)\textsuperscript{18} applies the various techniques of benefit-cost (NPV, IRR.B.C. ratio/Discounted Cash Flow) in his study of Manimuthar Reservoir Project. The study concludes that except for the financial productivity test, all other techniques applied to the appraisal of the project have proved it to be a profitable investment; the traditional financial criterion has indicated that the project yields only 2.62 percent as against the 4.5 percent, that was in vogue at the time the project was designed by the engineers.

The study by Sinha and Bhatia (1982)\textsuperscript{19} is quite different from earlier studies. It is a detailed study of the pre-sanction appraisal of the Auranga Reservoir Project in Bihar. It recommends the use of social cost – benefit analysis for the appraisal of irrigation projects and also advocates techno-economic analysis for the choice of the best among alternatives. It suggests some modifications needed to work out the social benefit-cost ratio in the form of weightage to the benefits accruing to small and marginal farmers, employment benefits, the objective of self-sufficiency and also the indirect benefits which result from backward and forward linkages. The
study suggests that a modified project plan (with ten percent more cash) is economically viable.

It is hypothesized that irrigation increases agricultural production/productivity by inducing changes in cropping pattern and also by increasing the cropping intensity. Testing this hypothesis has been the objective of many studies. Epstein (1962)\textsuperscript{20} made a comparative study of a wet and dry village in Mandya district, Karnataka (1954-1956). Singh and Singh (1962)\textsuperscript{21} studied the socio-economic effects of Bhakra dam adopting the ‘with and without’ approach. Jha (1967)\textsuperscript{22} examined the direct and indirect impact of irrigation under Tribeni canal in Bihar. He compared the project area with a control area. The findings of these studies are more or less the same in expansion of area under commercial crops, more stable production and a rise in the standard of living of the farmers.

Studies on Lower Bhawani Project (Tamil Nadu)\textsuperscript{23} throw light on an important consequence of irrigation – induced changes in cropping pattern. This project (1952) was originally conceived as a dry crop irrigation project, supplying irrigation to 4,000 ha. of rice
and 78,800 ha. for irrigated dry crops such as cotton, groundnuts and millets. But by 1958-59, the area under rice had increased to nearly 32 percent of the total area, depriving the lower reaches adequate water supplies. So in 1964, the state was forced to intervene. The command area was divided into two halves with outlets in even-numbered miles of the canal in one half and those in odd numbered miles in the other. In one year, the even half is designated Turn I and the other half Turn II. This is alternated each year. The canal water is released to farmers of Turn I from August 15 until December 15 for wet rice. Turn II receives water from December 16 to April 15 for irrigated dry crop, including groundnut and sesame. The water supply to even and odd areas is reversed in the following year. No crop restriction is made during the first season, but during the second season, rice cultivation is not permitted. This arrangement has succeeded in effecting the raising of a higher proportion of irrigated dry crops, in addition to paddy. Incidentally, this development brings out the scope for state intervention in regularizing the irrigation-induced changes in cropping pattern.
The National Council of Applied Economic Research (NCEAR) also conducted a few studies on the impact of irrigation. The Evaluation Study of Rajasthan Canal Project (1978-79)\textsuperscript{24} indicated that “with irrigation”, cropping pattern was found changing with wheat and gram replacing minor crops like bajra, and introduction of commercial crops like cotton. Turning to crop yields, it has been pointed out that in wheat, the yield was 96 kilogram per hectare ‘without irrigation’ and 1,637 kgs. Per/ha. ‘with irrigation’. Another performance evaluation of Gandak project\textsuperscript{25} by the NCEAR in 1985-86 showed that, after introduction of canal irrigation, the pattern of cropping has changed (paddy and wheat replacing inferior cereals) along with a change in the area cultivated. The area under commercial crops like sugarcane and tobacco was also increasing.

Dhawan D.D.\textsuperscript{26} studied the impact of irrigation on instability in farm output in Tamilnadu. The study compares output instability between pre- High Yielding Variety (HYV) and post- (HYV) periods and finds that in the latter period, instability is higher. Here, it should not be forgotten that the post HYV period is weather-wise, more unfavourable than the pre-HYV period. The
study mentions about arch-instability and reveals its prevalence in the state. During drought years, the farmers limit the irrigated acreage with the aim of protecting the crop yield, and in years of above normal rainfall, they maximize production by extending irrigated acreage, by utilizing the extra water availability.

Equity is an important criterion of performance of an irrigation system. Equity includes questions of who benefit from irrigation and how they benefit. It is most commonly applied to the allocation and appropriation of water. Daniel W. Bromley et al. present the case for a set-up in which the interest of the least advantaged irrigator (from the view point of distance from the outlet and size of holdings) is suitably weighed. The arguments are based on the five general principles of institutional design from John Rawl’s Theory of Justice. (viz. compatible liberty, knowledge and participation, shared concept of Justice, formal system of justice and rational rules).

In this context, the relative rights of the top enders and tail enders of an irrigation system are discussed. Robert Chambers remarks “the deprivation of tail ends is notorious and is confirmed
again and again. This deprivation is reflected in the crops grown, cultivation practices, yields and incomes”. Higher valued and more water intensive crops tend to be concentrated in head reaches. Yields almost always decline from head to tail. On the Gal Oya Left Bank in Sri Lanka, Paddy yields were found to decline from 40 bushels per acre on head reaches to 33 on middle and 26 on tails. For landless labourers, tail ends provide less work and less assured work. Chambers reports, “my own guess is that between 6 and 10 million hectares suffer from recognizable and damaging tail end deprivation and that is socially far more serious than the more visible problem of water logging”. In this context, the need for improved management of irrigation system is evident”.

Dawan and Sudarshan,\textsuperscript{29} have shown that the failure of land reforms in the redistribution of land to the poor and in the consolidation of holdings have also resulted in inequitable distribution of water.

Studies were undertaken also on the role of irrigation as a lever of economic development. Irrigation should be viewed as an input in rural development (and not merely in agricultural
production). In that connection, V.M. Rao points out that with the current “thoroughly illogical ownership-cum-operational pattern of agricultural land”, development of irrigation is bound to benefit only the larger farmer. He stresses the need for light irrigation (over a larger area) instead of perennial irrigation (confined to a relatively small area as seen in the areas of Green Revolution) on the ground that the spread-out of agricultural development will widen the contact of villages with the urban markets which could motivate and mobilize the forces of development.

**Institutional issues**

As defined by Caruthers and Morrison (1996) “an institution is the interaction of preferences, rules, individual strategies and norms. An institution is a set of rules, the structures, the actions among actors, while organizations are collective actors who might be subject to institutional constraints”. It is a bundle of enforced rights and rules in the society.

Raju (1995) while discussing the Acts and Rules of Irrigation Management in India, avers that the “Unrecorded
customs priority” ownership in waters, is one of the rights to use, this right can be exercised by an individual, a group of individuals or a legal entity. The rights exercised by the state over water are not proprietary in nature, but sovereign in character. From this flows the inherent right of the state to administer or regulate the waters flowing within the territories, subject to the right of a riparian to get the customary quantity of water.

Moench (1988)\textsuperscript{33} examines the conflicts between the concept of water as a common property and the emerging consensus that it needs to be treated as an economic good to ensure efficiency of use in the context of scarcity. Some Indian court decisions are quoted which make the right to water a National or Fundamental Right under Article 21 of the constitution. The courts have also generally considered ground water to be a chattel to land. However, management of ground water on a sustainable basis is possible, only if some brakes are put on the power of individual land owners to extract ground water. The goal must be to strike a balance.

In India, water is a state subject – item No.17 of the State list in the 7\textsuperscript{th} schedule of the Constitution. Inter – state squabbles have
been an obstacle to full-scale development of National Water Resources.

Iyer (1998) asserts, “Water – resources management, rather than development should become the watch word for the future” (emphasis as in the original). Wade (1980) actually narrates a south Indian case on ‘Substituting Management – for water in canal irrigation,’ wherein a 50 percent reduction in water supply in a drought year was very effectively compensated through better operating procedures, without expensive rehabilitation of physical structures.

Loucks (2000) et al define Water Resources Management as “the vector sum of a programme of legislature policy, regulation, engineering practices and institutional traditions.” Simply it means putting water resources for the best beneficial use with all the technologies at our command.

The World Bank Participation Source Book enumerates the benefits of user-participation in irrigation management:

1. Such participation improves system performance for system design benefits from local knowledge and farmers have the
means and incentives to minimize costs and improve services. For example, irrigation user associations can reduce labour costs by paying lower wage, provide closer supervision of staff and reduce breakages when farmers feel a greater sense of ownership.

2. Public expenditure will be reduced with a reduction in government staff and contribution of cash, labour and materials by farmers. Farmer associations are more effective in collection of user fees than government agencies.

3. Building irrigation systems that are wanted, supported and owned by users themselves provides the best assurance of sustainability.

4. More available organizational arrangements and water delivery have been noted when participatory approaches are followed. A contributory factor is the socio-economic status of the leadership which tends to be closer to that of the ordinary member, involving more tenants and small farmers.

5. The transformation of water users from beneficiaries to partners can have a widespread impact, as farmers became trained and organized. It can increase local ability to co-
ordinate input supplies and to deal with other government agencies involved in rural development.

6. The kind of problems that typically delay the implementation of non-participatory irrigation projects, such as difficulties in negotiating rights of way or obstruction by farmers or local politicians may be avoided or solved.

The source book mentions also about the costs and risks of users’ participation. The costs in mobilizing field staff, training and organizing farmers and carrying out socio-economic research are there. Further, additional time is needed to establish a participatory approach and get the project off the ground. However, the additional costs are usually offset by subsequent savings in construction costs and higher loan repayment rates. Similarly, once the participatory approach is established, the implementation period can be reduced. Uma Sankar and Esha (1993)37 are very enthusiastic about the long tradition of farmers’ associations for the construction and maintenance of water works that exist throughout India. They refer to the panchayats in Karnataka and Maharashtra, Nattamni, Kavalmanyam, Neermanyam and Oppidi sangams in Tamil Nadu. They mention about the irrigation
functionaries such as nirkattis also. Another important institution of these systems is voluntary community labour (known as Kudimaramat in South India) for maintenance of supply channels and field channels. The study points out that funds for construction and maintenance came largely from gifts of lands made by individuals of the state (known as desavandam, bittuvatta, kattukodige, eripati, Kulapatti). Turning to the rules and norms of water distribution, the study notes that despite the bewildering variety of differences, even where many castes are involved, they enjoyed a fair amount of equity in water distribution. The study laments that in the post-independence privatization of irrigation, disappearance of farmers’ initiative has led to the decline of these traditional associations. The authors pin-point that the revival and modernization of these associations is “very much the need of the day”.

The technical superiority of some of these traditional works is pinpointed in some studies. Mahendale (1999)\textsuperscript{38} praises the age old technique of ‘bandharas’ (a series of earthen or stone dams, nearly 70 in a district, Maharashtra) which, managed by the beneficiary
group’s contribution of labour, are working without the problem of silting or maintenance.

Sengupta (2002)\textsuperscript{39} refers to the old ‘horseshoe’ shaped ‘anicuts’ at Thamirabarani Irrigation system (in contrast to the straight anicuts with flood banks on both sides) which permit diversion of water into the channel even during low flows and (unlike the modern flood banks that prevented drainage of water into the river) prevent water logging or leading to salinity.

Shah (1998)\textsuperscript{40}, however, has some misgivings. To quote him, “That there has been a breakdown of many local institutions does not mean that all of them are reversible or even desirable, for, in many instances they might re-instate caste and/or class hierarchies and some time, even ‘blind faith’. In any case, one doesn’t know what is peoples’ perception on revival of traditional local institutions”. However, the World Bank is very categorical when it reports (in the context of Pakistan) that “the brushing aside of healthy functioning, traditional water course committees, in favour of frequently token WUAs was an added mistake”.

SOCILOGICAL ISSUES

A study conducted by Rajagopal Madras Institute of Development Studies on ‘Water Management in Agriculture: Role of Institutions’ (Both farmers’ organization and Irrigation Bureaucracy) in a South Indian canal System is concerned with irrigation institutions and their role in water management and changes in them over a period since the first survey was conducted in 1985. The study rests on the premise that these institutions and their role in management are significantly conditioned by the agricultural and socio – economic environment (especially caste and class) of the region. Caste plays an important role in the working of institutions and management of village affairs including water. The institutions are stronger in the single caste village than multi - caste village. The survey shows that irrigation systems are not existing as blue print but continue to undergo changes in which institutions are important. Though there are many changes in irrigation and agriculture, caste (as a part of institution) continues to play an important role in irrigation and other village affairs. Besides this, the study concentrates on the factors affecting
changes in the control over land, structure and functions of the WUA, source of its funds and rules for water allocation.

Jose (1986) in his study, on ‘People’s Participation and Intensive Rural Development Programme in Kerala’, found that the level of literacy, political consciousness, local leaders and communication media were contributory factors for participation. The study conducted by Suresh and Joseph (1990), ‘Public Participation in Rural Development – a case study conducted on the non-governmental organization in Kerala,’ concluded that though administrative and organizational personnel had satisfactory level of perception regarding participation, attitude towards the same was below the desirable level. The degree of participation was determined by the socio-economic characteristics of participants, nature of programmes and type of organizations.

Gopalakrishnan (1989), while discussing on the need for group farming in Kerala, gives the steps that are to be taken before any group action: (i) systematic discussion of the common felt needs of the community; (ii) systematic planning to carry out the difficult programmes that have been selected by the community;
and (iii) mobilization and harnessing of physical, economic and social potentialities of the community.

Iskandar and Peter (2010) point out that socio-political transformation in Uzbekistan since the 1990s has generated the emergence of new, formal and particularly informal arrangements in irrigation water management. The main drivers of this change have been the individualization of farming, the ‘lack of fit’ of the existing physical infrastructure and the paucity of funds and other resources in the state water bureaucracy. An important finding of the research is that the emerging water management situation has implications for rural livelihoods. New arrangements for water management may lead to unequal water distribution among wealthy and poor, large farmers and small holders, and irrigation vs non-irrigation water uses. Water management may, consequently, develop as a vehicle for the intensification of socio-economic differentiation in Uzbekistan.

Karthikeyan, (2010) in his study on competition and conflicts among multiple users of tank irrigation system, studied social interactions among multiple user groups of tank irrigation
systems and proposed policies for sustainable management of tanks. Crop growers are the major competitors for water besides encroachers and 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 a major role in presenting the collective actions among the user groups to use the tank resources sustainably.

Kanagaraj, Subba and Shailaja (2003) in their studies found out that the co-efficient of multiple determination ($R^2$) for PWD tanks was 0.61. The regression co-efficient of farmers’ participation was found to be positive and significant, while the regression co-efficient of encroachment on water spread and foreshore area is negative and significant (-0.649) and indicates that one unit increase in encroachment area will result in 0.649 units decrease in tank performance. The maintenance expenditure has a negative sign, even though it is not statistically significant.
The negative sign for its co-efficient probably indicates spending more expenditure on poor performing tanks.

Abishek (2003)\(^48\) in his study finds that in Ananthapur district of Andhra Pradesh, tanks were a precarious source of irrigation even at the peak of their use. Hence, with the use of electricity supply and reduction in the cost of ground water extraction technology, farmers moved to ground water irrigation. Along with a rise in ground water irrigation, however, a decline in tank irrigated area was witnessed. It was also seen that the inequity in landholding in the command area of the tanks is strongly correlated to the maintenance of tanks. Tanks which had high levels of inequity in landholding in their command were also the best maintained. This shows that a strong control by a few over the tanks lends to better management. Diffusion of control leads to a decline in performance. A second trend that was seen is that the introduction of ground water irrigation hastened the decline of tanks by making landholding in tank commands more diffused. This is because the better-off farmers prefer to consolidate the landholdings near their tubewells, even at the expense of relinquishing their landholding in the tank command.
Solanki, (2003) has undertaken a case study in tribal dominated irrigation project where 77.14 percent farmers fall into the category of the tribals. The farmers of the project area were sub-divided as per their living situation i.e., non tribal organization and tribal organization. Each organization had taken water from the same outlet no. 14 B at Mohanpura minor. The data revealed that the non-tribal powerful farmers were not allowed to take water to the tribals, hence they were having poor socio-economic conditions. At a later stage, the water distribution was handed over to Water Users Association consisting of tribals and non-tribal farmers. A significant change was observed in socio-economic conditions of the tribal farmers after actively participating in WUA.

The final report of rehabilitation of integrated tank management systems in the Kaliveli Watershed, Viluppuram District brings out the relevance of Participatory Irrigation Management, which technically speaking, is a process for improving productivity and sustainability of irrigation systems and refers to the involvement of farmers in all aspects of irrigation management at all levels. Ultimately, this aims at maximizing the production potential for every drop of water released from the
source, whether it is surface water or ground water. It is reported that this can only be achieved after developing the components of system and management elements on-farm i.e., below sluice as well integrating natural resources management with social resources management, thereby ensuring the increase in overall irrigation efficiency, social equity and restoration of ecological balance among subsystems of irrigation system for sustainable agriculture production and effective functioning of WUAs.\textsuperscript{50}

George Chakckacherry\textsuperscript{51} in his thesis submitted to the Mahatma Gandhi University, Kottayam, for the Degree of Doctor of Philosophy in Sociology on ‘Farmer Participation in Irrigation Management’, (1993) studies two brand canal commands of the Right Bank Main Channel of the Neyyar Project - Chowra and Vizhinjam. The study finds that most of the farmer associations are either not functioning or not functioning properly. The reason for this situation is mainly attributed to the hurry shown by the officials in setting up the associations. The associations were formed by Command Area Development Agency (CADA) in a war footing, by motivating the farmers through promises of assured supply of water and more material incentives. In fact, the officials
who were assigned the task of forming the associations were neither trained, nor experienced enough, to influence the farmers for participating in irrigation management activities. Their concern was only to form the associations somehow or other. There are no officials to monitor the sustained performance of the associations or to oversee the fulfilment of the promises given to them. One of the hypotheses of the study is that “participation of the farmers will be more, if more incentives are offered”. An important finding of the study is that “the religious/caste/community influence in the participation of farmers in irrigation management is minimal”. “Data collected under the study prove that political differences among the farmers weaken participatory activities of them in irrigation management”. 

Raju K.V.\textsuperscript{52} advocates the adoption of certain principles to succeed in Participatory Irrigation Management: Emphasis should be placed on getting water users in charge of operation and maintenance (O & M) – the role of the irrigation department should be reduced to that of providing regulatory and support services. Further, training is needed both for water users and for agency staff, with special emphasis on middle and lower level field staff.
Jeyasekaran and Karunakaran (1989) report a case of ‘women cultivators’ Association successfully functioning in Madurai District of Tamilnadu, which undertakes all activities in irrigation management. There are no inconsistency in roles, unrealistic role expectations, non-commitment and group heterogeneity among the cultivators, lack of technical knowledge of inexperienced leadership. Kathleen Kilkely (1986) observes active participation of women in the irrigated agricultural production in Sri Lanka.

Social engineering of the formation of water user associations becomes much easier under the public trust framework (as against the private property regime), mainly due to five main factors: (a) there are no conflicts of ownership; (b) state is not the dictating partner; (c) local level flexibility is feasible in organizing the association and managing the water resources and (d) it is possible to clearly define the user charges.

Cerena (1985) emphasizes the need for “Social Engineering” of participation for effective social action. Social engineering consists of attempts to use the body of sociological knowledge in the design of policies on Institutions to accomplish some purpose.”
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