CHAPTER II

REVIEW OF LITERATURE
2.1 Introduction

In this chapter a brief review of the existing literature on the economics and pricing of irrigation is presented. The aim of this presentation is to review thoroughly the existing financial position of the irrigation projects in the country and different approaches to and practices of canal irrigation water pricing and briefly discuss the merits and demerits of each approach and the prevalent practices as pointed out by academicians and different commissions and committees set up by the government from time to time. For a systematic presentation the literature review has been organised and presented into four sections: (a) financial position of irrigation projects; (b) revision of water rates; (c) economics of irrigation; and (d) methodological issues.

2.2 Financial Working of Irrigation Projects

In this section, a critical review of literature on the economics and different aspects of financial performance of some major and medium irrigation projects is presented.

Ambegaonkar (1979) in his study found that the water rates existing in different states of India were too low and not sufficient to cover even the operation and maintenance costs of the projects. The author noted that there was no uniformity in charging water rates across different states of India and highlighted the need for a realistic and rational water rate policy. He suggested that the water rates might be charged on the basis of net additional benefits obtained by farmers as had been
recommended by various committees and commissions but they should at least cover the operation and maintenance costs of the projects. The author also sounded a caveat that the financial burden of the irrigation projects should not be borne by farmers who are not using the irrigation facility.

Ansari (1998) in his book cited different arguments for and against raising the water rates of major irrigation projects and asserted that irrigation projects being a decreasing cost industry, deficits were inevitable for equating price with marginal cost. In the beginning, i.e., when an irrigation project was constructed, it needed a huge capital investment, which were impossible to recover in short run. Hence, it had to be recovered over a long period of time, otherwise the initial rates would be too high (because of huge capital investment) for the irrigators. He also added that there were many indirect and diffused benefits of irrigation projects, all of which might not be chargeable but strongly asserted that the water rates must cover the costs of supplying irrigation water.

On the basis of a detailed study of five major and medium projects in Gujarat, Asopa, (1977) suggested that rational water pricing policy should take care of the economic, financial, political and social considerations of the irrigation projects. He asserted that the rates should be revised on the basis of crop-wise value productivity of water, keeping into consideration the paying capacity of cultivators and the equitable income distribution objective. The author also advocated that the rates could be fixed project-wise to suit socio-economic condition of farmers of a region and to bring desirable changes in cropping practices.
For determining appropriate and fair water rates for canal irrigation in West Bengal, Bhattacharjee (1974) suggested that the water rates must be determined on the basis of some practicable and rational approaches rather than agreement rates or some seasonal rates, fixed by an agreement by the government representatives with farmers before sowing of crops. These rates as prevalent in West Bengal were often too low. He pointed out that these low rates and poor collection of irrigation revenues had deteriorated the financial status of irrigation projects in the state. The author suggested that the rates should be fixed on the basis of extra benefits derived by farmers from irrigation as tax paying capacity of the irrigators was a function of both the enhanced production and the prices of the produce both of which had changed considerably after the rates were fixed. He suggested that the revised rates could be charged as per the recommendations of the Nijalingappa Committee (1964).

Carruthers and Clark (1981) found that water rates were rarely equivalent to the full costs (fixed costs + variable costs) of its supply and even less than the short run marginal cost. On the basis of their studies of different irrigation projects spread over many countries, the authors observed that the realised returns were very low compared to the predicted returns.

Champati and Patnaik (1984) in their study in Salandi Irrigation Project of Orissa suggested a rise in the rates of irrigation water to facilitate the recovery of the huge costs invested in these projects. They also found that the paying capacity of the beneficiary farmers was higher as compared to the non-beneficiary farmers and the system of slab rates of irrigation was very useful for fixing price of water for different
size groups of farmers. The authors further added that pricing could serve as a strategy to encourage certain types of cropping patterns in the regions and rates could be charged as a percentage of the net additional benefit (NAB) realised by the farmers.

The Central Water Commission (1988) observed that the water rates of canal irrigation existing in different states of India were highly diversified and based on arbitrary considerations which were not clearly specified. The Commission also found that the revenues from irrigation projects in all the states were not covering even the annual costs of the projects and urged an upward revision of the existing water rates.

The Central Water Commission (1993) like the Central Water Commission (1988) observed that the existing water rates of canal irrigation were too low to meet the operation and maintenance costs of running the irrigation projects in all the states and were based on some ad-hoc rather than rational approaches. The Commission also found that the burden of subsidy in the irrigation sector had been increasing continuously and suggested that this must be stopped to improve the financial position of the irrigation projects.

The Committee on Taxation of Agricultural Wealth and Income (1972) observed that the water rates prevailing in different states of India were low to meet the operating cost and far from being a source of revenue, irrigation projects needed subsidy even for their maintenance and operation. The Commission also recommended that if the irrigation schemes were taken as a social welfare measure
the rates should be raised because it was only the farmers in the command areas who got the facility of irrigation and derive additional benefit from it and so they should pay for this facility and those who were not getting the benefit should not be taxed in any way for this.

Dhawan (1989) while working on the cost aspects of major and minor irrigation works suggested that the social cost of the projects should also be assessed. He also opined that, besides social costs, the opportunity cost of the land submerged by reservoirs and loss of forests should also be considered. In addition, the author also pointed to some problems such as costs borne by the individual for getting and managing the irrigation water supply were not valued, the pay back period assumed at the time of project appraisal often differed from the actual and distorted the previous costing and costs borne by the government for researches, investigations, remodeling, replacements etc. for irrigation projects were not considered.

Dhawan (1992) found that the development of canal irrigation was very helpful for replenishment of groundwater and so the cost of canal water was less as it appeared to be. The lining of channels in the case of canal irrigation was very important to bring up the water table of a region and replenish the groundwater stock. This had also very significant effect on the supply of drinking water, natural vegetation and cropping practices, but these were all intangible benefits to be measured and evaluated. He also pointed out different problems relating to the management of the irrigation projects.
Various Finance Commissions from time to time have examined the cost and revenue aspects of irrigation projects and were of the opinion that the irrigation projects must earn a positive return to the state governments. The Second and Third Finance Commissions found that the irrigation projects functioning in various states were unable to break-even. The Fifth Finance Commission was optimistic and expected a 2.5 percent interest return on the capital invested apart from meeting the working expenses of the projects, though the facts were contrary. The Sixth Finance Commission recommended that the state governments should recover at least the working expenses of the projects from water rates while the Seventh Finance Commission advocated that the state governments should not only cover the operation and maintenance expenditure but also a portion of the capital investment which they recommended to be 1 percent of the total capital invested for the project. The Eighth Finance Commission did not expect any return on the capital investment but expected a return at least sufficient to cover the operation and maintenance costs of the projects.

Gopalakrishnan (1987) found that the burden of implicit subsidy on irrigation was becoming unbearable as the revenue receipts from irrigation were lower than the working expenses of the projects. The author found that the state-wise earnings from revenue receipts in irrigation were lower than the expenditure incurred for working and maintenance of the irrigation projects in 1974-75 and in 1984-85. The author argued that an irrigation project increased the income and the land productivity and helped to develop the infrastructural facilities like roads, electricity etc. which indirectly made the irrigated area more prosperous than the areas where it was not available. In view
of this, he opined, it is justifiable to impose irrigation cess and betterment levy on the farmers of the irrigated area to wipe out the financial losses of the irrigation projects and to avoid the burden of increasing subsidy.

While estimating input subsidies in Indian agriculture, Gulati (1989) found that the total input subsidy in Indian agriculture (for irrigation, fertilisers, electricity and credit) averaged over seven years, from 1980-81 to 1986-87, was Rs. 9,000 crore at all India level. It was approximately 17% of the net value added in Indian agriculture over that period. About 70% of the total subsidy was given to major and minor irrigation projects.

According to the Irrigation Commission (1972), since Independence, there had been a progressive deterioration in the financial position of the irrigation projects. The projects were running in huge losses and that creates a growing drain on the general revenues of the state. The Commission also found that in some of the states the collection of revenues was so low that they did not cover even the working expenses of the project.

Mitra (1990) in countering the arguments of Dhawan (1989) relating to the costing of irrigation projects on the basis of making simplistic assumptions made several critical remarks. He argued that the estimation of fixed cost on the basis of assumed project life of hundred years or so, was not very sound because in reality hundred years were sufficient to reconstruct the project. Because by that time the reservoirs would be filled up by siltation, the irrigation channels would be damaged by natural process and
other machineries would be totally depreciated. He also added that sometimes fixed
costs were calculated before the project actually started functioning. The author
opposed Dhawan’s calculation of the opportunity costs of the land under forest or
submergence and asserted that in most of the cases the estimation of the irrigation
potential is not very reliable.

While looking into the financial aspects of irrigation, Mitra (1990) found that there
was no unanimity about the need for increase of crop-based water rates. He
emphasized the efficacy of volumetric pricing to check the problems of wastage,
maldistribution and over-irrigation. The author stressed on the formation of water
users’ association to combat the problems of collection of revenues, distribution of
irrigation water and maintenance of distributaries.

Nayak (1992) pointed out several inadequacies and shortcomings in the planning of
irrigation projects which had been encountered in the past four decades of India’s
irrigation development history. She referred to several factors which caused
deterioration in the performance of irrigation projects. They included time and cost
overruns in the execution of new irrigation projects, widening gap between potential
created and utilised. It also included progressive dwindling of irrigation potential as
India had already developed two-thirds of its estimated potential, escalating costs,
lower than expected rates of returns from irrigation and unwillingness of farmers to
change their cropping patterns.
Patel (1987) found that the total revenue received from irrigation projects in Gujarat was much lower than the costs incurred in their operation and maintenance. He estimated that, in 1981-82, the total revenue receipt was Rs. 148 crores as against the operational and maintenance costs of Rs. 214 crores.

Patel (1988) in his study in Gujarat pointed out that the financial performance of different irrigation projects was disappointing and that they were unable to meet even their operational and maintenance costs. One of the reasons for this, according to the author, was the poor collection of revenues from the irrigators.

In his study of the pricing aspects of irrigation in Dantiwada project in Gujarat, Patel (1988) found that the canal irrigation charge was Rs 146/ha as against Rs 383/ha for private tube-wells. Thus the canal charge was only 37 percent of the charge of private tube-well irrigation. He pointed out that the cost of operation and maintenance, depreciation and interest was Rs 484/ha (Rs 175/ha on operation and maintenance and Rs 309/ha on interest at the rate of 6%) and the subsidy was Rs 338/ha, the rest was met from collection of irrigation charges. The author also added that even at zero percent rate of interest, some subsidy (Rs. 29/ha) would be needed. The opportunity cost was calculated at Rs. 247/ha for the project. He also noted that the big farmers enjoyed the benefits of subsidy on canal irrigation whereas no subsidy was available for well irrigation and to the farmers who did not have the facility of canal irrigation. He thought this subsidised facility would lead to inequality in income distribution among those groups of farmers.
Patei (1890) in his study of four canal irrigation projects of Gujarat viz. Dantiwada, Kakarpar, Mahi and Shetrunji found that there existed a huge gap between the revenue receipts from irrigation and the expenditure incurred in supplying irrigation to farmers' fields in all the four irrigation projects. He pointed out that the revenues receipts were less than 70 percent of the demand (except Shetrunji) and advocated an upward revision of water rates to improve the financial position of the irrigation projects.

The Planning Commission of the Government of India had deliberated many times on the issue of water rates for canal irrigation and had emphasised the need for revising the rates in all the states. During the First and Second Plans, the Commission thoroughly examined the water rates existing in different states and advocated their upward revision so as to meet the operation and maintenance costs of the projects. In the Third Plan, the Commission, besides recommending a raise in the water rates, suggested the imposition of other charges on irrigators like compulsory water cess, betterment levy etc. to improve the financial condition of the irrigation projects. In the Fourth Plan, it noted that the rates were too low in all the states and the irrigation projects were running in huge losses due to the increasing costs of operation and maintenance and long gestation period of the projects and advised the irrigation authorities to charge a portion of the fixed cost to the cultivators so as to avoid the burden of imposition of these costs on the rest of the community. The Commission also recommended that only the cultivators in the command areas who are getting the benefits of irrigation should pay for the benefits they were enjoying.
Venkateshwarlu, M. (1988) while studying the financial aspects of medium and major irrigation projects in Karnataka noted that the irrigation projects were running in losses and water rates covered not even 50% of the operating costs of the projects. Moreover, the water rates were not regularly paid by the farmers. This had led to huge arrears and increasing burden of subsidy. The author also made a comparison of the rates of canal and tube-well irrigation for different crops and showed that rates for canal irrigation were very low and can be substantially raised up.

2.3 Revision of Water Rates

In this section, the recommendations of different commissions and committees and the suggestions of various scholars for revision of water rates for major and medium irrigation projects are presented.

The Government of Bihar in 1967 appointed a commission, Bihar State Irrigation Commission, to look into the financial aspects of irrigation in the state. The Commission submitted its report in 1971 and recommended that the irrigation rates should at least cover the working expenses of the projects. It advocated that the rates should not exceed 8 percent of the gross benefit or 30% of the net additional benefit realised by farmers from irrigation.

The Irrigation Commission (1972) recommended that the water rates should be raised to such a level that, taken as a whole, irrigation schemes, did not impose any extra burden on tax payers. They also advocated a revision of water rates every five
years and suggested lower rates for lift irrigation from canals and higher rates for flow irrigation.

The Maharashtra Irrigation Commission (1982) recommended that the water rates for canal irrigation should be fixed within the range of 6 to 12 percent of the gross income, the higher limit being applicable to cash crops only and lower one for food and fodder crops which have lower profit margins.

The National Council of Applied Economics Research (1969) recommended an upward revision of water rates on the ground of three reasons. First, water rates in the past were deliberately kept low to popularise wet farming and at that time prices of farm products were also very low. But now when the situation has changed - farmers realise higher benefits from irrigation and prices of farm products have also gone up considerably - the rates should also be revised accordingly. Secondly, earlier the revenue receipts from major and medium irrigation projects covered a certain percentage of the capital investment, but now, with the huge escalation in the cost of construction of new projects, water rates did not cover even the operation and maintenance costs and consequently many new projects had become losing concerns. Finally, irrigation had increased the paying capacity of irrigators and so they should pay a portion of their benefits to cover the costs of irrigation projects (p 61-2).

The National Commission on Agriculture (1971) in their report submitted in 1976 examined the overall financial performance of the irrigation projects and emphasised the need for upward revision of water rates for irrigation to improve the progressively
deteriorating financial position of the irrigation projects. The Commission also found that irrigation rates had not been keeping pace with the rising prices in all the states and recommended an urgent and quick upward revision.

The Nijalingappa Committee (1964) had recommended that the rates of water might be fixed at 25% to 40% of the additional benefits depending upon the factors like rainfall, water requirement, yield and value of crop.

Patel (1990) in his study of financial performance of four major irrigation projects in Gujarat suggested revision of water rates of canal irrigation to improve the efficiency of irrigation. He advocated that the rates should be raised to such a level that at least the operation and maintenance costs of the projects are fully covered.

Patel (1992) while studying the policy issues of canal water rates in Gujarat suggested a rise in the water rates on three grounds; rising prices of material and labour; considerable increase in the construction costs of new projects; and enhanced paying capacity of the irrigators. He found that the underpricing of water was one of the root causes of poor maintenance of irrigation projects and deterioration of the quality of irrigation service.

Singh (1978) was strongly against irrigation subsidies except for a few initial years in those areas where irrigated farming was not very popular as was recommended by the Irrigation Commission (1972). He advocated raising of water rates on three grounds. Firstly, it would help the irrigation authorities to cover at least the operation
and maintenance cost of supplying water. Secondly, it would provide social justice because the farmers are getting the benefits from public investment in irrigation projects and so they should bear a major part of the cost of supply of water. Finally, higher water rates would lead to a more efficient use of irrigation water.

The Taxation Enquiry Committee (1953-55) formed by the Union Ministry of Finance, while looking into various aspects of general taxation in India, also reviewed the irrigation rates and suggested an upward revision. The Committee observed that the prices of agricultural produce had increased considerably in the war and post-war years which had improved the paying capacity of the irrigators but the irrigation rates had not been revised accordingly.

2.4 Economics of Irrigation Projects

In this section, we present a review of literature on direct benefits and costs of irrigation. The changes in the productivity of crops and in cropping pattern in irrigated areas and comparative profitability of canal irrigation and other sources of irrigation are also highlighted.

Dhawan (1983) in his study conducted in Kal Project in Konkan area found that the benefits of irrigation was less than that envisaged by the planners though there was significant increase in the yields, cropping intensity, labour employment and the net returns in the post project period.
Dhawan (1986) in his paper highlighted and explained the problems related to the management of irrigation in India. The problems included difficulties in calculating the utilisation of irrigation potential created, uneven distribution of benefits from irrigation among farmers, inadequacy of supply of irrigation water for modern farming, conveyance losses and wastage of irrigation water, deterioration of financial performance, over-exploitation of the ground water potential and water logging, siltation etc.

Dhawan (1988) in his study conducted in several states of India, found that canal irrigation had played an important role in increasing and stabilising the farm output. This was done by reducing the dependence of crop production on highly uncertain rainfall and by increasing the cropping intensity in irrigated regions through supply of irrigation water to crops in the off-seasons and by providing protective irrigation during dry spells/droughts. He also found that the rate of growth of groundwater irrigation was faster than that of surface irrigation. The author found that the benefit of irrigation was positively associated with farm-size across the states. Besides these positive effects, the author also pointed out several deleterious and unintended effects of canal irrigation like problems of waterlogging and consequently the development of salinisation in upper reaches; inequality in income distribution between the irrigated and unirrigated tracts; effects on human health like reappearance of diseases like malaria in the irrigated zones; excessive exploitation of groundwater leading to constantly falling water table etc.
Girl and Maliik (1984) suggested that the level of resource base and existing technology along with proper irrigation facilities were responsible for the variations of farm incomes. They found that the greater degree of inequality in the distribution of land and cropping intensity as found in the privately-owned tube-well command areas than in the publicly-owned tube-well command areas.

Ghosal (1988) found that the factors like undulating topography, poor drainage system, high water tables etc. were responsible for the low efficiency of irrigation projects in the eastern plains. According to the author, due to poor drainage, waterlogging and water salinity, millions of good lands were degraded and became unproductive every year. He suggested that proper layout of channels, timely supply of irrigation water and conjunctive use of surface and groundwater could improve the irrigation efficiency significantly.

In a study conducted by the National Bank for Agriculture and Rural Development (1988) in Udaipur District of Rajasthan, it was found that the water charges for tube-well irrigation were 43% and 45% of the total cost of cultivation of maize and wheat respectively and the total irrigation hours taken were found to be 81 in the case of diesel-operated pumpsets and 69 hours in electricity-operated pumpsets. It was also pointed out in the study that though there was significant increase in the net returns from the irrigated crops under tube-well irrigation but a considerable portion of it went to the payment of irrigation charges.
Shah (1991) while studying the development of groundwater irrigation and the efficiency of groundwater markets in Gujarat highlighted the role of water markets in the equitable development of groundwater irrigation. He found high variability in the groundwater markets across the state. He also found that the groundwater markets of Gujarat were the most well-developed ones in the country. He identified a number of factors that affect the power of water sellers and the functioning of water markets and suggested some policy measures for the effective management of groundwater irrigation and the conjunctive use of surface and groundwater.

Sidhu and Ramesh Chand (1984) found that the efficiency of irrigation water depended upon the allocation, timeliness and adequacy of its supply which ultimately decides its productivity and profitability. They also found that there was a high correlation between the returns obtained from irrigation and the additional amount invested for better irrigation facilities on a farm.

Singh (1978) studied the effect of additional water supply on the regional economy and concluded that the recovery of the additional investment was almost 100% per year in cases of small and medium farmers.

Thamodaran, Shashanka and Heady (1982) worked out the economic feasibility of concrete and silt-made canals and found that both were economically viable but those made of silt were more profitable.
Venkutareddy (1988) in his study conducted in Gokak taluka of Gokak canal area in Karnataka found that there were significant changes in the productivity of crops and in the cropping patterns in well irrigated areas. The author also suggested that to optimise the benefits of canal irrigation and to minimise the adverse effects of canal irrigation conjunctive use of surface and groundwater was very effective. The author in his paper also highlighted the advantages and benefits of well irrigation to supplement canal irrigation and the constraints in the development of well irrigation.

2.6 Methodological Issues

In this section, a review of literature on different approaches to and methods of pricing of canal water is presented. The scope and limitations of the various approaches and methods as prevalent in the country are also discussed. To get a comparative picture, literature on pricing of water for minor irrigation projects is also cited.

For evolving a suitable pricing policy for deep tube-well irrigation in West Bengal, Banerjee (1978) proposed a methodology in which she used both the demand for (benefit) and supply of (cost) irrigation. For the simplification of analysis, she made some assumptions relating to the technology and structure of the market, which in the second step were relaxed and social benefits and social costs were taken into account. For deriving a suitable pricing method, she considered cost aspects i.e. the total project cost (fixed cost and variable cost) of supplying irrigation water and the cost of cultivation of different crops as well as the direct benefits realised by farmers.
from irrigation. In the second step, from the social point of view, some policies like enforcement of land ceiling, and agricultural income taxation had been suggested by the author to maximise the social benefits.

Carruthers and Clark (1881) argued that water rates were fixed mainly on the basis of three functions, i.e., economic function, financial function and social function. They further added that because of the social and political obstacles associated with the execution of these functions, the financial position of the large irrigation projects was deteriorating rapidly. The authors suggested that promotional pricing policies could be introduced in the initial phase of the project to ensure full utilisation of the created potential and betterment levies for an equitable income distribution in the region where the project was functioning. They also asserted that unless farmers were below socially acceptable standards of living, full water rates should be charged, but when they were above that par, rates should be fixed and charged at a level that reflects the scarcity value of water. The authors also suggested that the revenue from irrigation should at least cover the short run marginal cost of supplying water.

The Central Water Commission, (1993) determined the rates of different crops in seven selected states on the basis of total water requirement and total cultivated area of main crops in each state as a whole and the total cost of running for all the projects taken together in the states. The Commission calculated the costs component by component like the operation and maintenance costs only, operation and maintenance costs plus interest plus one percent depreciation cost, operation and maintenance costs plus interest plus two percent depreciation cost etc. This was done to provide
several alternatives to the state governments so that they could adopt any one of the alternatives most suitable under their circumstances.

Gulati (1992) in his study on 'Prospects for Improving Irrigation Efficiency Through Water Pricing' found that the existing water rates were very low compared to both the cost of supplying irrigation and the benefits of irrigation. He also found that the water rates varied with crop and season and had not been revised for a long time. The author also observed that in all the states, the collection of revenues from the irradiation projects was very poor and did not cover even the annual costs of the projects. The author identified a number of factors - economic, socio-political and administrative-institutional - which explain the farmers' decision not to pay the irradiation charges. While assessing the farmers' capacity to pay for irrigation, the author found that there was substantial increase in the farm income from the irrigated cropping practices; a portion of which the farmers could easily pay as irrigation charge. The author also suggested some points to be considered in pricing of canal irrigation water and strongly recommended that the operation and maintenance costs of the projects must be covered by the revenue received.

The Irrigation Commission (1972) recommended that the water rates for canal irrigation should be fixed on the basis of the value of the produce realised by the farmers from irrigation (5 to 10 percent of the gross benefit, the upper limit being applicable to cash crops). It also hinted that the water rates should be fixed according to the water requirement of various crops, in different seasons and region considering the quality of irrigation (adequacy, dependability etc.) which should be divided into
different categories and the water rates be charged accordingly. The Commission advised a lower rate in the initial years in the regions where irrigated agriculture was not very popular to ensure full-utilisation of the created potential. According to the guidelines of the Commission the State policy about cropping pattern should use water rates as an instrument to facilitate certain cropping patterns and practices. It also emphasized that there should be minimum disparity in water rates among different projects and in different regions except in cases where there were wide variations in the quality of service.

In his paper on "Environmental Economics and Valuation of Economic Decisionmaking", Munasinghe (1992) advocates that the Contingent Valuation Method was very effective in pricing of goods and services for which either there are no markets or the markets are imperfect. The author argued that this method could serve as a very effective technique in the valuation of intangible benefits also and in certain cases it was the only technique available for valuation of such environmental amenities as scenic beauty, fresh air etc.

While searching for an appropriate methodology for pricing of canal irrigation, National Council of Agricultural Economics Research (1998) pointed out the limitations of both the existing approaches; cost approach and benefit approach. They advocated that the rates should be such that they (1) ensure the full utilisation of the created potential, (2) offer sufficient incentives to the irrigators in using irrigation water, and (3) encourage irrigators to achieve the National and/or state policy objectives regarding cropping patterns, irrigation management etc.
The National Water Policy (1987) recommended that the water rates should reflect the scarcity value of the resource to the users and should promote economy in water use. It also stressed that receipts from water charges should cover the annual operation and management costs and a part of the fixed costs. It emphasised the need for improving the quality of irrigation and for taking care of the needs of marginal and small farmers (CWC, 1993:2).

Some important findings of the Organisation of Cooperation and Economic Development (1987) about pricing of irrigation water in different countries are: (a) in two studies conducted in Australia and Canada, it was found that the prices of irrigation water changed the demand significantly; (b) in a study conducted in Mexico, it was observed that the volumetric pricing made the farmers more careful in the use of irrigation water; and (c) in a study conducted in Australia, it was found that transfer of basic rights to allocation of water under certain conditions improves the efficiency of irrigation considerably.

Patel (1990) advocated that water rates be charged on the basis of the irrigators' increased capacity to pay for irrigation due to the rise in per ha yield of irrigated crops and farm harvest prices of agricultural produce and suggested the benefit approach as a basis for determining water rates.

Patel (1992) suggested that water rates for canal irrigation should be such as to provide fair returns to irrigators from using irrigation water after payment of water
charges to the irrigation authority. He also asserted that economic use of irrigation water by irrigators and equity and uniformity in the treatment of the beneficiaries should also be kept in mind while fixing water rates.

Sangal (1991) while examining different aspects of using internal rate of return (IRR) as the sole criterion for bank financing of minor irrigation projects found that in states like Maharashtra and Gujarat, the economic water rates of deep tube-well/lift irrigation schemes were substantially higher than the prevailing water rates of flow irrigation. The author worked out crop-wise benefits of irrigation and observed that though there was a significant rise in the net income from irrigated crops, a major portion was spent on meeting the irrigation cost which was as high as 50% of net incremental income in the case of sugarcane. The author also found that in the case of water-intensive crops like sugarcane, cotton, vegetables etc., society incurs huge losses in providing irrigation. He suggested that the water rates should be charged on the basis of the quantity of water consumed at the water point rather than charging uniform flat rates irrespective of the quantity used by farmers. He also opined that the rates should be within the capacity of the farmers (in terms of net benefit from the crops), should at least cover the operation and maintenance costs of the projects and be revised from time to time.

Singh (1978) proposed a method for pricing canal water and suggests a practicable and relevant pricing policy. He asserts that pricing should take care of both the supply side, i.e., cost incurred in supplying water to irrigators’ fields and the demand side i.e., the direct benefit realised by farmers from irrigation. In determining the
water rates for irrigation, the cost (including the fixed cost and variable cost) of supplying water serves as the lower limit and the additional net benefit realised by farmers due to the use of water serves as the upper limit. The price should be determined on the 'no-profit-no-loss' basis and by making some adjustments in water rates calculated for different reaches of canal.

Taylor (1971) found that the irrigation projects fall under the category of decreasing cost industry and that the benefits of irrigation were spread over a wide range of people, with some enjoying benefits directly while others realising them indirectly. He opined that the prices of irrigation water should be charged on volumetric basis to reduce the wastage of irrigation water due to over-irrigation and field level losses. The author suggested that the government through different policies like giving incentives to certain crops, and ensuring remunerative prices for certain crops could facilitate the adoption of socially desired cropping patterns and practices. He also argues that by raising the water rates greater social justice and social equality could be achieved.

According to the Uttar Pradesh Irrigation Rates Committee, (1939), the value of water was a function of the cost of supply and the increase in the value of the produce from the land irrigated. In its opinion, water rates should vary within these two limits. The Committee recommended that the water rates should be so fixed as to offer sufficient inducements to irrigators but prevent them from extravagance or wastage of water (NCAER, 1959:64).
2.6 Concluding Remarks

An extensive and thorough review of the literature reveals that the prevailing water rates of major and medium canal irrigation projects in different states of India vary from state to state, from crop to crop, from season to season and even from project to project depending upon the variation in the considerations involved in determining them. The rates as exist in different states of the country are too low to cover even the operation and maintenance costs of the projects. This underpricing of canal water is one of the most important causes for its huge wastage. As it has been found that because of the very low water rates farmers are always found having a tendency to over-irrigate their crops. The poor collection of revenues from irrigation has resulted in poor maintenance of the irrigation channels, reservoirs. Expenditure on irrigation projects always exceeds the revenue receipts and necessitates huge subsidies in this sector which becomes a growing burden to the state exchequer. And unchecked continuance of this situation since independence has resulted in a progressive and fast deterioration in the financial performance of the irrigation projects in the country. Moreover, the existing low water rates have not been revised for a long time, in some cases for a decade or so while the general price level and the prices of the crop produce have gone up considerably.

The water rates are fixed on the basis of some ad-hoc and arbitrary approaches instead of some scientific and rational ones. In determining the rates there is hardly any consensus about the existing methods. As regards the benefits of irrigation, it has
been very well established many times that the capacity of the irrigators has increased considerably and that they could bear higher water rates.

While dealing with the pricing problems it has been felt by many scholars that the precise estimation of benefits and costs of irrigation projects is very difficult as some of the benefits and costs are diffused and not measurable by simple methods. The data gap and lack of appropriate techniques in measuring those benefits and costs make the pricing of canal irrigation water a complex problem and hence, there is a lack of specific and clear-cut guidelines to fix uniform water rates. As a result of this, different state governments administer different water rates to suit their own purpose and depending upon varying considerations.

To conclude, it can be said that to prevent the increasing financial deterioration of irrigation projects and to rationalise canal water pricing policy, a thorough restructuring of the water rates is urgently required as has been recommended time and again by several scholars.