CHAPTER 1

INTRODUCTION
CHAPTER - I

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In India, agricultural sector is the major sector with 70 percent of its population depending on it for livelihood. The increasing population and the scarcity of agricultural land responsible for an increasing imbalance in the demand and supply of agricultural products calls for alternatives to increase the supply of food and fibers. Various measures were taken in the Five Year Plans to increase agricultural output to meet the growing demand of the increasing population. This progress measured in terms of rate of growth in overall agricultural output initially came from the increased net area under cultivation. It was soon realized that net area under cultivation could not increase indefinitely and that, therefore, the rate of growth in agricultural output had to primarily depend on increase in productivity per acre and also an increase in the gross cropped area.

To compensate the increase in consumption of food as a result of mounting world population and its side effects already showing, the farm produce has to increase. The increase in agricultural produce depends on either the availability of cultivable land or on the usage of it. Cultivable land in the world is limited. It is difficult to engage full-time in a particular area where farming cannot depend on irregular and insufficient rainfall. Inspite of geographical and natural limitations, planners have to find an answer to the food problem facing the exploding population. The most likely solution lies in giving importance to utilizing waters of major rivers and irrigating the available cultivable dry lands. In this context the role of irrigation is crucial. Irrigation is the pre-requisite for the adoption of new technology in agriculture and for the rapid growth of agricultural sector. Irrigation tends to provide for intensive use of available lands and also cultivation of high-yielding hybrid-varieties of seeds, can augment agricultural production. It is said that as much as 80 percent of the required increase in food production
over the next few decades has to come from yield increase\(^1\). Irrigation is one of the critical factors in the growth of agricultural production in many developing countries, especially in South and Southeast Asia\(^2\). Canal irrigation is a direct source of livelihood for hundreds of millions of the rural poor of the developing world\(^3\). In a country like India where agriculture perpetually gambles with Monsoon, Irrigation acts as a protective and stabilising factor. However, irrigation is not merely a protective factor but also a productive one.

Recognising the importance of irrigation and the fact that the water is a scarce resource, it should be used economically and efficiently. Investment on irrigation can maximise the benefits only when it is made on right mode of irrigation at right time. The relative importance of various modes like canals, tanks, wells and others depend upon the physiography and climate of region. However, it is necessary to make use of the scarce resources, in the best possible manner, wherever and in whatever from, it is available\(^4\).

All civilizations and culture around the world began with agriculture. Man lived in caves and hunted for food. When he did not get animals, he began to eat roots and fruits and slowly began to grow such vegetables around his habitations and thus began agriculture. Researchers believe that every culture had its origin in agriculture\(^5\).

Agriculture, which began as a source of livelihood in our country became a tradition and a culture and became an inseparable part of our folklore. Thus, culture which began as the first occupation of man blossomed naturally with no interference what so ever of religion creed caste or subcaste. Once considered as a very sacred work, agriculture was counted the foremost of all work in the society. Those engaged in farming alone were known as Krishaks or Ryots. Spread all over India in different
provinces and speaking different languages, these farmers, have been facing a lot many problems.

All civilizations around the world have their origin on river banks. The importance of rivers for the all-round development of a nation and the country hence is obvious. The ancient civilizations have sprung on rivers like that of River Nile and River Sindhu. Not only man has benefited by the rivers but also all living creatures and all plants and trees depend on rivers as life sustaining source. Water is as essential as sun light or air. All great townships around the globe have born and been nourished and agriculture developed in river basins only. In India rivers like, Sindhu, Ganga, Yamuna, Brahmaputra, Krishna, Cauvery, Godavari and so on have become inseparable part of our culture. Rivers have thus come to play an important part in our lives.

In fact irrigation has proved, in certain large pockets of the country, a catalyst of improved agriculture especially where cash crops are grown. Investment on irrigation leads to multiple benefits both at the micro and at the macro levels. Irrigation enhances the income of the land owners by way of capital gains. The value of wet lands is considerably more than that of dry land. Investment on irrigation leads to conversion of dry land. At macro level, irrigation provides security against the vagaries of rainfall and prevents crop failures enabling the country to get higher yield. Sometimes it also helps to take two crops from the same field each year and thus increase the productivity of land. Besides these, irrigation helps generating employment, adoption of new technology and also supports many agro based industries.
Irrigation in India

India’s natural resource is as good as the natural resources found elsewhere in developed countries. There are millions of acres of exquisite land here. For people here, it has been an ingrained quality that every work is considered holy, be it temple building or irrigation. They are no lesser than people in developed countries, going by their wisdom and eminence. But the only and major drawback of people here is that they are lethargic and don’t work hard. Though there are major rivers and their tributaries that flow through the length and breadth of this country, yet there are few dry areas left to the mercy of the annual rainfall. For example excepting river Sindhu and river Ganga regions in the North and also the West coastal regions of the South, most parts of India experience arid conditions and the condition worsens when there is little rainfall and there is scarcity of even drinking water for animals and human beings. If the condition persists in the following years too it will lead to drought, famine and utter chaos.

Irrigation, as an important means for agriculture was acknowledged by our ancestors. Taking into account the varied geographical conditions which include the ups and downs of the land surface, the available water resource was put to use by these ancestors who constructed wells, ponds, lakes, dams and canals using home-devised techniques.

Irrigation is the process by which water is artificially diverted to lands where by it helps grow crops. When water comes from a higher region to a lower one and it irrigates the land such irrigation is known as “flow irrigation”. When water is mechanically made to flow from a lower level to higher level such irrigation system is known as “lift irrigation” (example pumpsets). There are three types of flow irrigation:
Perennial Irrigation: Water can be supplied whenever there is a need for it. There is a continuous supply of water here, because there is water throughout the year for irrigating lands. Inundation Irrigation: In this type of irrigation system, the excess of water overflowing rivers at certain points is used to irrigate lands. This system of irrigation is possible only during monsoon rains. Flood Irrigation: This type of irrigation is practiced in Egypt and Sindh where flood water is stored from time to time during floods and utilized for irrigation purposes. The top soil here is watered by flowing waters and thus a fertile land is prepared for cultivation.

History of the Development of Irrigation in India

While the problems besetting the building of an efficient and effective irrigation system are many and varied, some reflections on historical contexts and problems tend to provide meaningful insights to the nature of issues involved. The development of irrigation is very important because by this famine and drought conditions can be kept at bay. It may also help understanding and appreciating the present problems in proper perspective. During the rule of British company in India there were a total of 16 years of drought, and famine in various parts. After 1857, during the direct rule of the British Empire, 10 extensive great famines were experienced. Later while the terrible famine of 1866 claimed about 10 lakh lives in the old province of Orissa, the famine of 1876-78 took a toll of millions of lives. Such other famines were experienced during 1896-97, 1899-1900, 1906-07, 1907-08. Even after these famines, more drought conditions were felt in later years too.

This kind of drought condition could be controlled by taking apt measures in water management. All the said famines were as a result of poor rains and lack of enough irrigation facilities. The evolutionary processes of irrigation development seem to have been shaped by climatic and
geographical factors like, rainfall pattern, river basins, topography and soil characteristics. For example, in the arid and semi-arid regions where rainfall is low and erratic, tanks were constructed to store the surface run-offs during monsoon. Diversion weirs and inundation canals came into existence in deltaic regions and high rainfall zones where perennial rivers flow. Mining of underground aquifers took place in plains and in the vicinity of potential surface run-off and stream flows, where the intrinsic permeability of the soil and other earth materials through which water percolates to reach the zone where the process of saturation is high.

Apart from environmental compulsions which have presumably shaped the types of irrigation systems, enlightened self-interest of rulers was also the prime mover of water resources development in ancient India. It is said that all the Pre-British works were not necessarily for irrigation. For instance the prime aim of constructing Western Jamuna Canal was for the supply of water to the Moghul Emperor's hunting grounds at Hissar, while Ali Murdan's extension to Delhi was intended to feed the fountains and gardens of the imperial palace. Pre-British works were essentially based on simple and less costly structures. For instance, the systems taking off from the Yamuna and others in and around the Doab, shared the characteristics of avoiding high ground by following the course of rivers and drainage lines wherever possible. These crude works were thus vulnerable to the effects of floods and silt deposits. They were also causing swamps and damages to low lying land and were of limited use for purpose of irrigation. Keeping the limit and location-specific objectives in view, the systems were designed and executed either by the benevolent rulers or by the beneficiaries themselves. In the process, the integration of irrigation related processes seems to be a casualty even in the relatively small and less complicated systems in ancient times.
The advent of British rule in India has added new dimensions to the development of irrigation. British rulers could quite understand the productivity potentials of fertile Indian soils and their suitability to grow commercial and other food crops. With a view to promoting agricultural development for meeting challenges of frequently occurring famines attempts were made for bringing more area under irrigation. With the result, new irrigation schemes were initiated, in addition to improving tanks and inundation canals built by earlier rulers in several parts of the country. Canal building activity in India commenced in 1817 and was initially confined largely to the plans, north of Delhi and the deltaic region of Madras. Most of the early British schemes were, in fact, rehabilitated and extended versions of indigenous works found in various parts of the country. Some of the diversion schemes like upper Ganga canal, Upper Bari-Doab canal, Krishna and Godavari delta systems are important ingenious ways of harnessing major river flows during the British period. They were able to construct many of such systems with the help of private companies such as Madras Irrigation company and East India Irrigation and Canal Company for which the driving force was Sir Arthur Cotton

An analysis of irrigation development during the colonial period shows certain patterns of development. The prioritisation of irrigation in delta regions, as mentioned above, makes it clear that efforts were made to exploit first the fertile soils to increase agricultural production. That means the concentration was on naturally better endowed regions to extract as much surplus as possible. In doing so the colonial rulers did not opt for gigantic projects involving unduly large investment and technological sophistication's. As pointed earlier, the concentration was on improving already existing systems and adding a new systems and adding new systems like diversion weirs and barrages. The maximisation principle infers of revenue to the government and increase in agricultural production seems to have been built into the very design of the systems. Further more, it
appears that British government was adverse to large scale investments on irrigation works which were less remunerative, though they were socially beneficial. The attitude of the colonial government becomes clear from the following statement by a district engineer regarding the bunding of Munsur Valley. He observed that a large outlay of rupees 3,29,200 on one work of an isolated description in a not too prosperous, thinly populated part of the country, would not be advisable. This shows that naturally less endowed backward regions got a raw deal in allocation of funds for irrigation. This might, perhaps, have resulted in aggravation of regional disparities.

Over the years, a good deal of economic compulsion has influenced irrigation strategies and policy in general. Drought in some parts and deluge in other parts of the country have been a regular phenomena. The inadequacy of primitive sources of irrigation to increase agricultural production was felt in the wake of frequent occurrence of famines in the country. Particularly, the great famine of 1876-78 gave the country a severe jolt. The first famine Commission of 1880, setup in the wake of this catastrophe, emphasised the need for direct state initiative and intervention in the development of irrigation, particularly in the vulnerable areas. However, serious note of it was not taken because of relatively good agricultural years during 1880-85. Famine occurred again towards the end of 19th century (1897-98 and 1899-1900). This led to explanation of possible ways of increasing food production. It should be noted here that erratic behaviour of monsoon and the consequent occurrence of famines have necessitated to bring more area under irrigation. This shows that irrigation has essentially emerged as a disaster management strategy. Further more the productivity principle adopted by the British rule did not seem to hold good for all times to come. Need for developing naturally less endowed and backward regions in the wake of successive famines in the last quarter of the nineteenth century had necessitated a change in the outlook towards irrigation development. Thus, the first Irrigation Commission was appointed
in 1901 to study the effectiveness of irrigation in providing protection against famine and to suggest a comprehensive irrigation policy.

If the traditional agriculture which is presently a means of livelihood only has to change for good as a modern commercial agriculture, then the farmers should be provided with a regular supply of water for cultivating their lands. And this is the main purpose of the permanent irrigation system. If farmers are provided with a planned irrigatory system, they can to a large extent, improve their crop yield every year. According to the planning commission report, the irrigated land yields double the yield or more, then unirrigated land produces

Availability of irrigation not only enhances the yearly crop yield but also helps to produce multiple crops and also biannual crops. Using hybrid variety seeds, high quality manure and methods, farmers can further increase their lands produce qualitatively and quantitatively. Irrigation will facilitate the healthy growth of cash crops like sugarcane, paddy, cotton and Tobacco.

By charging higher tax on irrigated lands, the government in turn can be benefited. Also, through irrigation, self-dependency and self sufficiency can be obtained with regards to food products and raw materials and thereby the government can save on foreign exchange relating to import of the said goods. Normally, the irrigated land is priced and because the yield in such land is more, the farmers is better benefited with a higher yearly income. Thus their economic and social status and lifestyle sees an improvement-though gradually.

River valley projects, being multipurpose projects, also cater to the needs of factories, industries and homes by supplying electricity of varied voltage. Drinking water can be provided for human and animal consumption,
throughout the year, both in townships and the countryside by the irrigation canal schemes. By planting fruit-giving and flowering trees along the canals and such irrigation systems as reservoirs, the forest resources also can be given a boost.

At times when rivers get flooded, the local people living in the river basins lose their land and property; their kin and livestock; and suffer huge losses. To encounter such natural disaster as floods, and to control menacing floods the river valley projects are very useful. Due to irrigation projects, dry lands turn wet lands and there-by work in the wetlands keeps going on throughout the year and hence the workers here are thoroughly engaged. So the part time agricultural workers and seasonal workers get enough work to do throughout the year.\(^\text{15}\)

The irrigation facility, the supply of drinking water, etc have been the prime concern of the government since a long time. Also, the art of irrigating lands in India has been a very ancient one and there are many historical evidences to support this claim. One such claim lies during the prehistoric era that Narada Maharishi enquires Yudhistra of the Mahabharata fame thus: "Are farmers completely engaged and prospering and happy ?. Are there dams in different areas of the land and are they full ?. Farming in your land is not just dependent on rains, is it?" \(^\text{16}\). There are evidence in the Vedas too regarding the building of dams and canals and digging of wells. A commandment regarding a war strategy in the Manusmriti suggests that "A king who wishes to win over his enemy has to first destroy the irrigatory reservoir in the enemy territory."\(^\text{18}\). This proves that not only were the irrigatory reservoirs built but also much importance was given to them.

In his Arthasastra, Kautilya (BC. 300), the famous king council mentions thus "in wars in undate lands in the enemy territory by destroying lakes and breaking dams there". The Greek visitor Magasthenes, who had come to
India during the reign of Chandragupta Maurya, lavishly praised the irrigation system in India\(^9\).

**Irrigation Facility in Ancient Times**

The oldest and the best known dam were built of stone in BC 300 near Kathiwara and were called Sudharshan Dam. It went strong for 400 years and facilitated irrigation, which later on got destroyed during a great flood. In the 1\(^{st}\) century AD, the Emperors of the Chola dynasty built dams across the river Cauvery for irrigation purpose. In the 10\(^{th}\) century AD, the gigantic Bhaura lake near Pondicherry was built which had a bund measuring 16 miles (25.8 km). During the same period king Bhojaraj constructed the Bhojapura dam near Bhopal. In the 14\(^{th}\) century AD, the kings of Vijayanagar built the Anatharajasagara dam in the Kadapa district, while in Hampe numerous irrigation canals were dug Firoz shah Tuglak (AD 1351-1388) of the Tuglak dynasty built 50 dams and dug 30 ponds, while in the 16\(^{th}\) and 17\(^{th}\) centuries the Mughal Emperors constructed numerous dams and dug many canals. All these show how from time to time various administrations and rulers patronised the construction of dams and encouraged irrigation. However, not many of the above said works survive which glorify the past.

**Irrigation System in Pre-Independence India**

Since the beginning of the British rule in India and upto 1854 all public works including irrigation works (excepting the railway administration) were under the Military Boards authority and control. The army engineers, also called the Royal Engineers, prepared plans of irrigation systems. Among them were John Calvin, Prof. B.T. Coutly, Arthur Cotton and S. S. Jacob who were some of the experts on irrigation\(^{20}\). The military array at the waterfed areas of river Cauvery, the West and East bank canals of river
Yamuna, the Ganga canal and the Bari Doab canal are some of the major works undertaken by the Royal Engineers.

In 1854, the Public Works Department came into existence. Many military engineers were deputed to this department. Later on other civil engineers too were inducted. To privatise the Irrigation development work, some private entrepreneurs were given a chance, and two companies came forward. (i) The East India Irrigation and Canal Company (1858) and (ii) The Madras Irrigation Company (1863). However, none of the projects taken up by these companies was successful and so these companies had to be closed down. In the light of the experience that private companies are inefficient to take up large-scale irrigation projects, the government amended its irrigation policy in 1866. According to the new irrigation policy, (i) Government itself is to take up any irrigation projects (ii) For each specified irrigation project, money allocated will be generated by public funds loaned for the project (iii) To put the water of any river to its best use, methods and strategies should be devised at the planning level itself. Steps should be taken to see that the boundaries of the other provinces or the territories of other kingdoms do not become as a hindrance (iv) Before the irrigation project is taken up, it has to go through "productivity regulation". With a view to increasing agricultural production and also to ensure balanced regional development, independent India like many developing countries, has initiated construction of major irrigation systems. The increase in irrigation potential in the post-independence period is encouraging under the given resource constraints particularly of capital. But what is disturbing, according to the irrigation planners and administrators, is the inability to utilise fully the potential created.

The main principle behind the 'production regulation' is the specified percentage of profit that an irrigation project is supposed to get after deducting the cost incurred in the project from the income generated by it.
The said production regulation hampered the irrigation projects in drought affected areas. Taking this into consideration in 1903, Collin Scot Mankrif the chairman of the Irrigation Commission of India, gave his report thus-

"when an irrigation project is taken up, the government should ensure that the project will be helpful in mitigating conditions of drought, and famine and the government should see to it that it goes by the regulation relating to drought relief". The government readily accepted the above recommendations.

According to the 1921 Montague-Chelmsford Political Reformation (Act), the provincial governments were authorised to collect public funds to be loaned for irrigation projects. More autonomy was given to provincial government with regards to development of irrigation by the 1937 political reformation. The Royal Commission regarding agriculture recommended a Central News Bureau for Irrigation which got momentum when the government of India set up the Bureau in 1928.

When India got her independence in 1947, out of 216.6 million acres (87.1 million hectares) of cultivable land, only 58.1 million acres (23.47 million hectares) of land had irrigation facility (Planning Commission 1st Five Year Plan)^22. Nearly half of the irrigated land went to Pakistan during partition. Out of 26.1 million acres (10.6 million hectares) of land irrigated by the river Sindhu and its tributaries, 21.0 million acres (8.5 million hectares) went to Pakistan while the remaining 5.1 million acres (2.1 million hectares) was left with India. In the beginning of the First Five Year Plan, i.e., in 1950-51 there was a total of 22.6 million hectare of irrigated lands (Planning Commission 7th Five Year Plan Volume I and II)^23.

Classification of Irrigation Works

The irrigation works in India has been classified into Major, Medium and Minor works. Until 1978 irrigation works were classified on the basis of the
incurring cost. When the cost of the irrigation project is above rupees 5 crores then such works are classified under Major Irrigation Works. If the cost of the project is less than rupees 5 crores but more than rupees 25 lakh then such works are termed Medium Irrigation Works. When the cost of the project is less than rupees 25 lakh, (rupees 30 lakh in case of hilly areas) such irrigation projects are termed as Minor Irrigation Works (Planning Commission 7th Five Year Plan Volume I and II)\(^{24}\). Upto April of 1970, works costing rupees 15 lakh were considered as Minor irrigation works (Planning Commission 7th Five Year Plan Volume I and II)\(^{25}\).

After April 1978, the cost based classification of irrigation works became out-dated because a new classification method was adopted. Here the extent of land to be irrigated became the new basis. According to this classification method, the projects involving 10,000 hectares of land to be irrigated was termed as Major irrigation works. Projects involving below 10,000 hectares but above 2,000 hectares of land to be irrigated was termed medium irrigation projects. Projects involving lands below 2,000 hectares to be irrigated was called Minor irrigation projects (Planning Commission 4th Five Year Plan)\(^{26}\).

'Government canals, private canals, lakes, wells and others' is yet another classification. Some important policies of the five year plan aimed to promote irrigation also aimed at intensive cultivation system more yielding seeds, chemical fertilisers, pesticides and insecticides, usage of machinaries and implements were encouraged. The policy also aimed at improving the farmers income, industries, transport and entrepreneurship and also extending irrigation facility (Planning Commission 4th Five Year Plan)\(^{27}\).

Canal irrigation provides livelihoods of hundreds of millions of people in developing countries. In parts of South Asia, where it has been a massive
thrust in rural and national development, extensive irrigation co-exist with the greatest concentration of rural poverty in the world\(^26\).

**Irrigation in Early Twentieth Century**

By 1901, area irrigated by protective works was only a little over 0.12 million hectares, while the gross area irrigated from public works was about 7.5 million hectares of which 3 million hectares was from minor works like tanks and inundation canals\(^{29}\). Farmer managed irrigation systems also contributed their might to increase irrigation potential, as area irrigated by private works was 5.7 million hectares of which 70 percent was by wells and the remaining from tanks, streams and channels. Though private works contributed and continues to contribute their might for the expansion of irrigation, they remained outside the ambit of irrigation policy per se, except for a limited purpose of extending institutional financial support where initiative comes from individuals or communities.

A shift in the thrust of irrigation development from productive to protective is more significant. For, the British government was particular about the returns on investment and concentrated only on prime areas, environmental compulsions have, however, forced to relax the productive norms applied for irrigation systems. There was a spurt in protective irrigation works in the first two decades of this century. The recognition of its importance is revealed by a six-fold increase in outlay on protective works - the outlay has increased from rupees 2 crores in 1903 to about rupees 12 crores in 1921 as against a two-fold increase in the overall outlay on irrigation productive and productive together from rupees 40 crores in 1901 to rupees 79 crores in 1920-21\(^{30}\). At the end of this period, the area irrigated was 10.4 million hectares by public works and 8.9 million hectares by private works in British India and 3.3 million hectares in the former princely states with a total of 22.6 million hectares\(^31\).
The Bengal famine (1943) gave a spurt to further expansion of protective rather than productive irrigation works to increase food production. The realisation seemed to have come soon that public systems alone cannot meet shortages of food. The stress was therefore, on private irrigation works also. The Famine Enquiry Commission (1944) in particular emphasised the need for concentrating on private works. They perhaps thought that it was the best strategy to harness locally available water resources by using the local skills and materials, including capital. In a way this was a meaningful approach to tap the surplus resources and plough back the same for developmental purposes. By 1945, the area irrigated from private sources in undivided India, excluding princely states, was 10 million hectares of which 4.4 million hectares was by wells. This shows that ground water exploitation was as important as surface irrigation. However, it was the monopoly of private individuals. The following table shows the status of irrigation development in British period.
TABLE NO. 1.1

AREA IRRIGATED IN UNDIVIDED INDIA

(Net area irrigated in million hectares)

<table>
<thead>
<tr>
<th>Year</th>
<th>Public Sector</th>
<th>Private Sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>7.6 (57)</td>
<td>5.7 (43)</td>
<td>13.3 (100)</td>
</tr>
<tr>
<td>1920-21</td>
<td>10.4 (54)</td>
<td>8.9 (46)</td>
<td>19.3 (100)</td>
</tr>
<tr>
<td>1945</td>
<td>13.5 (58)</td>
<td>10 (42)</td>
<td>23.5 (100)</td>
</tr>
</tbody>
</table>

Note: Figures in parentheses are percentages.


Two distinct trends in the progress of irrigation are observed from the data presented above. In the first two decades (1900-1920) area irrigated by private sources has shown a perceptible increase (56.1 percent) when compared with public sector (36.8 percent), a reverse trend is observed in the subsequent two decades (1920-1945). Since British government initially was not favorably disposed to its expansionist role into less productive irrigation systems, increase in area irrigated under public works was understandably slow. When the state expansionism became inevitable to combat natural disasters like famines and droughts by extending irrigation to less endowed regions, the area under public works has naturally increased faster than under private works. While appreciating the inevitability of state expansionist role in the irrigation development, the slow pace of progress witnessed under private works was not welcome. That could be the reason why the Famine Enquiry Commission (1944), as pointed already, emphasised the need for encouraging private irrigation works to supplement the government works.

Between 1900 and 1945 area irrigated by public works has increased by 77.6 percent as against 75.4 percent to private sector, it indicates that the
colonial rule not only expanded state intervention but also encouraged irrigation under private sector. However, the performance of private sector, in terms of area irrigated, between 1921 and 1945 was not very encouraging. The area irrigated by private sources increased by only 12.4 percent between 1921 and 1945 as against 29.8 percent under public sector. Though irrigation development in British period took twists and turns in terms of thrust and direction, it had set the tone for the emergence of a dynamic and vibrant irrigation sector in the country. It is therefore, said that harnessing of waters of India's rivers for irrigation purposes would appear as one of the most positive ways in which the colonial regime contributed to Indian welfare.

The partition of the country in 1947 was yet another curtain raiser as for as irrigation chapter in Indian economic development is concerned. Irrigation profile of Indian union had changed. A major portion of the irrigation potential created in undivided India during the pre-independence period went to Pakistan. At the time of the partition in 1947, the net sown area in the country, including the princely states, was 116.8 million hectares. Of this 28.2 million hectares or 24 percent was irrigated. On partition, 18.3 million hectares of net sown area, of which 8.8 million hectares or nearly half was irrigated land, went to Pakistan. Of the balance left with India, only 19.4 million hectares or about one-fifth was irrigated. While India was left with 80 percent of the pre-partition population, got only 69 percent of the total irrigated area. This had naturally led to explore the possibilities of constructing irrigation works in the regions endowed with less natural resources, which in normal course tend to affect cost-benefit ratios.
Irrigation Under Plan Periods

Rural development and prosperity through irrigation has been a dominant theme in Indian planning since the beginning of the era of five year plans\(^{36}\).

The post independence period has opened up new venues in irrigation development with renewed emphasis on bringing more area under irrigation. The planners seem to have realised the inevitability of irrigation to insure against frequently occurring droughts and floods. Further, many agriculturally well developed areas, as mentioned earlier, remained with Pakistan after partition of the country in 1947. Thus, the need to accelerate the rate of irrigation development was actually felt after independence\(^{37}\).

Several large river development projects were launched between 1947 and the start of the first plan. With the beginning of planning in 1951, many more irrigation projects were started throughout the country. Each plan period saw successive increase in expenditure on major and medium irrigation projects. As a result, India now has very ambitious and largest irrigation programme in the world\(^{36}\).

It is obvious that in the anxiety to increase much needed irrigation potential, the emphasis in the early part of post independence period was on construction of irrigation projects in a big way to harness major rivers in the country. More than 500 major and medium irrigation projects have been taken up and nearly three-fifths of them have been completed. The gap between the irrigation potential created and actual utilisation has been on the increase. It is particularly true of major and medium irrigation where the gap has increased from 9.92 percent in the first five year plan to 15.29 percent in seventh five year plan\(^{30}\). It is reported that out of a total 245 major irrigation projects taken up for construction since the first five-year plan, only 25 percent have been completed by the end of sixth plan\(^{40}\). The area under irrigation has increased at the rate of 0.7 million hectares per
year during the first plan (1951-56). The growth rate has, however, accelerated to 1.6 million and 2.2 million hectares per year during the fifth and sixth plans respectively. By the end of sixth plan, the cumulative investment on major and medium irrigation projects was Rupees 1,50,260 millions\(^4\). During the seventh plan period, the area under irrigation has increased at the rate of 2.5 million hectares per year\(^5\). By the end of seventh plan (1985-90) the total irrigation potential (major, medium and minor irrigation) created was 79.74 million hectares, of which the share of major and medium projects was 41.27 percent\(^6\). The remaining have spilled over into the seventh plan and are likely to be completed in the eighth or subsequent plans, resulting in time / cost overruns. At the beginning of the eighth plan, as many as 144 major and 216 medium projects (capable, on full development, of adding 13.2 million hectares to irrigation potential) are on-going projects requiring on estimated rupees 23,000 crores for completion\(^7\).

Not only the outlay on major and medium irrigation, as pointed earlier, has increased in successive five-year plans, but also the cost per hectare of irrigation potential created rose steadily throughout the period of planning. It has increased from rupees 2,770 per hectare (at constant prices) in first five year plan to rupees 6,696 in sixth plan (141.7 percent)\(^8\). The rise in real expenditure per hectare of irrigation potential created is the result of three forces: a progressive increase in the number of projects under construction, meaning an increasing proportion of funds are spent on the early stages of projects, before they begin yielding benefits: a proportional shift to more difficult and higher cost projects as the easier and cheaper opportunities for irrigation development were used up; and improved standards of design and construction in order to capture greater agricultural benefits\(^9\). Non completion of projects within the stipulated periods, as revealed by the spillover of projects into successive plans, leads to escalation of costs due to inflation and jacksup per hectare cost of irrigation potential created.
Therefore it is equally, if not more, important to identify the constraints inhibiting the completion of projects on time.

After independence, the thrust on balanced regional development and the need for distributive justice have necessitated a change in the outlook of the national policies for developments, for which irrigation to chronically drought affected areas with undulating terrain's and different soil series has become inevitable. This change in irrigation policy perspective seems to have created different kinds of problems. Water distribution strategies have been changed with a view to optimising benefits from irrigation. For instance, in Krishnarajasagar, a major irrigation project in Karnataka state, a new policy of localisation\(^\text{47}\) was introduced to ensure efficient distribution of water. However, this new pattern was not accompanied by appropriate changes in the design of canal network to enforce it at the field level. For example, water control and regulating structures, measuring devices and other necessary infrastructure essential to accomplish the envisaged localisation pattern did not find place in the water distribution network.

The expansion of irrigated area has its own natural and critical limits. For, the ultimate irrigation potential in India from all sources is estimated at 113.5 million hectares\(^\text{46}\). So far, by the end of seventh plan 70 percent of this potential is already created. The limited land available for agriculture underscores the importance of optimum utilisation of irrigation potential available in the country. Although the total cultivable area in the country is reported to be 185 million hectares, the possibilities of its being reduced further in the coming decades can not be ruled out due to increasing pressure on lands for urbanisation, industrialisation and other developmental works. The National Commission on Agriculture had projected in 1972 that net area sown in 1985 and 2000 AD will be 145 million hectares and 150 million hectares, respectively. In 1985, we were still at 141 million hectares and it is doubtful whether the net sown area will
increase to 150 million hectares by 2000 AD. The options, therefore, narrow down to intensive cultivation and increased productivity, which ultimately depends on irrigation. This calls for a coordinated effort to increase production possibilities under the given resources of water.

The forgoing discussion brings out certain trends in irrigation development in pre and post-independence periods. British government had concentrated essentially on prime areas where returns to investment in irrigation were assured. Importance was given to rehabilitate the already existing systems, apart from constructing new ones. The systems were essentially barrages and diversion weirs, where environmental hazards were relatively less. For, the scope for submergence of forest and displacement of persons was either nil or may be negligible, even if any. The frequent occurrence of droughts and famines in the last quarter of nineteenth century had heightened the importance of irrigation, where the thrust shifted more towards protective systems. Among the private systems, well irrigation was more prominent. Colonial rule seems to have encouraged harnessing of both surface and ground water resources. The partition of India in 1947 had left the country with a fragile cover of irrigation as a relatively larger proportion of irrigated area went to Pakistan.

Independent India, therefore, had to start with a slender base of irrigation. The pressure of population had necessitated further increase in area irrigated. Since the fertile and less difficult terrains were already exploited for irrigation, the hydrologically difficult locations and terrains had to be tapped for increasing irrigation potential. Democratic government in the post-independence period, wedded to balanced regional development and distributive justice was committed to exploit available water resources to the maximum extent possible. With the result, number of major and medium projects has increased. The spread out of limited capital resources thinly on more number of projects, instead of concentrating on a few and completing
them on time, had resulted in inadequate capital to complete the projects on time. This has led to time overruns which in turn resulted in cost overruns necessitating the revision of project budgets several times. In spite of all these constraints, irrigation potential created has increased steadily year after year. But, whatever potential is created has not been utilised fully. This has led to thinking about the strategies to be adopted for making fuller use of irrigation potential created and optimise the benefits.

Construction of dams and canal network do not bring by itself desired results without proper plan for judicious use of water. This is particularly so in view of the importance given to major and medium irrigation projects in post-independence period.

With this background on irrigation development at the national level, we will present the status of irrigation development in Karnataka, the state to which the study region belongs to, in the following section.

Irrigation in Karnataka

In India different types of irrigation namely, Canals, Tanks and Wells are adopted. A regional analysis of the state wise data reveals that tank irrigation is more prevalent in the southern part of the country. Southern region consisting of four states Andrapradesh, Tamil Nadu, Karnataka and Kerala account for 60 percent of the irrigated area under tanks in the country. 30 percent of the net irrigated area of the Southern Region is under tanks while in Karnataka it is about 30.46 percent

The irrigation potential created in Karnataka during the pre-independence era was very low. There were some notable irrigation works built in pre-independence period. The available evidence proves that, irrigation was extensively practiced in ancient Karnataka. Kadamba King Chuta Nagasri of Banavasi constructed tanks at Chandravalli and Talagunda. Table shown
below is some of the tanks which were constructed by the kings/rulers during their period.

**TABLE NO. 1.2**

**TANKS CONSTRUCTED AND REPAIRED BY THE ANCIENT RULERS**

<table>
<thead>
<tr>
<th>Kingdoms</th>
<th>Number of Tanks Constructed</th>
<th>Number of Tanks Reconstructed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoysalas</td>
<td>215</td>
<td>36</td>
</tr>
<tr>
<td>Vijayanagar king</td>
<td>77</td>
<td>19</td>
</tr>
<tr>
<td>Gangas</td>
<td>23</td>
<td>07</td>
</tr>
<tr>
<td>Chalukyas</td>
<td>27</td>
<td>02</td>
</tr>
<tr>
<td>Cholas</td>
<td>20</td>
<td>05</td>
</tr>
<tr>
<td>Rashtrakutas</td>
<td>04</td>
<td>01</td>
</tr>
<tr>
<td>Kadambas</td>
<td>07</td>
<td>-</td>
</tr>
<tr>
<td>Yadavas</td>
<td>08</td>
<td>01</td>
</tr>
<tr>
<td>Others</td>
<td>153</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>634</td>
<td>99</td>
</tr>
</tbody>
</table>


During sixth century many tanks resembling oceans were constructed by the Ganga King Durvinitha. He believed that the construction of tanks and canals was a meritorious act and it should be undertaken with the same interest with which temples were constructed. The Ballarayana Samudra, Bharama Sagara, Devaraya Samudra etc., are some of the tanks constructed by the ancient Kings which are existing even today. The need and importance of irrigation has been recognised since the drawn of civilisation. It has been well documented by Gulathi. He says, 'irrigation in many countries is an old art... as old civilisation... but for the whole world it is a modern science-science of survival'. In India, even today, irrigation is being practised as an "old art" and also being pursued as a "modern science". 
The Nagavarma II, in his Kannada dictionary "Abhidana Vastukosa" (1042 BC) mentions about two types of lands, devamatrika-land dependent on rainfall, Nadimatrika-land dependent on irrigation. The inscriptions also have given details of different types of irrigation systems existed during the ancient period\(^52\) (Gazetteer of Karnataka Part I : 1982). There were however no major and medium irrigation projects in the state till the end of 19\(^{th}\) century. But tank irrigation held prominent position even in the historic period. The records of Yalandur tank of 1060 BC explain about the sluices and canals of Cauvery\(^53\). The records of Shikaripura reveal the construction of "Mahasethuve" across river Varda\(^54\). Narasimharaja is a well-known meritorious work of historic period. The state of Karnataka has been famous for irrigation and it accounts for 1/4\(^{th}\) of tanks in the country\(^55\). Sulekere covers (14 sq. miles), Ayyanakere, Madagadakere, Vyasasamudra, Ramasagara, etc., are a few more well-known ancient tanks of Karnataka.

The Imperial Gazetteer of India, referring to irrigation in native states, describes that "among individual states, the first place may be given to Mysore. Almost every valley contains a chain of tanks, the first overflowing into the second and so on until the terminal tank is filled" \(^56\) (Puttaswamaiah : 1980). The tanks were classified based on main valleys and sub-valleys.

Bangaradoddi Channel which was constructed by Sri Kanteerava Narasimaraj Wodyer, Hemavathy and Lakshmana Thirtha are the noted creations of the ancient rulers. Vijayanagar channel is one of the ancient and noteworthy irrigation work built during 1600 AD. The Cauvery channels were completed by the end of 19\(^{th}\) century. The other two major irrigation works completed during the 19\(^{th}\) century are Vani Vilas Sagar ancient and Gokak Canal.
Irrigation Development During Pre-Independence Period

The 20th century marks a milestone in the history of irrigation development. It has witnessed the birth of several major and medium irrigation projects in the country in general and the State of Karnataka in particular. The irrigation Commission was appointed in 1901. After a systematic detailed analysis, the Commission presented a most valuable report in the year 1903, containing sound policies and programmes for the development of irrigation works in the country. The recurrence of droughts in the State of Karnataka during 1889, 1904, 1905, 1908, 1911, 1913, 1918, 1920, 1922, 1926, 1934, 1937 and 1945 have stressed the necessity for major and medium irrigation works in the state (Gazetteer of Karnataka, Part I : 1982). The Bhadra anicut (1917) and the Anjanapur anicut were the two major irrigation works started in the first quarter of the 20th century. The important projects like Vani Vilas Sagar across river Vedavathi, Krishnaraja Sagar (1911) across river Cauvery were initiated. Krishnaraja Sagar, a major irrigation project completed in 1933 was recommended by the First Irrigation Commission to store 1218 mcum of water to irrigate 20,200 hectares.

To begin with, major Sankey was one of the first engineers of old Mysore State who devoted his attention for the systematic development of irrigation in the State. During the first half of the present century, Sir M. Visveswaraiah, an outstanding Engineer-Statesman of Mysore State, was responsible for the establishment of many medium and major irrigation projects not only in Karnataka but also in different parts of the country. He was an Architect of Krishnaraja Sagar and Tippagondana Halli reservoirs and was also an architect and adviser to many other projects of the country. Government of India established Central Board of Irrigation for the systematic development of irrigation in the country in the year 1927. In 1949, the Central Board of Irrigation was renamed as Central Board of
Irrigation and Power. The progress of irrigation development was tardy due to economic depressions of nineteen thirties and the Second World War. In the post-war era much importance was given to irrigation development and several major and medium irrigation projects were initiated for the reconstruction of the economy and to augment agricultural production to meet the demand for food from ever growing population. During pre-Independence period about 10 major and medium irrigation projects such as Anjanapura, Bhadra Anicut, Kanva, Marconahally, Nugu, Ambigola, Tunga, Byramangala, Kolchi, Ragoli Bunda, TungaBhadra and Ghataprabha were started. The area irrigated during the pre-Independence period was only (7.1 lakh hectare) 6 percent of the net area cultivated in the State, rest 93.7 net area cultivated was completely dependent on rain.

Irrigation Development in Karnataka after Independence

The droughts of 1952, 1965, 1967, 1972, 1975 and 1979 underlined the need for many more major and medium irrigation works to counter the effects of drought. Between 1950-86 approximately 51 major and medium projects were undertaken, out of which 26 are completed and the rest of the projects are expected to be completed by the end of the ninth five-year plan. Some of the important major and medium irrigation projects initiated during the planning era are Upper Krishna State-I, Malaprabha, Ghataprabha, Harangi, Hemavathi, Kabini, Varuna, Yagachi etc.

Karnataka occupies twelfth position in gross irrigated area among the major states in India. The geographical area of the state is 1,91,773 square kilometers accounting for 5.85 percent of the total area of the country. According to 1991 census, population of the state is 44.81 millions (provisional) accounting for 5.31 percent of the country’s total population. Agriculture is the single largest occupation of the state. It is, therefore,
natural that irrigation should be gain importance. The state allocates about 25 percent of the total plan expenditure to the development of irrigation. The priority accorded to irrigation in Karnataka is in consonance with the national policy.

**Water Wealth of Karnataka**

The State has been drained by seven river systems including their tributaries. The Krishna and Cauvery river basins cover approximately three-fourth of the total area of the State. The total estimated annual yield of surface water is around 3440 TMC as shown in table 1.3 from the river systems, but it is estimated that only 1687 TMC of water potential could be economically utilised, annually. The annual water potential available under the West flowing river is 2500 TMC, of which a meager amount is utilised for irrigation purpose. It is found feasible to utilise the whole potential by diverting the rivers like Aghanasaini, the Mahanadi and distributories of Nethravathi to Krishna and Cauvery rivers.
TABLE NO. 1.3

ANNUAL YIELD OF SURFACE WATER RESOURCES
IN KARNATAKA (IN TMC)

<table>
<thead>
<tr>
<th>River Basin</th>
<th>Basin Area in '000' sq. Kms.</th>
<th>Average Annual Yield</th>
<th>Annual Cultivable Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krishna</td>
<td>113.01 (58.9)</td>
<td>970 (28.2)</td>
<td>1156 (100)</td>
</tr>
<tr>
<td>Cauvery</td>
<td>36.13 (18.8)</td>
<td>388 (11.3)</td>
<td>414.10 (100)</td>
</tr>
<tr>
<td>Godavari</td>
<td>4.43 (2.3)</td>
<td>50 (1.4)</td>
<td>22.37 (100)</td>
</tr>
<tr>
<td>West Flowing</td>
<td>24.53 (12.8)</td>
<td>2000 (58.1)</td>
<td>66.95 (100)</td>
</tr>
<tr>
<td>North Pennar</td>
<td>6.94 (3.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Pennar</td>
<td>3.76 (2.0)</td>
<td>32 (1.0)</td>
<td>27.30 (100)</td>
</tr>
<tr>
<td>Palar</td>
<td>2.97 (1.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>191.77 (100)</strong></td>
<td><strong>3440 (100)</strong></td>
<td><strong>1686.72 (100)</strong></td>
</tr>
</tbody>
</table>

Note: Figures in Parentheses are respective percentages.


Creation and Utilisation of Irrigation Potential in Karnataka

The state of Karnataka has a geographical area of 19.05 million hectare of which around 10074775 hectares was sown during the 1997-98\(^4\), and it has a population of 44,977,200 according to 1991 census. The ultimate irrigation potential of the state from all sources has estimated around 55 lakh hectares. Major and medium irrigation projects account for 35 lakh hectare under ground water resources\(^5\) (Irrigation Department: 1987). It is estimated that if the existing ground water is fully utilised, it is possible to irrigate an additional potential of 1.2 million hectare in the state.

The total irrigation potential created before independence was only (7.1 lakh hectare), 6.3 percent of the net sown area of the state. It is estimated that when all the irrigation project are completed approximately 50 percent of the cultivable area would be irrigated. The net area irrigated as against
the net sown area increased from 6.3 percent to 23.6 percent by the end of 1997-98. Till the end of 1987-88, 29.06 lakh hectares of potential (53 percent), 12.88 lakh hectares from major and medium irrigation projects and 15.87 lakh hectares of irrigation potential was created under minor irrigation projects and 56 percent under minor irrigation works. During the pre-independence period minor irrigation accounted for nearly 2/3rd of the irrigated area as against 1/3rd of the area irrigated from major and medium irrigation projects. But after Independence importance for major and medium irrigation increased. As a result, most of the resources were diverted to major and medium works and the amount spent on minor irrigation is only one-fifth of the major and medium irrigation projects, the creation of irrigation potential is highly insignificant. There is wide fluctuation so far as the proportion of potential created during the different plan periods both under major and medium and minor irrigation works (Irrigation Department: 1988).

The operational losses in major irrigation projects have been increasing indicating poor performance. It is pointed out in the document on the approach to Karnataka Seventh Five Year plan that "the returns from irrigation have been disappointingly low. Major surface irrigation projects in particular, are known to linger without final completion of several decades.

A brief review presented so far on the status of irrigation in Karnataka points out many similarities with the trends observed in the country, the thrust on major and medium irrigation in Karnataka is a post-independence phenomenon. Almost 25 percent of the plan outlays were earmarked for irrigation. Many projects are lingering on for decades without completion. The returns on investment are poor. Therefore the need to improve irrigation efficiency in the state is as acute as that of the country as a whole.
The priority accorded to irrigation development at the national and state levels is no doubt in accordance with the developmental needs in general. At the same time the concern for ensuring cost-effective benefits which change the life style of the people through Socio-Economic changes from irrigation is more justified, a review of which is presented in the chapter that follows.

Chapter Scheme

The study has been divided into eight chapters each of which discusses one specific issue. A brief resume of each chapter is given below.

Chapter 1 - Introduces the research topic and looks into the various issues which rise out of the fixed cultivable land and the alternate use made available out of the same by introducing canal irrigation. This chapter focus of the issues relating to the irrigation facility and its impact on the lives of people living in such condition and the possible developments that have come up in the due course after irrigation in different places. The views of different authors under different study regarding the impact of irrigation and the need to extend these facilities to the dry land in order to improve the lives of the people in unirrigated lands.

Chapter 2- Brings out the research design. Here, the problem under study is in focus and lays down the objectives, and later lists out the hypotheses which are to be tested in due course. Other than highlighting the techniques and tools, the chapter describing the study area, the research design lays down the sample design and the Interview Schedule design. Finally the limitations of the study is addressed other than the chapter scheme.

Chapter 3- Critically surveys the existing / available literature on irrigation, agriculture, social and economic change, impact of wet land over
dry land and, major and minor irrigation related literatures thus, highlighting the authors view.

Chapter 4- Under the head of profiles, the chapter views the different stages of study area. Firstly it pictures the state profile and brings out the important features that lie in Karnataka state. Secondly the chapter talks of the district profile, wherein, different aspects are touched like, historical background, topography, drainage system, geology, flora and fauna, climate, political background, social life, agriculture, cropping pattern, transport network, marketing facilities, education and administration. The chapter further describes of the taluks in detail.

Chapter 5- This chapter calls for the attention of the thinkers as it deals particularly with the social aspects in the study area. Here, different aspects such as respondent sex, religion, marital status, education, age, caste, residence, drinking water, marriage, etc., are brought under study. Other than looking into the individual taluk, a side by side comparison is also done in between the dry and wet taluk under study with the same variable.

Chapter 6- Outline of the economic issues is brought under the chapter. The main points discussed here are regarding, the land holdings, employment, income, expenditure, savings and yield in agriculture. In this chapter the above items are brought forth to study the economic status of the respondents and further the above said variables are considered for a comparative study with Srirangapatna and Nagamangala taluks.

Chapter 7- This chapter brings out a broad outline of the above two chapters which focuses light on the issue of the impact of
irrigation over both social and economic aspects. This further paves way for the researcher to point out certain issues which may in due course help the policy makers and future researchers to bring out a perfect solution for the regional imbalance arising due to economic upliftment in parts of the districts with irrigation and at the same time a stagnant / slow progressing economy in some other parts of the districts which is without irrigation. This economic change directly affects the social, political and cultural aspects of a region. Further birds eye view on the women issues are tackled in this chapter.

Chapter 8- Here the summary of the whole thesis is brought forth. The main stress is given on the findings of this desertion and in the end the researcher comes out with certain remarks on the findings. Thus this chapter ends with bringing together important conclusions that are drawn from the study.
Reference:


4. Dr. Kalayan Kumar DasGupta, Dr. Hemalatha Gopinath, Proloykumar Ghosh.- Economics of Tank Irrigation (A case study of Tumkur district) ISEC, Bangalore, 1976.p.2


10. Ion Stone - p.14

11. Ion Stone - p. 19


21. According to new revised classification made in 1978, a project with Culturable Command Area (CCA) of more than 10,000 hectares is classified as major, that with CCA between 2,000 hectares and 10,000 hectares as medium and with CCA of 2,000 hectares as minor irrigation scheme.


35. Ibid., 1976, p. 14


37. Abbie, Leslie, etc, - Economic return to investment in irrigation in India, World Bank Staff Working papers, No.536. The World Bank, Washington DC, 1982. pp. 3-4

38. Abbie, Leslie, etc, - 1982. Ibid., p.4


44. Government of India, Planning commission- Water resources development in the Eight plan, A background notes. p.3.

45. Abbie, Leslie, etc, - 1982. p.5
46. Abbie, Leslie, etc, - 1982. p.5

47. Demarcation of irrigated area for different crops to be grown in different seasons is known as localisation. It is mostly confined to new systems in South India.


50. Dr. Kalayan Kumar DasGuptha and others, 1976. p.2


52. Govindaiah, T. - (ISEC), Bangalore, 1992. p.11

53. Ibid., p.12

54. Ibid., p.12

55. Ibid., p.12


58. Ibid., p.14

59. Ibid., p.15

60. Ibid., p.15


63. Government of Karnataka, Irrigation Department (1935) - Irrigation projects in Karnataka (major and Medium)- 1985. p.1

64. Govindaiah, T. - (ISEC), Bangalore, 1992. p.26


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