# PERFORMANCE OF SURFACE IRRIGATION SCHEMES IN INDIA

By

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## ABSTRACT

A number of major, medium and minor irrigation schemes have been executed in all the States in India after independence. Although the schemes have helped in increasing food production, performance of many of the schemes are not satisfactory. There is considerable wastage of irrigation water due to heavy conveyance losses and poor onfirm irrigation management. Various factors responsible for poor efficiency of these projects have been critically examined in the paper. It is found that gross receipts from most of the projects are too low to meet even the working expenses due to repair and maintenance, administrative charges etc. Considering the poor return from the major and medium irrigation schemes, which are fast becoming National liability, it is recommended that the operation and maintenance of the irrigation schemes be handed over to either consumers' cooperatives or private companies.

## 1. INTRODUCTION

History shows that the economic prosperity of a country and its cultural wealth are closely related to the development of Irrigation Schemes. In the year 1951 when we had started first five year plan, India had a population of 300 million and the area covered by Irrigation was only 23 million ha producing 90 million tons food grain. India had rightly emphasized on the development of a large number of major, medium and minor irrigation schemes to assure firm water supply to the agricultural community. It is because of the irrigation development, India is self sufficient in food today

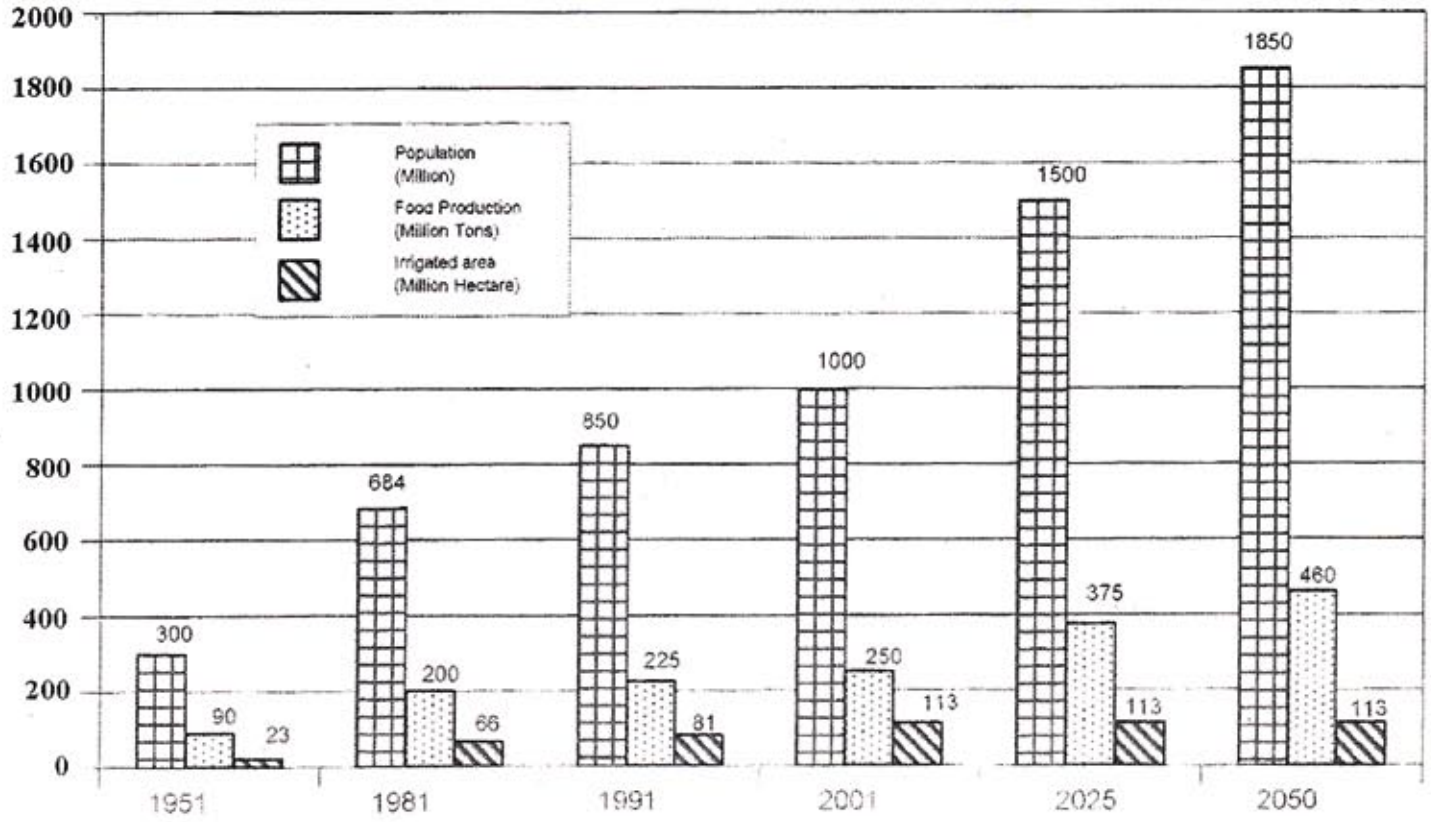



**Fig 1 - Growth in population, food production & irrigated area in India (1951 – 2050)**

producing 250 million tons foodgrain for our 1000 million of people, with an irrigated area of 113 m.ha. Fig. 1 shows the projected growth in population, foodgrain production and irrigated area up to 2050. Demand of water has been steadily rising not only from agricultural sector (83%) but from other sectors as well e.g. municipal demand (4.5%), industry and tourism (3.5%), energy (3%) and miscellaneous demand (6%). It has been estimated (Iyer, 1989) that by 2025, India's total demand of water shall be of the order of 1050 $km^3$ while the total available water resources from the different Indian river basins is about 1100 $km^3$ -almost equal to the demand. Since the population and demand for food will continue to rise (Fig. 1), the country will have to face scarcity of irrigation water after 2025. It may be seen that the ultimate irrigation potential of 113 mha is going to remain constant. Therefore, the only way the country can feed the people is through greater productivity of land for which more water is needed. It is in this context that the efficiency of water use for irrigation schemes consuming the largest share of water plays an important role. Even a small increase in irrigation efficiency will cause substantial savings of water, which can be either diverted for other uses or with the same amount of water; more food and fibre can be produced. Objective of this paper is to examine the performance of many of the existing irrigation schemes in the country.

## 2. PERFORMANCE OF SMALL AND BIG IRRIGATION SCHEMES

India has executed a number of major and medium irrigation schemes (for areas greater than 3000 ha) e.g.. DVC, Ramganga, Bhakra-Nangal, Tungabhadra, Narmada-Sagar, Hirakud, Nagarjun Sagar to name a few. A large number of minor irrigation schemes (for area less than 3000 ha) has also been completed side by side in all the States. Although there is no systematic analysis to find the Project efficiency (defined as ratio of the amount of water consumptively used and the amount of water released from storage) of these irrigation schemes, it is generally believed that smaller schemes have better performance compared to major schemes primarily due to better control and management of water. In this connection, Zimermann (1966), a leading Irrigation Consultant, observed "There is a recurrent controversy as to whether the benefit from crop return is increased by spreading available water over a large area in quantity well below plant moisture requirement or by irrigating according to the optimum net demand over small area. The former approach is favoured by many authorities often for political reasons because it permits an egalitarian water distribution policy that is drought insurance for all. The result has often been sparse distribution of a relatively small amount of water through a widely spaced unlined canal network which theoretically commands a vast area but actually only small, isolated scattered tracts of land area very sparsely irrigated. Virtually most of the water from these systems is lost in conveyance and most of the remaining water is lost because of inefficient irrigation management. The vast lengths of canals and ditches act unintentionally as an efficient ground water recharge network often critically contributing to a serious water logging and salinity problem." Many of the major irrigation projects in India are having common attributes, operating at low project efficiency. Author (Mazumder, 1984) had the opportunity of finding project efficiency of three major irrigation projects in West Bengal. The average project efficiency was found to vary from 18.6% to 38.8.%. Most of the irrigation water gets lost in conveyance and field application and the management of water at the farm level is extremely poor.

## 3. WASTAGE OF IRRIGATION WATER

Compared to minor irrigation (mostly at farmer's control), wastage of water in medium and major irrigation schemes (under Government control) are much more. About 60 to 80% of water diverted from the Head works for irrigation purpose is wasted and only 20 to 40% of water is consumptively used by the crops in the three projects mentioned above. The conveyance losses in different stretches of the irrigation canal system as found by a working committee for VIII Plan (CWC) is found to be as given in Table 1 below. Primary reason for such huge wastage of irrigation water stored, diverted, regulated and transmitted with so much of public money are well known. These are briefly discussed underneath.

(i) **Unlined Canal Systems**: Most of the irrigation canals are unlined resulting in seepage and percolation losses. Since unlined canals have to be designed against erosion, permissible

velocity (depending on the type of soil) is quite low compared to lined canals. As a result, time of travel from the storage reservoir to the farmlands are considerably higher resulting in greater losses. In tropical country like India, there is also substantial loss of water due to evaporation, which is also dependent on surface area and time of travel-both being high in unlined canals.

Resistance of open unlined canals increase several time if it is not well maintained. Most of open canals have luxurious growth of weeds and water hyacinth which evapo-transpires more water than evaporation from bare surface. There are scouring of bed and banks, cracks and piping in unlined canals resulting in substantial loss of water before it reaches farm.

**Table 1 - Conveyance Losses in Main Canal and Branches**

| Type of Canal | In North India | As found by a sub-Committee for MP, UP, and Maharashtra | Purna Project |
|---|---|---|---|
| Main Canal | 17% | 25% | N.A. |
| Branches | 8% | 20% | 20% |
| Distributaries | 20% | 20% | 20% |
| Total | 45% | 65% | N.A. |

### (ii) Poor On Farm Water Management

In a country like India where most of the farmers are extremely poor, there is hardly any 'on farm developments' e.g. land shaping and land levelling, lining of watercourses and field channels, farm roads, service tanks etc. There is hardly any irrigation schedule depending on type of soil, type of crop and its stage of growth, climatic conditions, etc. Lack of proper drainage, unscientific method of irrigation application, absence of rotational delivery system etc. have resulted in colossal misuse of irrigation water diverted from outlets.

### (iii) Inadequate and Unreliable Supply at the Outlets

To be of greatest use to the crops, the irrigation application must be timely and in quantities adequate to meet the consumptive requirement at any given stage of growth. Large irrigation system, where it takes several days for the water to reach from the storage/diversion works to the farm point, the timely supply of water in required quantities are often not realized. The very purpose of irrigation is defeated if it is not timely. Any shortage of soil moisture at critical stages of plant growth results in substantial reduction in crop yield. Operation of the irrigation system, mostly done manually, is dependent on so many factors related to man, machine and structures. During Kharif/monsoon season, net irrigation requirement is governed by effective rainfall. Any water reaching the farm during rainfall has to be wasted through tail clusters/ escapes. Proper water scheduling and rotation of irrigation need some expertise and enlighted farmers. Design assumptions, design inputs, construction quality, operation and maintenance of the project are interrelated and govern reliability and adequacy of irrigation.

### (iv) Water charging and Realisation of Irrigation rates

Because of the prevalent policy of charging irrigation water (Planning Commission, 92) on the basis of area of individual land holding, farmers, specially the head enders, have a tendency to draw as much water they can without bothering for the tail enders. Applying water beyond field capacity of soil results in percolation losses. Except rice, (requiring submergence irrigation), no other crop should be irrigated beyond field capacity. Computation of exact depth, duration and frequency of irrigation application, depending on preirrigation soil moisture content, stage of growth and root zone depth, type of soil etc. requires some expertise mostly beyond the reach of common farmers in India. Volumetric measurement of irrigation water supplied to any farmer and charging rate on the basis of actual volumetric consumption is the best way to achieve high user efficiency and reduce wastage of water. Installation, operation and maintenance of flow

meters e.g. Parshall flume; Improved Venturi flume (Mazumder '99), Cut throat flume, etc., billing of water, realization of water rates from individual farmers are herculean tasks. Water should be charged for bulk supply only at the outlet level. Beyond the outlet, the water users' cooperative/association has to distribute the water according to the need of individual farmers. For equitable and scientific distribution of water amongst the farmers and realization of rates, considerable cooperation and understanding is needed between the supplier and the consumer. As in most cases of our public life, there is utter confusion and lack of clarity at the consumer's level wherever the government tries to control. Perhaps it will be wise for the government owning most of the major and medium irrigation schemes, to handover the distribution of water and realizing the water rates to private companies similar to road projects where highway authorities collect toll from road users through private contractors on lease basis.

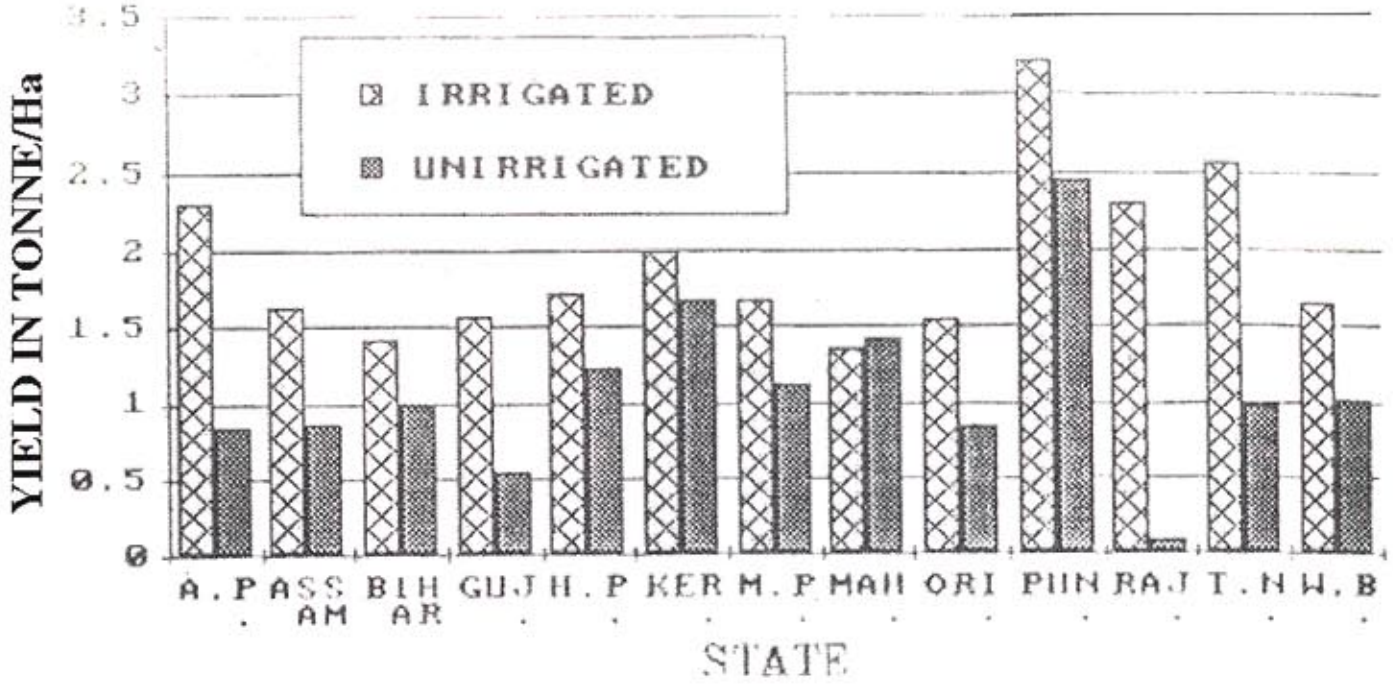
## 4. REVIEW OF BENEFITS- COSTS ANALYSIS OF IRRIGATION SCHEME

In all proposals for irrigation schemes - minor, medium or major-benefit-cost analysis is essential to find whether the proposed scheme is economically justified. No investor is going to invest money in any project unless benefit – cost (B/C) ratio is more than unity. For a given life of the project and bank interest rate, present worth of capital costs, maintenance cost, overhead and administrative costs etc. are found. Similarly, present worth of net benefits i.e. the difference in benefits from the project with and without irrigation is found. Benefits include market price of crops and fodders produced, power generated and miscellaneous other wealths created. Usually the project authorities have a tendency to overestimate benefits and under estimate the costs. For example, the crop yield due to irrigation is often exaggerated. Fig. 2 shows the yield of rice and wheat crops in different States of India with and without irrigation (Mohile '94). It may be seen that the increase in yield due to introduction of irrigation is only marginal in most of the states. Similarly, cost of irrigation projects is highly increased due to long time overrun, escalation in price and rampant corruption. Many a projects have been found to be a burden on the society due to their poor performance. Attempt should be made to compare periodically the estimated preplan B/C ratio with actual performance after the completion of the project. Considering the heavy investments (from Rs. 442 crores in 1$^{st}$ plan to about Rs. 40,000 crores in 9$^{th}$ plan), it is extremely important for a developing economy like India, to carry out critical review of the financial performance of all major and medium irrigation schemes with a view to analyse the various factors responsible for their poor functioning.

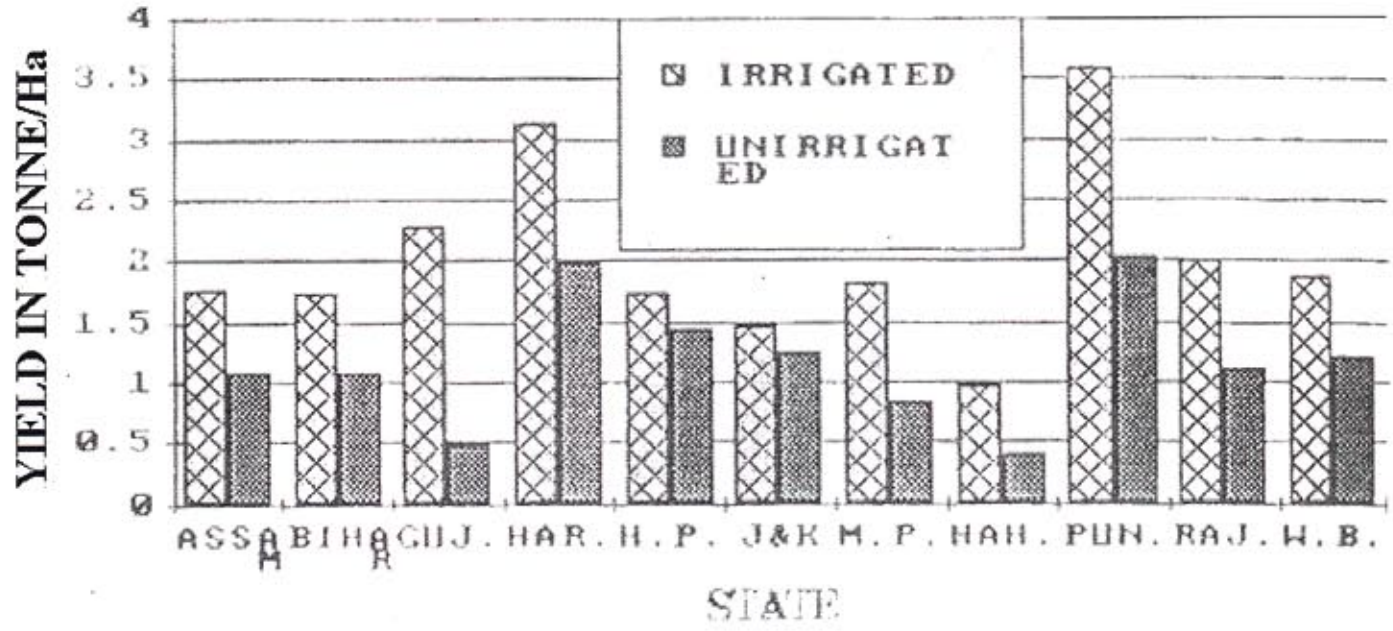
Apart from poor irrigation efficiency and loss of precious water, about one third of the irrigated command areas are facing acute problem of water logging, salinity and alkalinity. CADA was established in all command areas for integrated development of command area under irrigation schemes. But the bureaucratic functioning of most of such CADA was found to be ineffective in improving the performance. However, institutes like WALMI, headed by agriculture/irrigation experts have been found to deliver the goods to the farming communities and it should be further strengthened.

## 5. RECEIPTS AND EXPENDITURE

According to a compilation made by Central Water Commission (CWC 1990) on financial aspects of Irrigation and Multipurpose River Projects, the gross annual revenues are much below the annual working expenses. When interest on the capital borrowed from World Bank or other Financial Institutions were added up, the total deficit in the year 1986-87 alone was found to be of the order of Rs. 1200 crores. The annual deficit is increasing every year. Unrecovered costs are subsidies. But one must not assume that this subsidy accrues only to users of irrigation. Part of it represents the cost of inefficiency due to poor planning, design, operation and maintenance of the irrigation system. It is not possible to quantify how much of the subsidy is attributable to inefficiency and how much subsidy benefit goes to the farmers through underpricing of irrigation water. Objective should be to reduce government subsidy, improve efficiency and effectively manage irrigation water as well as increase the collection of irrigation rate.




**(a) Rice**




**(b) Wheat**

**Fig 2 - Comparison of yield with and without irrigation in different states in India. (a) for Rice and (b) for Wheat**

Revenue return from irrigation schemes may be taken as the gross receipts from the scheme which may be due to (i) sale of water to farmers i.e. irrigation rates (ii) sale of power (iii) navigation receipts (iv) proceed from plantation (v) irrigation cess and different kinds of levies. Working expenses include (i) Direction and Administration (ii) Machinery and Equipment (iii) Extension and improvement (iv) Maintenance and repairs (v) Works etc. Table – 2 shows the gross receipts and working expenses per hectare of irrigation (Mohile'94) for different states of India with an average all India figure. On average, gross receipts is found to be only about 15% of working expenses. Fig. 3 shows the declining trend of gross receipts as percentage of working expenses. Table - 2 also gives the irrigation rates for the different states. From the above table, it is apparent that the present water rates in all the states are too low to meet even the working expenses. The Govt. responsible for supply of irrigation water is perhaps afraid to enhance the rates or realize it in order to cover up their

inefficiency and corruption. More the inefficiency less will be the collection and more will be the subsidy required. Thus most of the Govt. constructed and Govt controlled irrigation projects have become a liability rather than an asset to the Nation. If the receipts cannot cover even a part of working expenses due to repair and maintenance of a scheme, not to speak of interest on the borrowed capital and the depreciation cost of the project, operation of irrigation schemes should be handed over to the private sector like other Govt. owned infrastructures.

**Table 2 - Working expenses and gross receipt per hectare of potential utilized of irrigation and multipurpose river projects and range of water rates (Rs/Ha)**

| S.No. | States | Working Expenses | Gross Receipts | Range of water rates | | |
|---|---|---|---|---|---|---|
| 1. | Andhra Pradesh | 115 | 21 | 49 | To | 371 |
| 2. | Bihar | 117 | 35 | 30 | To | 158 |
| 3. | Gujarat | 398 | 141 | 15 | To | 830 |
| 4. | Haryana | 170 | 64 | 7 | To | 99 |
| 5. | Jammu and Kashmir | 199 | 12 | 1 | To | 289 |
| 6. | Karnataka | 189 | 56 | 20 | To | 556 |
| 7. | Madhya Pradesh | 312 | 94 | 15 | To | 297 |
| 8 | Maharashtra | 312 | 148 | 20 | To | 750 |
| 9. | Orissa | 44 | 28 | 6 | To | 185 |
| 10. | Punjab | 87 | 71 | 14 | To | 81 |
| 11 | Rajasthan | 212 | 93 | 20 | To | 143 |
| 12 | Tamil Nadu | 90 | 7 | 6 | To | 65 |
| 13 | Uttar Pradesh | 118 | 57 | 7 | To | 237 |
| 14 | West Bengal | 111 | 10 | 74 | To | 593 |
| | All India | 142 | 22 | N.A. | | |

## 6. CONCLUSIONS

India has successfully completed a large number of irrigation schemes after independence. This has definitely helped us in meeting the challenge of food production for our ever-increasing population. Many of the major and medium schemes are, however, operating at poor efficiency due to high conveyance loss and poor on farm irrigation management. Irrigation rate and the realization of rate are too low to meet even the working expenses. Many of the projects are fast becoming national liabilities. It is desirable that the distribution and management of irrigation water, realization of rates, etc. be handed over to private companies or to the water users co-operatives.

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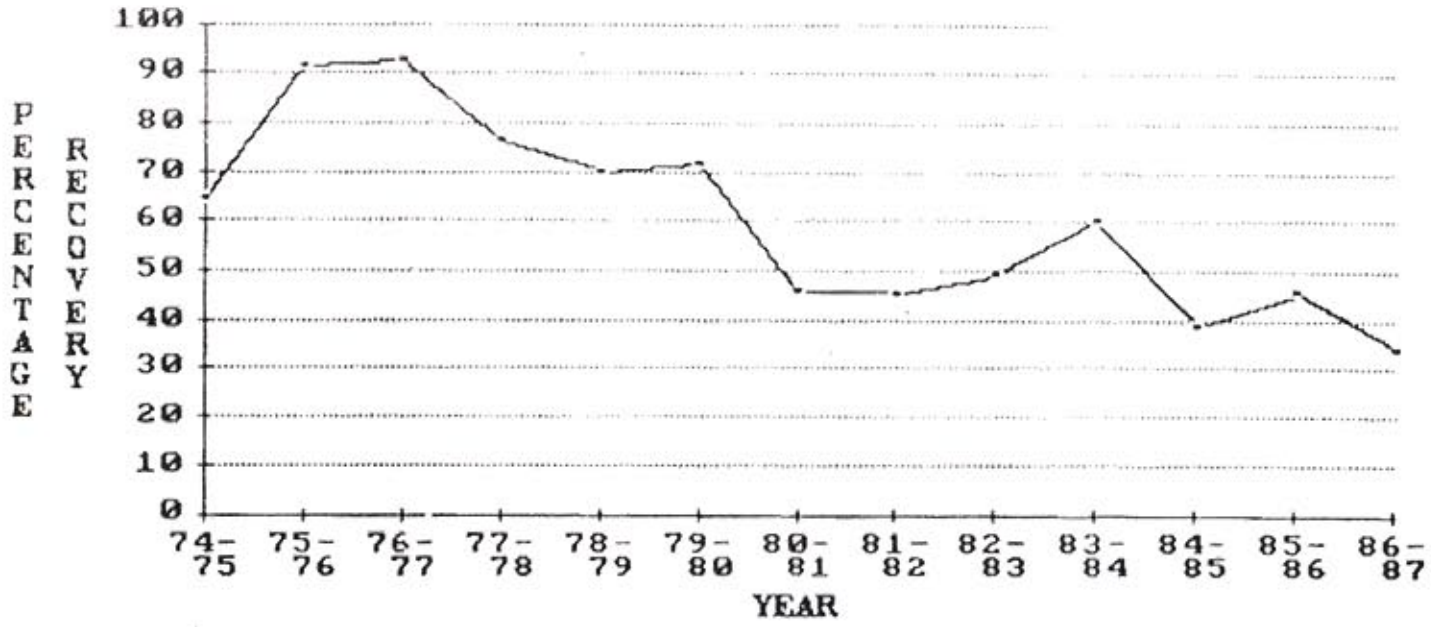


**Fig 3 - Year-wise percentage recovery of working expenses for 15 states in India**

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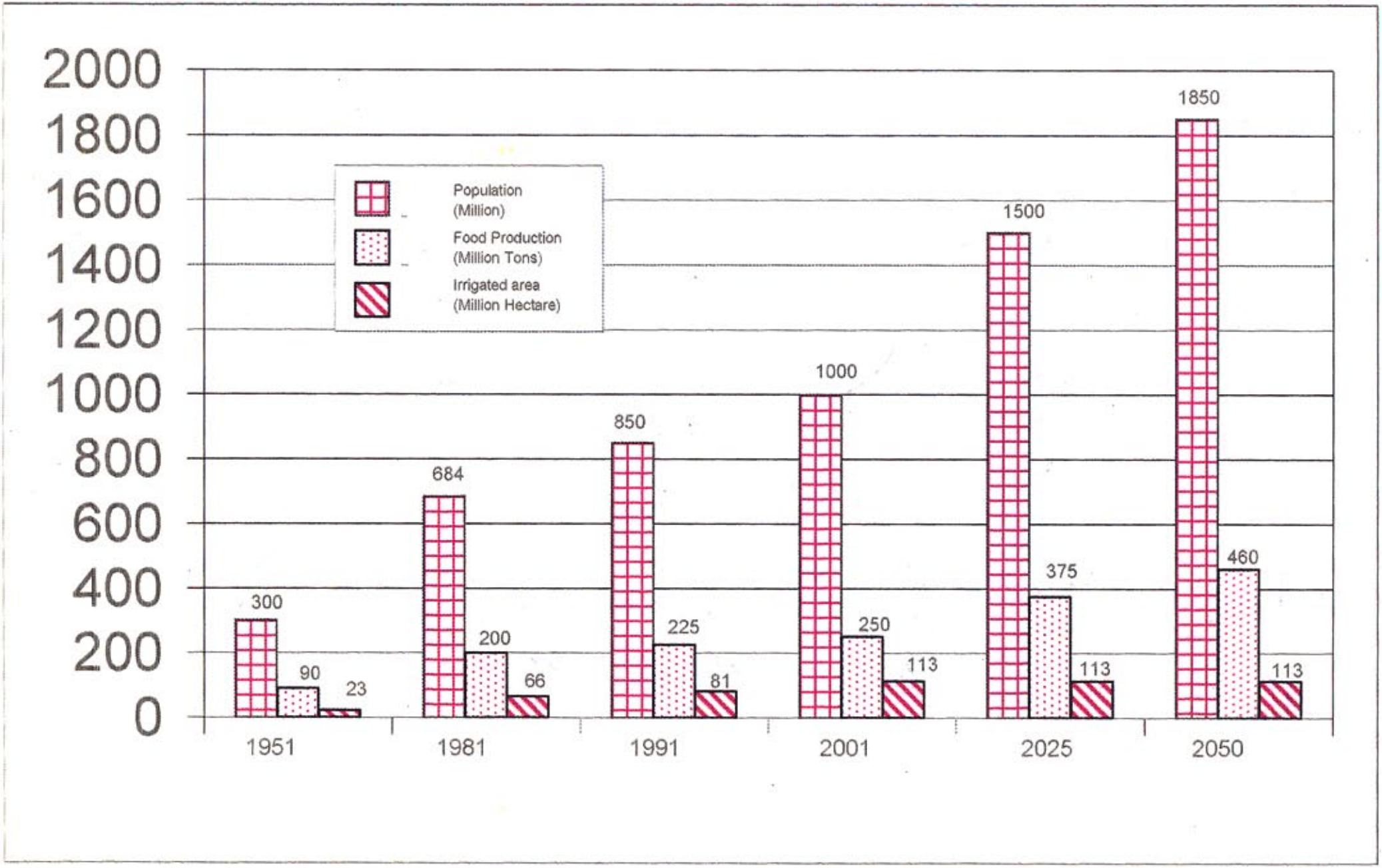
FIG. 1 GROWTH IN POPULATION, FOOD PRODUCTION & IRRIGATED AREA IN INDIA
1951 - 2050



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