CHAPTER III

A REVIEW OF SELECTED LITERATURE
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In the present chapter an attempt is made to review the literature pertaining to different aspects of irrigation and its impact on certain important variables having a bearing on agricultural development. Such a review would enable us to develop the necessary insights and comprehend the problems associated with irrigation as a strategic input in agricultural development.

Irrigation development is beset with a wide range of problems and constraints as observed in the preceding chapter. However, notwithstanding the shortcomings in its performance, irrigation has assumed greater significance in developmental planning, especially of third world countries, for it holds key to increase much needed agricultural production. Therefore, attempts were made by several scholars, from time to time, to diagnose the reasons for presumably less efficient performance of irrigation projects, particularly of large systems and also the need to irrigate the dry land for more output. In this chapter a review of select studies on various issues of irrigation is presented.

In order to examine effectiveness of irrigation, particular attention is to be given to comparative studies on dry and wet (irrigated) lands, literature and ongoing research studies in the country and also other parts of the world. For it enables to understand the problems, constraints and issues inhibiting the efficiency of irrigation, other than the positive effects.

Scarlet Epstein T. (1962) - Being an economist, Epstein's first task has been to describe what is happening in the two study villages Wangala, a wet village and Dalena, a dry village. She collected innumerable statistics of income, expenditure, cost, capital, distribution, the balance of payment and
other quantitative expressions which gives a full account of the results of economic activity. The other area she happens to look into as a good anthropologist is by collecting data on social institutions on kinship, caste, class, religion and political allegiance. Here she uses both the data to show how institutions have respondent to changing opportunity. Further her emphasis was on the effect of economic opportunities on social institutions - she rejoices because economic progress was favoured and she was glad that incompatible social institutions could not stand in its way.

Other than studying Wangala, under three aspects of economic, political and social organisation and change she compares the same with Dalena, with the same parameter.

Scarlet Epstein T. (1973)\(^2\) - "I studied the impact of irrigation on the economic and social organisation of two villages within a regional economy. Dalena, a dry, and Wangala, a wet village are situated close to each other within the same culture area near Mandya town in Mysore State, South India". Epstein revisits the villages after a span of 10 years and closely observes and argues the constant counter posing both in space and time of Dalena and Wangala. This book is simply an elaborate gloss acutely and meticulously worked out in the context of Indian rural development. She tells about the South Indian farmers who grows richer and richer on the one hand and the poor goes poorer. In the study the author along with her co-workers studies the village indepth to find out the changes which has come about after her earlier studies which highlights social, political and economic aspects. Also she talks about the villages under study which was in the past the present and might be in future. The author distinctly brings out the difference of the two villages and points out the economic prosperity of Wangala when compared with Dalena. Due to serious competition from outsiders, the potters and goldsmiths have more or less surrendered their craft occupation. Further irrigation on the rural hinterland results in
increased productivity which in-turn encouraged in faster rate of urban expansion offering more and more commercial and employment opportunity. Another most important for villagers in the area was the improved schooling facilities provided. Significantly the author puts on record the increase in land price between 1958 and 1971. She tells that there is 330 percent increase in wet land price in Wangala which happens to be wet village while in Dalena the wet land prices are still higher than Wangala.

Scarlet Epstein T. Suryanarayana, A.P. ,Thimmegowda, T. (1998)\(^3\). The trio authors brings out a book on forty years of rural transformation where the researcher- Epstein continuously visits the sample villages Wangala and Dalena to study the gradual change due to irrigation and the other without irrigation. During the process of study, other than looking into the social, political and economic aspects, the researcher observes forty years of change which is interlinked with all the three above said variables.

Research Assistant, Suryanarayana, while describing his first experience of the village life compares both the villages with social amenities and economic amenities available with the village from the past 40 years. However, Thimmegowda takes the opportunity as a villager (of Wangala) to describe its traditional social system the economic and political change and also puts across the pros and cons of socio-economic development. Scarlet however, after taking into account the changes taken place in the society predicts what the future holds for the village. She discusses of seven different problems such as social awareness, population growth and development, rural development and growing water shortage, role of women in rural development, appropriate education, political decentralisation and participatory administration and finally democracy, political parities and village fractions.
Rajapurohit A. R. and Mabel Koilpillai, The duo authors looks critically into the two studies by Scarlet Epstein, a Social Anthropologist, on impact of irrigation on rural communities in South India. At the meso-regional level, they set hypothesis which they hope to test in their future investigation. The main item they set to find solution are first, large scale migration of labors from dry village to near by town. Secondly, labour migrated from dry to wet village within the region. Thirdly, large scale migration of the labour from outside the region to the wet village. Fourthly, the scheduled cast population always said to be at a disadvantage in the case of the three courses of labour migration (mentioned above). Fifthly, the wet villages would follow the path of economic introversion by concentrating on agriculture. Sixthly, the dry villages would diversify their economics and embrace non agricultural pursuits.

After analysing meso-regional level study the authors come out to prove the hypothesis with supporting statistics. They say it is locational factor which influence the concentration of agricultural workers and not irrigation alone, thus the study repudiate the hypothesis the wet village would follow the economic introversion by concentrating on agriculture. Another aspects which they come across is that of population exodus that took place from the villagers nearer to town, more scheduled cast persons left the villages than the non schedule caste persons. It is also found that the outsiders who migrated the village situated beyond five kilometers within ten kilometers from Mandya town mainly belong to non scheduled caste. Finally it is found that Mandya town received the schedule caste and non scheduled cast population in almost same proportion. Thus the meso-regional evidence permits to repudiate three of the four above said hypothesis urged upon by Epstein.

Ramakrishna Reddy, K. Significance of Indian agricultural economy is not debatable. Here different strategies were adopted from time to time like Co-operative Farming, Intensive Agricultural District Programme (IADP), Green
revolution and Integrated Rural Development Programme. Irrigation is said to have direct bearing on agricultural strategies in India. An assured water supply helps increase farm yield and income and facilitates increased capital formation. Irrigation in India performs protective and productive functions where protective irrigation makes the moisture deficiency in soil to ensure the healthy growth of crops and the productive irrigation helps to raise the second and third crop. Irrigation also creates employment in predominant agricultural economy.

The author focuses is study on Anantpur economy of Andhra Pradesh where agriculture is the mainstay and more than 3/4 of total work force is engaged in agriculture sector. Perennial rivers are absent in the rain fall is lowest in this district in Andhra Pradesh. Thus as the irrigation facilities are meager, tanks and wells constitute the major source of irrigation followed by canals and other sources. It is however, concluded as between the wells and tanks, as the constituent source of minor irrigation too pronounced a priority for wells over tanks may lead to mortality among wells and unarrested indifference towards tanks.

Kanaka Manjari Mishra,6 Irrigation paves way for adoption of multiple cropping and use of modern inputs including improved varieties of seeds. Thereby, enhancing agricultural production. Crop yield is stabilised by saving crop from drought situation and thus increases employment potential in rural areas through changes in the cropping pattern. In view of such high importance of irrigation in predominately agrarian economy, a heavy investment as already made during the previous plan periods and development of irrigation and a substantial outlay is likely to be incurred on this account in the years to come. The expenditure as to be realised at least partially from the cultivators for reinvestment through which this different task has to be tackled. The author mainly focuses on the irrigation rates in Orissa and their by infers that, to improve irrigation facility, there
should be fixed time limit for each project which should to be strictly adhered to. Secondly, once a project, its financial estimates are approved, on no account, additional sanction should be made. Finally there should be complete list of investigated projects which can be taken in short notice and completed within a short period of one or two years there by reduce gap between contemporary cropping pattern and recommended cropping pattern. Thereby, help in effective utilisation of irrigation water.

Carruthers, I.D. and Clayton, E.S.⁷ say that post-project evaluation studies are undertaken to provide feedback to planners. Thus, intended goals are being met and identify possible weaknesses in projects, thereby, meet the conditions of international lending agencies, and learn from previous experiences for a more realistic and effective planning of future irrigation development projects.

Ian Stone⁸ says that various historical studies on the impact of irrigation on Indian agriculture have pointed out that the availability of water crucially determines the nature of agricultural production. Backwardness in a region may be due to differences in terrain, climate, rainfall and similar other factors. Irrigation in such cases helps a great deal in reducing the disparity. Irrigation is a tool by which land is made useful in both cases; in the drought-prone areas by providing water for the land, and in waterlogged areas by draining water out of the land.

The increasing outlay on irrigation, in the successive five year plan, shows its importance in the country's developmental efforts. It is necessary to examine the magnitude and spread of benefits from irrigation projects. Prior to the planning era, irrigation works being mostly minor projects and river diversion schemes, the concern for evaluating benefits was, understandably, low. However, the shift towards capital-intensive major and medium irrigation projects in post-independence period, created awareness among planners, bureaucrats, technocrats and social scientists
of the need for evaluating the benefits of huge investments in irrigation. In order to establish economic viability, social desirability, environmental safety and clientele acceptability of the benefits from irrigation, a critical examination of its impact is desirable.

Procedural questions requiring attention in post-project evaluations are:

a) How long projects must be in operation until their benefits mature to a point where it is meaningful to quantify the benefits; and

b) Over what period an evaluation should extend to permit satisfactory analysis of year-to-year variations in such factors as weather, pests and prices. Donald C. Taylor (1980)³

Dhawan's ¹⁰ study points at several important features;

1. The productivity differences between irrigated and unirrigated lands vary a great deal between the states.

2. This differential is inversely related to rainfall, i.e. the irrigation impact is greater (less) in areas of lower (high) rainfall.

3. Given rainfall, differences in fertiliser intensity seem to have a significant bearing on the magnitude of gains in productivity from irrigation.

Thus, the author insists on the need of irrigation in underdeveloped areas to remove or lessen inter regional disparity in the levels of development.

The studies on irrigation impact are mainly of two types, namely, longitudinal and cross-sectional. A comparison of actual after project performance with before-project situation is longitudinal approach, while 'with - without' project comparison is cross-sectional study. Longitudinal studies are possible where pre-irrigation Socio-economic bench mark data are available. Since suitable Socio-economic bench mark data often are not available and the length of effective memory recall for most respondents, especially for detailed
quantitative data, is limited, this approach is considered erroneous. The major limitation to 'with -without' approach is possible difficulty in finding a without - project situation that can be considered similar in all respects, except the presence of irrigation, to the with-project situation. In practice, however, it is frequently possible to make a close enough guessimate for this approach to be used. Donald C. Taylor. Thus, the majority of studies use the with-without approach.

Review of available literature on a particular issue or topic helps identifying the research gaps and even focus on dimensions of problems. Examination of divergent issues studied by different scholars tends to provide meaningful solutions that fit into general policy framework. Let us first look at some studies, if any, done during the colonial period. It will not be surprising to learn that the concern for evaluation of canal irrigation was quite evident even during the colonial period. The bases of such concern may, however, be different from the present ones. They seem to have primarily concerned with the results of irrigation in general and revenue collection to the government in particular. The evidences of some pioneer attempts in this direction dates back to 1858 when an official publication entitled "Reports on the Direct and Indirect benefits of the Godavari and Krishna Anicuts", was brought out in Madras. One of those reports by Taylor on the direct and indirect benefits of the Godavari Anicut in the Rajahmundri District (Now in East Godavari District of Andhra Pradesh) is a pioneering work on the subject. Gadgil, D.R. The study addresses primarily to the role of irrigation in increasing revenue of the government. It also points out to the potential for employment generation, production and productivity increase and consequent increase in trade activities. The thrust of the study is perhaps justified under the existing political and administrative trends of that period. An attempt to look at the
benefits of irrigation is, however, well in order and trend setter for future evaluation studies.

Patel and Patel\textsuperscript{13} in their study observed that the employment of human labour in the irrigated farms is higher by 34 man-days per hectare or by 61 percent over the one used in the rainfed farms. In the same way, population size of the villages also influenced the percent of workers to total population. In general, the percentages were higher in respect of the bigger villages. Similarly, the irrigation levels also influenced the percentages in a remarkable way. Irrigation levels, associated with population size and distance from town greatly determined the percent of workers to total population.

In the early part of the present century, little systematic efforts were made to measure the benefits of irrigation. Kanwar Sain\textsuperscript{14}, refers to the increased return to the cultivator from irrigation in the form of increase inland values and additional income from farm products. He suggests that a part of the increased land values due to irrigation need to be credited to irrigation projects. Perhaps, this reference about crediting irrigation projects with part of the increased land values must have, later on, resulted in present day betterment levy.

Gadgil's study,\textsuperscript{15} a cross-sectional one, covering two irrigated villages from the Godavari and Pravara canals, and two un-irrigated villages from the adjacent area, is first of its kind in evolving a systematic methodology to inquire into the direct and indirect benefits of irrigation. In the introductory note, he refers to the nature and scope of earlier studies and points out that no systematic efforts at exploitation of the area under command had been made and the government had adopted an attitude of complete laissez-faire towards farming community. Therefore, progress had been uneven and not very rapid. This he attributes, though not explicitly, for lack of
administrative planning to support irrigated agricultural programmes to help traditional farmer exploiting benefits from irrigation.

Economic returns from irrigation have been classified into two categories, namely, direct and indirect returns. The direct benefits include cultivation of high value crops leading to higher production, income and employment potential. On the other hand indirect benefits give rise to demand for labour, accessories and materials leading to economic activities relating to production, trading and transportation. The increase in agricultural production as revealed by the study may surprise none, as it is most obvious. But the inequitable distribution of those benefits is a matter of concern. For, irrigation is expected to reduce income inequalities in the countryside. The study reveals that at the tail-end of the canal, the effect is almost nil in terms of the actual increase in production in any particular year. Employment has shown an increase in irrigated areas. Immigration of agricultural labour during harvesting season has been a significant feature. The factors contributing for inequitable distribution of water and consequent inequalities in income have not been identified. This is an area where further research, probing into the issues and problems inhibiting the irrigation efficiency is necessary.

Many studies on irrigation in post-independence period have covered a variety of obvious, observable problems of irrigation development.

Savale study depicts that the irrigated farm could thus employ almost 5 1/2 times more than human labour and 2 1/2 times more of bullock labour as compared to similar size of dry farm. The growth of employment due to adoption of new technology is considerably higher in unirrigated area. Increase in irrigated area and technology inputs like high yielding variety and fertilisers have lead to increase agricultural output and increase labour utilisation. The author mansions that even a successful agricultural
production development strategy, however, can only partially absorb the growing agricultural labour force.

Karl A Wittfogel\textsuperscript{17} describes the characteristics of hydraulic economy. According to him, irrigated agriculture has three characteristics: (a) it involves a specific type of division of labour, (b) intensifies cultivation and (c) necessitates co-operation on a large scale. The third characteristic has been described by a number of students of oriental farming. The second was frequently noted but rarely analyzed. The first has been given practically no attention. The neglect, according to him, is particularly unfortunate since the hydraulic patterns of Organisation and operation have decisively affected the managerial role of the hydraulic state. This, in effect, hints at inadequate administrative planning.

Baldev Singh\textsuperscript{18} in his study says that increase in mandays per acre of irrigated over unirrigated land in certain crops is higher than the increase in output per acre. For all crops in Amritsar and Ferozepur, it is observed that both output and employment per acre of irrigated land have nearly doubled to that of unirrigated land.

Some other scholars have tried to project the potential benefits from irrigation. A study, by Sovani and Rath\textsuperscript{19} on Hirakud Dam in Orissa attempts to provide a systematic theoretical base for projecting economic benefits of an irrigation project. The objective was to assess benefits which might accrue in future because of the construction of irrigation project. The results based on assumptions may be far from reality in view of the diversity of resource spectrum in a project. Their assumption of 20-21 years for maturity of benefits from an irrigation project needs to be taken with caution in view of modern farm technology. The view that farmers will not switch over from traditional cropping pattern lacks empirical support.
However, the warning about adverse effects of irrigation is timely in the wake of expansion of major irrigation in the country; "irrigation is known to produce water logging and damage to soils by salinisation, if not properly handled". The pointed reference to ground water rise in the canal commands underlines the importance of drainage and conjunctive use of canal and ground water. The results are, however, more philosophical in nature opening up several issues for further research, especially adverse effects on soil and its impact on environment.

Mellor also underlines the importance of linkages for economic growth in developing countries. He visualises a definite increase in agricultural incomes after irrigation and expects a strategy be evolved to plough black the surplus incomes locally in a more efficient way. These observations reiterate the need for administrative planning in irrigation command area.

According to Lakdawala, expansion of irrigation and the spread of new technology should be the main planks of a programme of improvement in the standard of living and the generation of employment in the standard of living and the generation of employment opportunities at the required level of productivity.

Dhawan examined the magnitude of increase in farm income due to canal irrigation in Gima and Ghod Command in Maharashtra. He opines that introduction of irrigation has, no doubt, increased farm income but has also increased the absolute income differential in the farm sector in the two commands. The larger farmers, according to him, on account of superior access to all inputs—irrigation, credit, extension services, education and communication—have gained greater advantage of income benefits per unit of irrigation as compared to small farmers. However, this observation lacks empirical support.
Ghosh, M. G.\textsuperscript{23} says that the labour employment went up by 145 per cent due to two factors, viz., (a) increase in the cropping intensity and (b) higher labour needs of the high-yielding seeds of rice.

Deridder and Erez\textsuperscript{24} say that irrigated farming is the transition from a complex and traditional way of farming to new modern agriculture and its social aspects must be fully understood before decisions on costly investments are taken. The planning and development of agriculture is not just a matter of design, implementation and operation of a modern water supply system. Irrigation methods, Water distribution strategies to ensure adequacy and timeliness need to be well articulated to enable farmers to understand them and switch over to irrigated agriculture. For, yields of crop depend to a great extent on availability of water in right time and in right quantity.

Charan\textsuperscript{25} found that the gross returns in different sizegroups were two to three times more on the irrigated holdings as compared to unirrigated holdings. Similarly, the total mandays of employment are significantly higher on the irrigated holdings as compared to the unirrigated holdings.

Hudson\textsuperscript{26} emphasises the need for including economic forces in water distribution system design. But he found in his study in Utah Valley, that many farmers respond slowly to changing economic conditions because of shifting land tenure, fixed water rights and limited information.

Adinarayana\textsuperscript{27} study shows that the increase in the employment of human labour on the irrigated farms is more than one hundred per cent. The increase is not only due to irrigation but also due to inclusion of high proportions of labour intensive non-foodgrains crops in the cropping pattern of the irrigated farms.

Pasandaran\textsuperscript{28} focused on the concepts and procedures used in allocating and distributing water within irrigation systems. He describes certain
systems of irrigation management in the Pakalen Sampean Irrigation Project in East Java, Indonesia, and analyses the effects of water availability and water management decisions on cropping systems, intensities, and yields. He says that two types of decisions-on planning and operation-are important in managing irrigation water. The 'Pasten' concept (the relationship between the water supply that is available at the intake gate and turnouts, and the water needed by crops at different growth stages) which he illustrated in the study has practical relevance in estimating realistic irrigation potential. His estimation of demand for water by using indices of relative irrigation requirements for various crops at different growth rates, is ideal for fixing the expected area to be irrigated with a given supply of water.

He concludes that in the blocks with plentiful supply of water the yields are high. Of course, it is obvious. But, his example of tertiary blocks with lowest water supplies having largest area under paddy with higher yields than in the blocks with abundant water supply needs explanation. There must have been differences in soil types and water management practices. In the blocks of lower supply is at the cost of other non-remunerative crops.

Maji and Sirohi study shows that the intensity of cropping in the irrigated area was 157 per cent as compared to 100 per cent in the unirrigated area. The gross returns of the farms were Rupees 419.81 and Rupees 1,053.22 per acre in unirrigated and irrigated areas respectively. This indicates that the per acre gross productivity in the irrigated area registered an increase of Rupees 633.41 (150 per cent) over that in the unirrigated area. The above facts bear testimony of intensive use of land and other resources and ought to be regarded as the impact of irrigation.

Thavaraj, in a study on Muda Irrigation Scheme in Malaysia, emphasised the importance of integrating non-engineering aspects in irrigation system design. Many irrigation projects, according to him, have fallen short of
expectations. It is partly because the design was based solely on technical considerations. This is believed to have led to cost escalations, subjecting irrigation to poor performance. This calls for distillation of past experience to facilitate incorporating corrective measures while designing new projects.

Thavaraj is of the opinion that the design of irrigation system for long-term stability must include not only engineering considerations of water storage, conveyance, and delivery, but also agricultural, economic, social, political, legal and environmental considerations. He underlines the importance of multi-disciplinary approach, in which each specialist understands the interaction between his discipline and that of his co-workers, to integrate various factors into a final design. Specialists from various disciplines like engineering, agriculture, soil science, economics must collaborate from the outset in the design process of problem identification, data collection, field investigation, design analysis, pilot testing, selections of final design, and project implementation. He concludes by saying that the creation of engineering hardware is not an end in itself but a means to provide an environment favourable to crop production and increased farm income.

Kahion, Miglani and Singh's study explains that cropping intensity in the irrigated area (131.62 per cent) was found to be substantially higher than in the unirrigated areas (88.87 per cent).

Leentton examines some techniques to measure productivity and equity in large scale irrigation systems. He measures productivity with reference to quantity and timings of water delivered to farmers and crop yields from irrigated land. Measures are the variability of water delivery or yields between individual farmers located within the command of an outlet, or minor, distributory, branch or main canal system.

Patel found out that cropping intensity for the irrigated farmers in small, medium and large size-groups and at the aggregate level is higher by about
28.5 per cent, 19.8 per cent, 16.8 per cent and 19.9 per cent than that for dry farmers in small, medium and large size-groups and at the aggregate level respectively.

Rajagopalan and Sivanappan\textsuperscript{34} found that yield variability is not due to water use alone, and it is contributed by many other factors. This observation, explains the need for identifying various technical, economic, social and institutional parameters that interact in irrigated agriculture.

The study on the impact of irrigation on rural development, as per Nadakarni,\textsuperscript{35} adopted a different approach. The impact was measured through a comparison across villages, not by usual method of comparing output and income from irrigated and dry holdings within a village or irrigated and dry plots within a holding. This was done with a view to assessing the impact on the development of village as a whole, including its weaker sections. The study covered 15 villages in Karnataka, Andhra Pradesh and Tamil Nadu and presented a comprehensive picture of irrigation impact. Apart from the need to make irrigation management itself more efficient and meaningful by making it apart of an overall strategy for coordinated management of land and water, involving popular group action where necessary. Irrigation as also to be viewed only as a part of an overall strategy for rural development and cannot be wholly identified with it.

Mitra \textsuperscript{36} referred to the irrigation potential created and actual utilisation in the study of Mula irrigation project in Maharashtra. The gap between irrigation potential and utilisation in major irrigation projects is viewed as a major problem by the planners and bureaucrats in the context of increasing cost of construction. Mitra is of the opinion that there is a need to define irrigation potential in the context of overall on-farm development strategy. He emphasised the importance of examining reasons for the low and the variable percentage utilisation.
Patel and Patel study reveals that the cropping pattern and input structure in the irrigated farms are distinctly different from those observed for the rainfed farms.

Tripathy emphasised the importance of Command Area Development Authority for optimum utilisation of irrigation potential created. He considered on-farm development as the chief function of Command Area Development Authority and compared productivity of crops with and without on-farm development works. According to him on-farm development has promoted better water utilisation resulting in higher yields. There is a need to probe as to why farmers are not taking up on-farm development works inspite of its positive on overall farm business.

The foregoing review shows the dynamic and complex nature of irrigation system building. A wide range of issues related to revenue returns, direct and indirect economic benefits to the region in general and to the farmers in particular, irrigation policies and programmes, on-farm development, environmental issues and water management has been addressed to by several scholars. It is clear from the review that though irrigation is a complex social system, apart from being an engineering system, mostly the problems are looked at in isolation. Further, majority of the findings lack empirical support; with the result, one may tend to get an impression that they are opinionistic, being mostly philosophical in nature. Longitudinal approach to evaluate irrigation benefits seems to be a rarity. With the result, it has become rather difficult to establish causal relationship between various factors affecting irrigation efficiency. Hence, there is a need for a longitudinal study covering most, if not all, of the factors related to irrigation development.

This study tries, in a modest way, to examine comprehensively the problems and prospects of irrigation in canal command areas. The
approach and thrust of the study are different from earlier studies at least on two aspects: (a) it is a longitudinal study and (b) the thrust of the study would be a clientele a dimension. There is hardly any study which has examined the views of the beneficiaries about various irrigation programmes and policies. With the result, farmers knowledge and understanding of the irrigation-related factors and impact on implementation of Command Area Development Authority programmes has remained unexplored. One really does not know as to how the inadequate and improper understanding by the farmers of the new technology influences the irrigation efficiency in general and productivity of crops in particular. At the same time, the limitation of a researcher to cover entire range of problems associated with irrigation should be appreciated. Keeping in view the constraints of time, resources and other necessary wherewithal, the study confines to a few important factors relating to efficient and effective utilisation of irrigation potential created.

Colin Clark, 30 in the preface of his book "The Economics of Irrigation" has narrated the problem of irrigation rates. Where he says, "Some advocates of irrigation not only fail to understand economics but the simplest principle of accounting as well and are unable even to distinguish gross from net return". In chapter Six of the same book, he has further categorically stated "Charges made for irrigation water are often well below cost". He has extensively studied the amount of irrigation rates for a vast part of the world, like Australia, India, Pakistan, Kenya, France, Italy, Germany, America and has based his conclusion on careful selection of data.

Before independence, irrigation projects were required to satisfy a financial criterion for sanction. They had to be financially viable and show a profit. However, in the case of protective irrigation works, which were a few and far between, this requirement was relaxed. The benefit-cost criterion was first mooted for adoption by a study group headed by Prof.D.R.Gadgil. 40
This criterion was also recommended by the Nijalingappa Committee in 1964 {The Committee to suggest Ways and Means to Improve the Finance returns from the irrigation projects, Government of India, Ministry of Irrigation and Power (1964)}. The Gadgil group stated that, "benefit-cost ratio is not a faultless criterion and we do not want to minimize its defect."

The economic criterion to be applied to irrigation projects should also give a satisfactory means of comparing the relative economic worth of a number of projects for fixing their inter-state priorities. This would require a change from the criterion of benefit cost ratio currently in use. The internal rate of return criterion has widely been used for evaluating projects posed for loans. The National Commission on Agriculture favours the departure from the benefit-cost criterion and recommends this new criterion for future adoption.{ Report of the National Commission on Agriculture, 1976, Op.Cit }

Conclusion

The foregoing review indicates that many attempts have been made in the past to assess and evaluate the impact of irrigation on important facts of agricultural development. These studies reveal that there have been marked changes in the cropping pattern, cropping intensity and incomes of the farmers due to irrigation. Besides, irrigation has also helped in increasing employment of labour and gross returns. Irrigation leads to higher level of input; results in higher per hectare yield on the irrigated farms as compared to the dry farms.

Regarding the impact of irrigation on production and productivity, almost all the studies have found that irrigation makes a difference to production and productivity. The net returns per rupee of capital invested on irrigated farms are relatively higher. Net returns from 7.5 acre of irrigated farm are almost
equal to a 60 acre dry farm, showing a large potential for irrigation in agricultural development.
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