Chapter-IV

AN ANALYSIS OF IRRIGATION AND AGRICULTURE IN INDIA
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In the context of the underdeveloped countries like India, development is defined as a sustained increase in the real per capita income together with an improvement in the distribution of material welfare. This definition involves advancement on two aspects of economic life, namely, income and distribution.

As for income, the focus is on the rise in the per capita income. This requires a growth rate which is higher than the rate of increase in population. Since the population growth is quite high in the range of two to three percent and the income levels very low in countries like India the growth rate of national income has to be sufficiently large to make any significant impact on the dismal income situation. It is also necessary that the rise in the per capita income should be sustained one. In other words, the rise should continue over a long period spread over several decades.

Further, the rise in the per capita income has to be in real terms, this requires that the rise in the money should be higher than the rise in the price - level.

It is only then that on an average more goods and services will became available.

As for distribution, the improvement in it is essential to raise the economic status of the poor. The growth of National income as has been amply proved by the experience of several developing countries
does not automatically trickle down to the people at the bottom rung of the income ladder. The empirical data has show that while the National per capital income of the poor did not rise. It, infact, fell in some countries so that the rich became richer and the poor poorer. The reason is obvious. Because of the gross inequalities of assets, both physical (like health, education, skill etc), the poor do not have the necessary where withal to participate in and benefit from growth. Beside, these resources poor people, there are those who are unable to get out of their object poverty for reasons beyond their control such as old age, illness etc. It is, therefore necessary that the government undertakes policies that redistribute the productive assets in favour of the poor also change the pattern of its public expenditure to provide free or low priced facilities of health, education, training etc to the poor.

It has thus clear that development as defined above, rightly incorporates both growth and distribution in its ambit. All this will raise the living levels of all the people. Thus irrigation in agriculture plays a dominant role in improving the standard of living.

Role of Agriculture in Indian Economy:

1As discussed above, agriculture plays an important role in the development of an economy. In this context we now celebrate the present standing of agriculture in the Indian economy. In a nutshell its position is an all - embracing one. So much that the very existence of economic activities of the entire people is bound up with the state and health of this sector. This all pervading influence can be gauged from the following facts and figures.

Large Share of National Income:

An aspect of its important stature can be seen from the large contributions it makes to the country's gross domestic product (G.D.P.). Although this reflects the inadequate development of the non-agricultural sectors, yet this fact highlights the large ness of the proportion of agricultural products which mark the profile of domestic product by industrial origin. No doubt with the faster development of the non-agricultural sectors, in recent years, its share has fallen. Yet it continues to be significant at above 27 percent at present with still faster growth in future, its share may fall further (because of higher growth of other sectors), but in terms of the quantities, its standing in the economy will continue to be quite significant.

Provides Large Employment and Support for Many Activities:

Being the producer of largest amount of commodities in the country, it provides employment and work for living to an overwhelming majority of the Indian masses.

Besides a large number earn their living by working in occupations depend upon agriculture. Like storage – processing, and trade and transport of agricultural products. In villages a large majority of the people earn from cultivation and allied agro industries. A considerable part of the labour force, in towns and cities also finds jobs in marketing, export and other activities connected with agriculture.

Large Supplies of Food and Fodder:

In a poor country where every large proportion of income is spent on food, it is of crucial importance that agriculture meets al most the
entire food needs of the people. Certainly imports of food grains have
played an important role in meeting the needs of rising population. Yet
the fact should not be lost sight of the proportion of food imports has
always been small. Excepting the two years, 1966 and 1967, when
food imports were higher then 10 percent of the net availability of food
grains in the country, in most of the years these were less than 5
percent. In some years these imports were marginal and in others
there were infact export of food grains.

Agriculture also provides fodder to sustain livestock, comprised
of cattle, buffaloes, sheep goats, horses, ponies etc and poultry. Their
number runs into crores. Those provide employment and income to the
large many in the rural and hilly areas. Their produce constitutes a
significant proportion (26 percent) of the out put from agriculture
sector. This excludes the contribution of animal drought power. the
various products of the livestock are the source of nourishing food,
including milk eggs, and meat of drought power for farm operations
and of commercial products like wool and hides.

Large Foreign Trade :

Agriculture contributes a sizeable part of exports and is an
important segment of imports of the country. The exports of
agricultural products have been quite large and rising all though these
years, particularly since the 1970's. These exports at present
constitute 15 to 20 percent of the total exports of the country. Besides
the export of products from activities allied to agriculture constitute a
significant proportion of the total exports. If to this we add the export
of products based on agriculture, the contribution becomes larger still.
This makes it an important contributor to the national Kitty of foreign
currencies. Not only it earns a sizeable amount of foreign exchange, its earnings are of special significance for the country’s development. It is because its almost entire earnings are available for the import of non-agricultural development goods as agriculture itself needs little imports as its inputs.

Imports of agricultural products are important, although small in the country’s foreign trade. Their total value has often fluctuated. Nevertheless these have been considerable. These form around 5 to 7 percent of country’s total imports among import item, the important ones are: Pulses, oil seeds, animal and vegetable oils and fats, agricultural machinery and implements etc. These imports for the agricultural sector involve expenditure of valuable foreign exchange. Thus both from the angle of exports and imports agriculture occupies an important place in the life and economy of the country.

**Significant Placing in Government Budgets :**

The budgets of the government of both the state and the centre have been considerably influenced by the expenditure on its development on the other. The total estimated yield from land revenue and other agricultural tax has been for example, around Rs.1600 crores.

It is no doubt a small amount, a little less than one percent of the revenue from the states, taxes. But all the same it does make some difference to the revenues of state government who are always short of funds. Perhaps not incorrectly, this sector is being viewed according to the recommendations of the Raj Committee, as a potential source of big tax revenues in future. In this background it is essential to have glimpse of the irrigation out lay during plan period. (Table 4.1 and Fig.4.1)
Table 4.1

Irrigation Outlay and Development During Plan Periods:

Investment on Irrigation

<table>
<thead>
<tr>
<th>Plan</th>
<th>Investments (Rupees in Crores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Plan</td>
<td>455</td>
</tr>
<tr>
<td>II plan</td>
<td>430</td>
</tr>
<tr>
<td>III plan</td>
<td>665</td>
</tr>
<tr>
<td>Annual plans</td>
<td>471</td>
</tr>
<tr>
<td>IV plan</td>
<td>1354</td>
</tr>
<tr>
<td>V plan</td>
<td>3876</td>
</tr>
<tr>
<td>VI plan</td>
<td>10,930</td>
</tr>
<tr>
<td>VII plan</td>
<td>16,590</td>
</tr>
<tr>
<td>VIII plan</td>
<td>32,525</td>
</tr>
<tr>
<td>IX plan</td>
<td>55,420</td>
</tr>
<tr>
<td>X plan</td>
<td>103,315</td>
</tr>
</tbody>
</table>

Source: Indian Economy, A.N. Agarwal.
Fig. 4.1:
Bar graph showing Irrigation Outlay and Development during Plan Periods

Investments (Rupees in crores)

Plans

I Plan  II plan  III plan  Annual plans  IV plan  V plan  VI plan  VII plan  VIII plan  IX plan  X plan

455  435  665  471  1344  3616  10830  16560  32535  88420  103315
Influences Industrial Structure, Transport and Other Services:

Agriculture through the provision of raw materials determines a large part of the country's industrial set up. Many industries process agricultural products and many other manufacture agricultural products into finished goods. Examples are vanaspathi, rice bran oil, cotton seed oil, coconut and copra oil, cotton textiles, jute manufactories etc. Those constitute a significant part of the industrial profile of the country, particularly in respect of consumer goods for domestic consumption and exports.

Internal trade too is influenced much by the agricultural operations. In fact quite a substantial part of the country is trade is in agricultural products. A large part of transport is also dependent on agriculture. No less is the support that other services like banking, storage etc., get from the large operations in the agricultural sector.

Progressive agriculture will demand, among other things (i.e., favorable institutional and organizational structure), improvement in inputs and methods irrigation, better seeds, better manures and fertilizers, land reclamation and oil conservation, plan protection use of mechanization etc., these are various aspects of agricultural inputs which have to be considered here.

Irrigation:

Water is indispensable to agricultural production. In areas where rainfall is plentiful and well distribution over the year, there is no problem of water. But rainfall in certain areas is very scanty as well as

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uncertain. This is so in Deccan and central India, Punjab and Rajasthan. In these areas artificial irrigation is absolutely essential for without it cultivation is almost impossible. In certain regions, rainfall may be abundant but it may be concentrated in a short period of the year, the rest of the year being dry. As a result cultivation may not be possible for the whole year. In these regions, provision of irrigation will facilitate growing of more than one crop in the year. Finally, there are certain food and cash crop such as rice and sugarcane which require abundant, regular and continues supply of water. In short, water is a vital input to increase agricultural output to keep pace with the food requirements of the ever-increasing population.

**Sources of Irrigation in India:**

Since 1950-51 considerable importance was attached to the provision of canal irrigation. Canal irrigated area has increased from 8.3 million hectares to 17.1 million hectares during 1950-51 and 1992-93. Even then, its relative importance has come down 40% to 33 percent. During the period, it is well irrigation, particularly tubewell irrigation which has made the most spectacular progress. In 1960-61 0.1 million hectares were irrigated by tubewells, but in 1992-93. Over 14 million hectares were served by tubewell irrigation. Tubewell accounts for 30 percent of total irrigated area, well irrigated area has increased from 6 million hectares to 26.5 million hectares during the last 42 years. Well irrigation in 1992-93 accounted for 53 percent of the total irrigated area as compared to only 29 percent in 1950-51. The growth of well irrigation has been at the expense of irrigation from tanks and other sources in India. This is shown in Table-4.2 and Fig.4.2
### Table-4.2

**Table showing Area irrigated by sources in India**

<table>
<thead>
<tr>
<th>Sources of Irrigation</th>
<th>1950-51</th>
<th>1992-93</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area million Hectares</td>
<td>Percentage</td>
</tr>
<tr>
<td>Canal</td>
<td>8.3</td>
<td>40</td>
</tr>
<tr>
<td>Wells including tube wells</td>
<td>6.0</td>
<td>29</td>
</tr>
<tr>
<td>Tanks</td>
<td>3.6</td>
<td>17</td>
</tr>
<tr>
<td>Other sources</td>
<td>3.0</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>20.9</td>
<td>100</td>
</tr>
</tbody>
</table>

**Source:** Tata Service Ltd., Statistical Outline of India (1997-98).
Fig. 4.2: Bar graph showing Area irrigated by sources in India (1950-51, 1992-93)
In India irrigation works are classified into major and minor irrigation works. Since 1951 the "major" irrigation projects were defined as those costing more than Rs.5 crores “medium” projects as those costing between Rs.25 lakhs and Rs.5 crores and “minor” irrigation works costing less than Rs.25 lakhs each. Since 1978-79, the planning commission has adopted the following classification of irrigation schemes.

A. **Major Irrigation Scheme**:  
Those with cultural command areas (CCA) more than 10,000 hectares.

B. **Medium Schemes**:  
Those with culturable command (CCA) between 2000 and 10000 hectares.

C. **Minor Irrigation**:  
Those with culturable command areas (CCA) up to 2000 hectares. Gross are net irrigated area is shown in table.
Chapter IV

Table 4.3

Gross and net irrigated area in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Net irrigated area</th>
<th>Gross irrigated area</th>
<th>Area irrigated more than once</th>
<th>Net irrigated area as percent of sown area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>20.9</td>
<td>22.6</td>
<td>1.7</td>
<td>17.6</td>
</tr>
<tr>
<td>1970-71</td>
<td>31.1</td>
<td>38.2</td>
<td>7.1</td>
<td>22.1</td>
</tr>
<tr>
<td>1994-95</td>
<td>53.0</td>
<td>70.6</td>
<td>17.6</td>
<td>37.5</td>
</tr>
</tbody>
</table>

As a consequence of irrigation, about 17.6 percent of cropped area was irrigated in 1950-51 this has increased to 37.5 percent in 1994-95. Further there has been a gradual improvement in area irrigated more than once. In 1950-51, area irrigated area irrigated more than once was 1.7 million hectare of 8.1 percent of net irrigated area in 1994-95 this had increased to 17.6 million hectares or 33 percent in 1994-95. Area irrigated more than once is a kind of land augmentation and is, therefore very crucial in raising agricultural output.

Irrigation Potential:

When India started planned economic development in 1951, the irrigation potential from major and medium irrigation was about 10 million hectares and from minor irrigation works was 13 million hectares, totaling 23 million hectares.

Development irrigation potential is shown in Table-4.4
Table-4.4

Development of irrigation potential (Cumulative coverage)

(1950-51 to 1996-97)

<table>
<thead>
<tr>
<th>Year</th>
<th>Major and medium works</th>
<th>Minor works</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>10</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>1980-81</td>
<td>27</td>
<td>31</td>
<td>58</td>
</tr>
<tr>
<td>1990-91</td>
<td>30</td>
<td>48</td>
<td>78</td>
</tr>
<tr>
<td>1998-99</td>
<td>35</td>
<td>58</td>
<td>93</td>
</tr>
<tr>
<td>Ultimate potential</td>
<td>59</td>
<td>81</td>
<td>140</td>
</tr>
</tbody>
</table>

By 1998 to 1999 the total irrigation potential created had increased to 93 million hectares. Ministry of water resources has recently estimated that India's ultimate irrigation potential from major and medium works increased to 59 million hectares and minor works contributed 81 million hectares making a total of 140 million hectares.

The present long-term objective is to utilize the available water resources fully by the year 2010. For this purpose the government has prepared a national perspective for water resources development, which includes also storage and interbasin in transfer from surplus to deficit and drought prone areas.

Irrigation Potential and Actual Utilization:

Unfortunately, the irrigation potential created over the years (in major and medium works) has not been fully utilized. Over the years, the gap between the potential created and the actual utilization was widening. For instance, at the end of the seventh plan (1989-90), the irrigation potential created and the actual irrigation utilized were 77 million hectares and 69 million hectares respectively. The gap (between potential) had widned to 8 million hectares. By 1996-97 this gap between potential and actual irrigation has widened still further against irrigation potential of 93 million hectares created, the non utilization was only 84 million hectares. The actual utilization of the created irrigation potential occurs mainly and drains and in land levelling
With a view to narrowing the gap between the potential created through the major and medium works and its ground level full utilization, the government had started the command area development (CAD) programme. The basic objective of CAD programme is to maximize productivity in the irrigation command areas through an integrated approach covering farm development works. Including construction of field channels and fields drains, land shaping wherever necessary and the introduction of rotational supply of water to ensure equitable and assumed distribution to individual farm holdings. CAD programme has not been particularly successful even though the Eight Plan expected greater participation of the farmers in the various activities of CAD programme.

The emphasis in recent years is on minor irrigation works using ground water resources. Minor irrigation works are relatively less capital intensive and do not take long to construct. Expansion of minor irrigation works, however, depends on private initiate and naturally it depends upon the formers, perception of profitability, easy and cheap availability of such facilities as electric power, supply of diesel construction material credit etc. Expansion of rural electrification works, minor irrigation works are of special importance to raising pulses and oil seeds as these crops require only limited irrigation
facilities. Finally, there is almost no time lag between the creation of irrigation potential and its utilization is the case of minor works.

In 1950-51, only 8.2 percent of the net irrigated area was sown more than once; the percentage rose to 33 percent in 1994-95. This means that either the bulk of irrigation gives security to only one crop or agronomi practices in the irrigated areas have not developed sufficiently to permit more than one crop. If we assume that the entire irrigated area can be made to support two crops. Then 69 percent of irrigated land is under-utilized. This extent of underutilization is not met with in any other type of planned the possibility of raising 10 to 11 tonnes of hectare on irrigated land subject to multiple cropping and proper alternative rotations of crops. Full utilization of existing irrigation resources alone can, therefore, boost food graining production from the present 200 million tonnes to anything between 300 and 400 million tonnes. The following are some of the important factors for under utilization and the necessary steps to remove them.

(i) Indian farmers by and large lack the necessary knowledge to optimize irrigation use. They do not know appropriate agronomic practices including suitable varieties of short-maturing crops, appropriate crop rotations etc. In this connection, it is necessary to provide better extension services suitably linked with research organization of scientists and adopted to multi cropping farming practices.
Supporting facilities necessary for optimum use of irrigation etc., land levelling, land shaping, land consolidation efficient and channels etc., are absent in many parts of the country.

Even major and medium irrigation works have not been properly maintained. Minor irrigation works particularly tanks and open wells, have been largely neglected. To remove this important defect, it is necessary to undertake extensive rehabilitation, renovation and modernization of existing irrigation systems.

Faulty irrigation practices and absence of proper and adequate drainage facilities have not only been responsible for waste of water but for waterlogging, salinity and alkalinity which have permanently damaged considerable portion of cultivatable land. Education in water management and provision of drainage facilities will help to remove this defect. It has been planned to install 6 lakh shallow tubewells in certain districts of Uttar Pradesh, Bihar, Orissa, West Bengal, Assam and Andhra Pradesh where ground water, potential assured irrigation facilities at low cost in these potentially high output and yield areas.

Irrigation in the Ninth Plan:

The ninth plan intended to enlarge irrigation capacity and at the same time improve the efficiency of irrigation. The overall strategy of irrigation development and management in the Ninth plan has the following ingredients.
1. To bridge the gap between potential created and its utilization by strengthening the command area development (CAD) programme institutional reform and promoting farmers involvement in irrigation management, this is achieved with great success.

2. To complete all ongoing projects particularly those which were started during pre fifth plan periods, and the projected completes.

3. To introduce National pricing of irrigation water based initially on operation and management (O & M) cost.

4. To encourage and implement the conjunctive use of ground and surface water towards optimal utilization of water resources and to have its development environmentally sustainable as well.

**Proposed Outlays and Targets:**

As against an investment of Rs.54.106 crores on irrigation and flood control in the Eight plan (at 1996-97 prices), the ninth plan proposed an outlay of Rs.56.441 crores on irrigation and flood control in the public, which is marginally higher by only 4.5 percent of the eight plan outlay. This is shown below in Table-4.5.
Table-4.5

Ninth Plan Outlay for Irrigation and control 1997-2000
at 1996-97 prices

<table>
<thead>
<tr>
<th>Head</th>
<th>Rs. Crores</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major and medium irrigation</td>
<td>43.035</td>
<td>76.30</td>
</tr>
<tr>
<td>Minor irrigation</td>
<td>9.315</td>
<td>16.50</td>
</tr>
<tr>
<td>Command area development</td>
<td>3.013</td>
<td>5.30</td>
</tr>
<tr>
<td>Flood control</td>
<td>1.078</td>
<td>1.90</td>
</tr>
<tr>
<td>Total</td>
<td>56.441</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Compiled and computed from planning commission ninth year plan 1997 2002, Vol.-IV.
Irrigation Water Charges:

Although the planners have been advocating the rationalization of water rate so as to recover annual maintenance and operation charges and a part of the fixed costs, most state government have at present very low irrigation water rates and these rates have not been revised for the last 2-3 decades. A few states revised water rates but with held their implementation on political considerations. Most of the north-eastern states with the exception of Assam and Manipur do not charge any irrigation water rate. The states of Andhra Pradesh, Maharasstra, Haryana and Orissa have revised the water rates recently. There is a need to persuade the state to rationalize water rates.

Private Sector Participation in Irrigation:

The increasing demand for investment in irrigation cannot be met by the public sector from its own sources. It was therefore, found desirable to open the irrigation sector for private sector participation so as to supplement of effort of the state to extend irrigation facilities necessary for boosting agricultural production. For this purpose the government appointed a committee under the chairmanship of Mr. P.V. Rangiah Naidu, the then minister of state of water resources, which submitted its report in December 1997. Since the committee was pre occupied with the idea of finding sources of private investment in irrigation, it conceived of private sector participation in a very narrow sense and included only the participation of corporate sector, but did not include private groups. Such as, water users associations (WUA's), Non Governmental Organization (NGO's) and general public critics highlighted the narrow focus of this committee and insisted that privatization of irrigation should not only include private corporate sector, but also Water User’s Associations (WOA’s) NGO’s and the general public. Table-4.6 has outlined the various forms of privatization in irrigation.
### Table 4.6

**Major Players and their roles in Privatization**

<table>
<thead>
<tr>
<th>Main group</th>
<th>Sub group</th>
<th>Participation configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private corporate sector</strong></td>
<td>Irrigation companies</td>
<td>A. Build own operate system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Build own transfer system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Lease own operate system</td>
</tr>
<tr>
<td></td>
<td>Consulting outfits</td>
<td>A. Engineering consultancy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Managerial consultancy</td>
</tr>
<tr>
<td></td>
<td>Contracting firms</td>
<td>A. Main contracting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Sub contracting</td>
</tr>
<tr>
<td><strong>Water users associations</strong></td>
<td></td>
<td>A. Turn over system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Water bound system</td>
</tr>
<tr>
<td><strong>NGO’s</strong></td>
<td>Formal organizations /informal /local organizations</td>
<td>Legal /technical services organization services construction via water bond.</td>
</tr>
<tr>
<td><strong>General Public</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Source**: Compiled and computed from Planning Commission, Ninth year Plan, 1997-2002, Vol.IV.
Role of Government:

Privatization of irrigation will help it reduce the direct role of the government in irrigation financing, but its role as a facilitator and regulator will be greatly enhanced. The major areas in which the government has to play its role are:

1. While private sector participation may be more suitable for medium and minor projects, it may pose problems in the case of major projects. The government has, therefore, to continue its role of financing big irrigation projects.

2. The help the private sector, clearances such as forest, environment, resettlement and rehabilitation of oustees, acquisition of land etc., should be carried out by the government department.

3. The government should offer concessions to private sector investors to augment their return. These concessions can take the form of tax concessions, moratorium on loans, tourism facilities navigation etc.

4. The government should be a guarantee on the return of investment by the private sector of the government and the private sector in the agreement for such participation.

Privatization of irrigation has potential overtones and it would, therefore, be desirable in the first instance to undertake those forms of privatization, which are politically less sensitive in the present setup. At the first stage, it would be in the fitness of things to promote WUA's, NGO's. At the second stage, it would be prudent to undertake
legal and institutional reforms to facilitate the process of privatization of irrigation. As the first and the second stage get consolidated the more difficult options involving private corporate sector in construction and management of irrigation may be attempted. Such a sequencing of privatization has greater chance of success since it would have prepared the ground for a change over by policy makers from state sponsored irrigation practiced for the last five decades to a privatized pattern of irrigation and development.

**Source of Problems:**

Water is available in abundance on the surface (rainfall and rivers) and under the ground (through the see page of a part of the surface water). However despite its abundant supply, the country is faced with some serious problems.

**Surface and Ground Water:**

3 Of the two sources of surface water, one is rainfall. The annual average rainfall over the country is around 1000 mm /40 inches. It is, however, very unevenly distributed, geographically and time wise, spatially, there are areas (like the west coast and the Assam region) which get as much as two and a half times or more rainfall than the average. At the other end are areas (like Rajasthan desert and Ladakh) where it is very scantily at one fourth, or less of rainfall than the average. Time wise the bulk of rainfall occurs in the south-west monsoon period covering 4-5 months of June to October. A small part occurs in the North-east monsoon period of two months in November.

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and December. A large part of the country experience acute shortage in the other months.

As for rivers, the other source of surface water there are 14 major rivers (with a catchment area of over 20,000 sq km. each), 44 medium rivers with a catchments area of 2,000-20,000 Sq km each) and the rest large many, are the minor ones (with a catchments area of less than 2,000 sq km each). As for their flows there are perennial rivers of the Himalayan region which are show fed and carry considerable quantities of water throughout the year. And there are seasonal rivers which depend on rainfall and carry enormous water during the monsoon period (June-October), but a mere trickle in the dry – weather period.

Ground Water is a part of the surface water which gets accumulated below the surface of the ground. Of the water that seeps into the soil, a portion remains in the top layers of the earth and produces moisture which is essential for the growth of vegetation. The remaining percolates into the porous strata and goes below the surface. Unlike rains and rivers which cover most parts of the country, ground water, is available largely in certain areas like, for example, the Indo-Gengetic plains of Pubjab, Haryana, Uttar Pradesh, Bihar and West Bengal. Actually, large many areas of the country remain unexplored in so for as this source of water is concerned.

**Acute Scarcity :**

Among he problems that the country is up against, the most serious is its shortage in several respects, like for drinking, irrigation etc. The percapita fresh water resources at present (1996) is a mere
2.167 cubic meters. Its smallness is obvious when looks at the world average at 8.338. It is less than even the average of the income economic at 5.214 and for lower than that of the high income economics at 8.565. The average for the country, though very low, does not represent the entire reality even remotely with many areas getting much less than the average and some remaining completely day for months.

Of the several uses, the shortage of drinking water is a painful reality for large many. With 18 percent of rural population, and 15 percent of urban population, without access to safe water. In fact the water available for domestic use (drinking, municipal use public services, commercial establishments, and houses) is small at only 3 percent of the total available. It is 10 percent for the world and 15 percent in the case of the high –income countries. The other users, namely agriculture and industry which get 93 percent and 4 percent respectively of the total available, too are faced with severe shortages of water for irrigation for cooling etc.

Worsening Pollution:

Another problem is that of the pollution of water which in on the increase because of the fast –rising population and rapid industrialization of the country. A major part of the problem is contamination of the water, caused by the disease bearing human waste agro industrial effluents, intensive use of fertilizers etc.

As a result the surface water, largely that of the rivers, get contaminated with toxic chemical and heavy metals such as lead and mercury even the ground water is getting polluted because of the
seepage of water contaminated by the improper use and disposal of heavy metals, synthetic chemical and other hazardous water.

The consequences are appalling. The supply of clear water gets reduced substantially. The use of such water for drinking and bathing causes infection leading to such killer diseases as typhoid, cholera, etc., effecting most the children and the poor. The damage to the finisharies, the main source of protein and livelihood for many is tremendous. The lands too get spoilt with harmful chemicals eating into the vitals of the soils with polluted materials accumulated, navigation in several slow moving rivers ceases to be smooth.

Floods occurring during the monsoons, are almost a regular yearly, phenomenon most of years these are devastating in their effects, causing havoc to the human life, the animal life, the lands, the standing crops and the property caused primarily by heavy rains the swollen rivers become savage as with deforestation on an increasing state, there is nothing on the way of the rivers to abstract or slow down their flows. This causes erosion of the lands around the rivers. This in turn results in the rich top soil from being carried away form the hills to the rivers and then to the sea. Also there takes places siltation of the rivers beds. The silt deposits by raising the river beds, make the floods more ferocious which also reduces their navigation capacities.

No less damaging are the drought which too are a recurring phenomenon in some parts of the country like those in Rajastan. These areas go without water, even when it is raining else where. These cause severe hardships to the people for want of water for drinking, livestock production, irrigation etc. Sown crops wither away.
The quality of lands gets deteriorated. Together with floods, these calamities cause huge losses of various kinds. Government at the centre and the states incur huge expenditure for fighting floods and droughts and for the rehabilitation of the affected people.

**Remedial Measures:**

Plagued with serious problems of water supply, it is necessary that we devise ways and means to make the best of this precious resource.

**Additions and Conservation:**

The most important first step is to augment water supplies form out of the big potential that lies untapped and conserve it in a manner that it is available to all and throughout the year. As for increase in the quantity of water, there is ample scope for the same. The present fresh water with drawals stand at just 500 billion cubic meter. This is just 26.2 percent of the total resources. Further increase in the water supply can be made by using developing technologies for discovering new sites of ground water. Desalination of seawater, creation of artificial rains etc.

As for conservation of water, the most important remedy in a monsoon fed country like India, lies in augmenting the ground water. For this a number of measures need to be adopted. One, for example, concerns levelling of land, along side extensive contour building so as to collect water that will seep in to the soil. Another remedy is to cover the soil with vegetation (like fodder crops, forests etc), so that the flow of the surface water gets slowed down, which in turn, will result in greater seepage of water into the sub-soil. Besides, measures need to
be taken to expand the age-old practice of storing water in dams and tanks and carrying the same through canals. Storing water in dams, as in the modern practice for generation of electricity, is also of great help in conserving water. All these measures will also reduce the intensing of floods. Besides, measures to predict floods and to take timely action to protect people and property can go a long way in reducing the fury of floods.

**Optimum Utilization:**

It is also essential that the use pattern of water is so designed as maximizes down of priorities with the need for drinking heading the list followed by agriculture (Farming and livestock production) industries etc., an important aspect of the water use is to ensure its even distribution. Spatially and temporally, linking of rivers in particular the perennial ones, in the form of a national grid, can be of great help in diverting surplus water to deficit water areas. Another essential step is to ensure that the available water is not wasted. This requires in the first place measures to prevent pollution of water, as also treatment of polluted water.

Secondly, there is the need for an economic use of water. For example, the age old practice of irrigating land through what is aptly described as a flooding of land, has to be given-up. Instead sprinkle and drip systems of irrigation as practiced in Israel need to be adopted. Again to overcome the problems of water-logging and salinity provision of drainage of water along with the creation of irrigation facilities must be made. An important aspect of an optimum utilization of water is the consideration of efficiency in delivering water and in making use of the
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same. It requires the use of the most modern technologies so as the minimize the real to costs of water supply and its use.

All these considerations listed above concern the supply side of water. However, demand side too is important. Given the overall scarcity and the rapidly rising needs, it is necessary that the consumption of water is also kept with in limits. Though education and publicity, consumers /users of water need to be sensitized on this vital matter, so as to keep a healthy balance between the supply and demand.

Unfortunately the present practice in respect of water pricing is for from satisfactory. In agriculture, for example, water is used almost free of any charge in several areas of the country. As a result irrigation system is such as involves much waste of water. In urban areas the picture too is no better consumers are charged only for costs incurred on the supply of water and for clearing of water after use.

In order that the county acquires a proper water system an appropriate pricing policy has to be applied, such a policy should have the following elements : different rates for different users (for example, normal charges for drinking water); subsidization of water supplies to weaker sections (like small farmers, poor people etc); over all the charges should cover running costs and the investment costs.

As discussed above the country's water system can be upgraded to serve best the interests of the people. If its management is done along the lines which ensures the required additions and conservation of water its optimum utilization and appropriate pricing.
National Agricultural Policy -2000:

In the context of the present state of agriculture and its problems, we may now discuss the government's policy in titled the National Agricultural policy, announced in July 2000.

Main Features:

The policy covers several aspects of the agricultural sector as is obvious from the official document which says “The national policy on agriculture seeks to actualize the vast untapped growth potential of Indian agriculture, strengthen rural infrastructure, to support faster agricultural development, promote value addition accelerate the growth of agro-business create employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization.”

The policy aims at achieving an annual agricultural growth rate of over 4 percent. It is to be: growth that is based on efficient use of resources and conserves soil, water and bio-diversity, growth with equity, which is widespread across regions and farmers, growth in demand driven and caters to domestic markets and maximizes benefits from export of agricultural products in face of the challenges arising from economic liberalization and globalization; growth that is sustainable technologically environmentally and economically.

A set of measures relate to the land reforms. These are meant to encourage consideration of small and fragmented holding. These also aim at speeding up the reforms in respect of the right of the tenant and share croppers. Updated of land records has also been provided for.
The private sector is also brought in through land leasing (i.e., giving private lands on lease for agricultural operations) and contact farming.

An in aims, so in its means, the policy has provided for some much needed reforms of the agricultural sector. One desirable change concerns the enlargement of the functioning of the market. The policy aims at doing away with several controls, besides progressively removing regulations restrictions on the movement of agricultural commodities.

**Comprehensive in Nature:**

The National Agricultural Policy -2000: The policy is good also for the reason that it is all embracing in its scope. It brings in its orbit almost all that concerns agriculture: farming; animal husbandry; fisheries, both marine and inland; and agri business. In the development of the sector, the policy covers almost all the aspects agriculture; investment, growth, productivity, terms of trade, technology, environment, liberalization etc.

**Progress of Agriculture:**

1. "A Scheme for giving matching grant to those panchayats who invest on development of community wastelands through J.R.Y funds should be finalized.

2. The efforts of N.W.D.B. for raising awareness need to be further strengthened through video films pamphlets, electronic and print media.

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3. The evaluation and monitoring work in K.W.D.B. needs to be strengthened.

4. State government who have not created a department board for wastelands development should be requested to set up a department immediately.

5. The issue of legislation to discourage farmers from leaving land fallow should be referred to the land reforms Division and the department of rural development.

6. The progress regarding the creation of a single department for land resources should be put up before the Board in its next meeting. The DOWD should vigorously pursue the idea of creation of this department.

7. Guidelines for delegating the power to sanction IWDP scheme under the common guidelines for the future years should be drawn up.

8. ICAR be asked to organize a workshop on the process of herbs and medicines being grown in the watershed projects.

Wastelands Development Task Force:

1. In June 1994, the central government considered the creation of the wastelands development task force, held under the chairmanship of secretary (RD –WD). In this meeting it was decided that a force should be created to develop the inaccessible and highly degraded ravines morena district of Madhya Pradesh.
2. Objectives:

The W.D.T.F. will have the objective to provide disciplined force for regeneration of wastelands through afforestation including:

- In situ soil and moisture conservation;
- Plantation
- Maintenance of plantation
- Protection

3. In order to fulfill this objective it has been decided to raise a force of 300 ex-service man under the command of the territorial Army. A core group of 15 army /territorial army personal will be constituted. This force will work in the ravines located on a site identified by the state government and will take up development of 390 hectares of ravines every year.

4. For 1994-95 Budget provision of Rs.1.50 crores have been provided. The expected expenditure on the initial raising of the force will be Rs.81.82 lakhs and the recurring cost for the force will be Rs.53.56 lakhs.

Wasteland development technologies are shown in Table.4.7.
**Wastelands Development Technologies:**

**Table-4.7**

The following statement showing the wastelands development technologies.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Type of Wastelands</th>
<th>Associated Institutes</th>
<th>Available technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gullied and ravinous</td>
<td>FRI Dehradun CSWCRI</td>
<td>Technology available but economics varies depending upon the severity of the problem.</td>
</tr>
<tr>
<td>2</td>
<td>Uplands with and without scrub</td>
<td>FDI Dehradun SFRI Jabalpur, IDF Jabalpur</td>
<td>- Do-</td>
</tr>
<tr>
<td>3</td>
<td>Degraded forest areas</td>
<td>FDI, D. Dun IGFRI Jhansi, CAZRI Jodhpur, SFRI Jodhpur, SFRI Jabalpur (MP) IDF Jabalpur</td>
<td>Technology available recommendations may very depending upon site factors.</td>
</tr>
<tr>
<td>4</td>
<td>Sand deserts including coastal deserts</td>
<td>CSSRI Karnal, CSMCRI Gujarat, CAZRI Jodhpur</td>
<td>Technology available</td>
</tr>
<tr>
<td>5</td>
<td>Water logged and marshy lands</td>
<td>FRI Dehradun, SFRI Jabalpur (MP)</td>
<td>Technology available but needs refinement</td>
</tr>
<tr>
<td>6</td>
<td>Saline and alkaline</td>
<td>CSSRI Karnal, CAZRI Jodhpur, CSMCRI Gujarat Research wing of UP Forest Department, B.B.R.I. Lucknow</td>
<td>- Do -</td>
</tr>
<tr>
<td>7</td>
<td>Shipiting cultivation</td>
<td>D.F.R.T. Jorhat, IDF Jabalpur</td>
<td>Technology is to be developed.</td>
</tr>
<tr>
<td>8</td>
<td>Degraded pastures and grazing lands</td>
<td>IGFRI Jansi FRI Dehradun CAZRI Jodhpur</td>
<td>Technology available</td>
</tr>
<tr>
<td>9</td>
<td>Mined waste lands</td>
<td>FRI Dehradun, IDF Jabalpur, SFRI Jabalpur</td>
<td>Technology is to be refined</td>
</tr>
<tr>
<td>10</td>
<td>Steep hilly slopes</td>
<td>FRI Dehradun, Research wing U.P. Forest Department</td>
<td>Technology available</td>
</tr>
<tr>
<td>11</td>
<td>Barren rocky/Sheet Rock Areas</td>
<td>FRI Dehradun SFRI Jodhpur</td>
<td>Technology available but costly</td>
</tr>
<tr>
<td>12</td>
<td>Snow covered and/or gracial areas</td>
<td>FRI Dehradun</td>
<td>Technology to be developed</td>
</tr>
</tbody>
</table>

**Source:** Developing India’s Wastelands Government Ministry of Environment and Forests
Like India, Pakistan too is a water irrigation dominated country. But there is no water problem. Therefore they can concentrate more producing salt and other things.

It can be said that in Egypt and Sudan country’s water irrigation is developed from the Ancient period like in India. But there the ancient method of irrigation is followed since Nile river over flows throughout this year abundant water create the problem of strength in soil, production etc.

Soil is losing its fertility in Australia, Jawa, Japan, France, Speria and other countries. It is the significant problem in these states. Fertile soil, after water irrigation loses its fertility and to use the same sort soil, again new programmes have to framed.

Country like Japan, Israel, Tunishia face the problem of lack Agricultural land and Greece, Russia, Iran, Iraq, Speria, Turkey, Moracco face the problems like Salty soil, soil erosion etc.

When we analyze the problems of water irrigation regions all over world similarities in these problems are understood and several scientists are researching concerning these problems.

We must give important to following steps:

1. Rain and water harvesting, recycling of water
2. Managing of reservoir
   (a) Desiltation of reservoir

5 Problems of Irrigation by Department of Agriculture and Irrigation Department, Bangalore.
(b) Identifying the border of reservoir (using topo sheets and satellite remote sensing).

(c) Identifying of the border of reservoir (with the help of village map).

(d) Identification of sub-reservoir and small reservoir.

(e) Westernization of water reservoir on the basis of earth capacity dividing.

(f) The role of reservoir in large irrigation planning in management.

(g) Water in management.

3. Creativity of Bunds

(a) Different sizes of Bunds practiced as in Karnataka

(b) Distance and bifurcation of Bunds

(c) Ultimate bund, and basic line of plain bunds

(d) To have bed of a stream of stones

4. Flood gates

(a) Types and structure of greater to be divide

(b) Selecting of place of gates

(c) Structure of water flowing over the gates

(d) Structure of various types of gates.

(e) Identification of length and width of tank gates.

5. Channel Bund

(a) Selection of the place of channel bund

(b) Preparation of quotation paper on channel bunds

(c) Structure of channel bund

(d) Preparing map of the bund
6. Check dams

(a) Selecting the place of check dam and preparation of paper survey.

(b) Preparation the map of small check dam depth of the channel width of the bottom, height and width of the top identifying the slope of the two sides of the channel.

(c) Survey of land of small check dam (depth of the channel)

(d) Structure of small check dams

(e) Identifying the width of the bottom of the check dam

(f) Identifying the length and width of bottom and top of the main wall.

(g) Identification of the strength of the main wall of the check dam.

**Uses of Rivers in Different Objective Planning's:**

7In India rivers are used for different objectives since the planning era started with the brief introduction from some significant planning’s uses from different angles of rivers and the complete scope of these can be understood.

In 1958, Damodhar Valley corporation was started on the basis of American Tennesi valley corporation to the complete developments of Bihar and Damodar and Borokar valley’s of West Bengal to implement Damodhar valley programme were framed. This programme has different objectives of checking floods, providing irrigation to several regions, electricity, shipping system, forestry and providing tourism facilities. To the implement these objectives dams, reservoirs and

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electric industries are constructed at Telaiya, Konar, Millan, Panchatal till and to provide irrigation facilities to 9.7 lakhs acres land from Raniganj coal centres, where the coal mines are constructed to Calcutta shipping facility too is constructed.

Backranangal programme and other prominent programme with different objectives is completely utilized by Punjab, Haryana and Rajasthan states. Damsand reservoirs, electricity producing units constructed Bakra and Nagnal to Sutlej river provides water resources to 14.6 lakhs hectares land through main channels. To check floods, forestry, construction of Tourist places are other objectives of this programme. Beas river programme is utilized by Punjab, Haryana and Rajasthan states.

According to Hirkud valley, programme three dams are constructed at Hirakud, Tikapara and Naraja and electricity producing units are constructed. Hirakud dam is the biggest dam in the world which provides water for four lakhs hectares. Electricity units produce 1.33 lakh K.W. electricity. This is helpful in controlling the river fishing and construction tourist places.

River Kosi which is useful to Bihar and parts of Nepal along with providing water to 5.7 lakh hectares, it is also useful to produce electricity.

The uses of Rihand project of Uttar Pradesh, Madhya Pradesh and Chambal project of Rajasthan, Tungabhadra project of Andhra Pradesh and is Nagarajunasagar project of Karnataka etc., now implemented for the reformation of modern Indian economy.
Directive Principles of Irrigation Project:

The significant factors considered while giving prominence to irrigation and electricity project are mentioned in the First planning. They are as follows.

1. While utilizing river water several purposes the projects are given more importance, than others, which are more useful in increasing the national economy.

2. More concentration give to the projects which gives immediate out put and also useful completely to the people.

3. While implementing the programmes, regional food demands and the development of economically backward regions are considered.

Table-4.8 provides a birds eye view of development of irrigation in different states.
### Table 4.8

**Development of Irrigation Different states from 1951-52 to 1984-85**  
*(In thousand hectares)*

<table>
<thead>
<tr>
<th>States</th>
<th>Big and middle irrigation projects</th>
<th>Small Irrigation projects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Final Ability</td>
<td>Irrigation ability constructed at the time of 1984-85</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>5000</td>
<td>3628</td>
</tr>
<tr>
<td>Assam</td>
<td>970</td>
<td>129</td>
</tr>
<tr>
<td>Bihar</td>
<td>6500</td>
<td>2979</td>
</tr>
<tr>
<td>Gujarat</td>
<td>3000</td>
<td>1264</td>
</tr>
<tr>
<td>Haryana</td>
<td>3000</td>
<td>1929</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>50</td>
<td>06</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>250</td>
<td>138</td>
</tr>
<tr>
<td>Karnataka</td>
<td>2500</td>
<td>1269</td>
</tr>
<tr>
<td>Kerala</td>
<td>1000</td>
<td>564</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>6000</td>
<td>1802</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>4100</td>
<td>1700</td>
</tr>
<tr>
<td>Manipura</td>
<td>135</td>
<td>43</td>
</tr>
<tr>
<td>Meghalaya</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Nagland</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>

93
<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Rainfall</th>
<th>Rainfall %</th>
<th>Area (Ha)</th>
<th>Yield (Ton)</th>
<th>Production (Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orissa</td>
<td>3600</td>
<td>1568</td>
<td>43.6</td>
<td>2300</td>
<td>1060</td>
<td>46.1</td>
</tr>
<tr>
<td>Punjab</td>
<td>3000</td>
<td>2462</td>
<td>82.1</td>
<td>3550</td>
<td>3174</td>
<td>89.4</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>2750</td>
<td>1812</td>
<td>65.9</td>
<td>2400</td>
<td>1987</td>
<td>82.8</td>
</tr>
<tr>
<td>Sikkim</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>22</td>
<td>14</td>
<td>63.6</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>1500</td>
<td>1244</td>
<td>82.9</td>
<td>2400</td>
<td>1950</td>
<td>81.3</td>
</tr>
<tr>
<td>Tripura</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>115</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>12500</td>
<td>6813</td>
<td>54.5</td>
<td>0</td>
<td>13200</td>
<td>11990</td>
</tr>
<tr>
<td>West Bengal</td>
<td>2310</td>
<td>1587</td>
<td>68.7</td>
<td>3800</td>
<td>1712</td>
<td>45.1</td>
</tr>
<tr>
<td>Central Territories</td>
<td>160</td>
<td>20</td>
<td>12.5</td>
<td>250</td>
<td>133</td>
<td>53.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>58475</td>
<td>30497</td>
<td>52.1</td>
<td>54857</td>
<td>37778</td>
<td>68.1</td>
</tr>
</tbody>
</table>

Methods of Irrigation:

1. Watering to the Paddy Field:

   It is called 'Flood system'. The land in leveled and the water flows all over the field simultaneously with this same quality and water. This method is followed when the water from lake or channel is used. This needs abundant of water. Sometimes more water is used than necessity. This method is not appropriate for the soil which does not give up water immediately. This water touches the tees and so is attacked to disease immediately. It also create problem to the roots to breath.

   This method is of no use when the land is levelled.

2. Basic Method:

   In this system, little away from the plant the soil is taken back and a kind of small wall is constructed to check the water and the water is flown in to the plant. Watering through a bed of stream of water covers the complete area equally. For the small plants small bed of sand around the plant is constructed and it is widened as the plant grows up. It is widened to the end of the branches when it grows to a old tree. This method is helpful to the small plants. This is not used in a valley kind of land. This water should be absorbed by the land immediately. Otherwise the trunk of the tree will decay. This needs more water.

3. Check system:

   It resembles flood system instead of single plant, watering is done to several plants at a time small beds of and is constructed to all the
plants. A bed of a stream of water is situated to two lines of plants. This method needs less water than the first method. Sometimes this water is not absorbed immediately and so the structure of the land is affected.

4. Ring System:

This method, to some extent, resembles check system, 60-90 cm away from the free a hole of 15 cm length and deep is dug and water is stored in it. If the trees are old the distance of the ring too is increased. In this method water does not delayed and affected to any disease. Fertilizer too can be put into the ring. If there is heavy rain the stored water may damage the trees.

3. Border strip or modified ferro system:

This is a good method water is bifurcated to sub-channels from the main channel. Therefore water is observed by the whole land, and the soil too is not transported or eroded. This is a easy system. To this method the land should be levelled and abundant of water is needed.

6. Ferro System:

Land is levelled, beds of a stream of water are contracted and water is flown through these beds of a stream of water. There is a difference in the number of beds of a stream of water. For small plants a bed of stream of water is constructed for two lines of plants. Generally the lengths of this channel will be 60 to 100 metres. Their width will be 45 cms and depth will be 15 cm watering the big trees in this system line channels are constructed at the distance of 100 to 150 cm abundant water is necessary to this method and the sub channels
should not be to deeper, whole land is not moisted. Therefore the soil is not eroded.

7. **Sprinkler System:**

Sprinkler system is used in coffee, tea, etc. Plantations, watering is done through the pipes. These pipes are placed between the lines and water spreads over the land through the sprinkler. To this system water must rush quickly. Drops of water fall of the plants and are not affected since they are small water drops and the soil too does not change its place or eroded. This needs more money. More water is necessary for this method. It the watering is done in this system when there is too heat of the sun and wind water is evaporated into the air.

8. **Pot Irrigation:**

This is suitable when there is lack of water, watering can be done in this system to coconut and tees and leacky. Leacky pots are buried 1 metre away from these and those leacky pots are filled with water. Through these pots water leaks all over the time. Burnt pots are good to this system. Those pots should contain 10 litres of water, small holes are made to those pots and these are filled with ropes. When the water is filled the water through the ropes mingles the soil. These pots can be filled once in a week. The top of the pot is covered.

Sometimes they are broken and these broken pots should be replaced by the new ones. One pot to a small plant and two to the big plant are enough. They are burried to neck level.
9. Hand Watering:

This method is used in nursery level of the plants and when there is a less number of plants, generally this system is used all over.

It is better to use this method when the seeds are sown. Generally the farmer takes pot and place hit hand against to the mouchi of the pot and spreads water over the field. By this method the seed may come out of soil or the plant may break. Therefore water with the facility of sprinkler can be used. So that there won’t be force of the water and the whole land is moisted. Since it has a strong handle it can hold easily.

Drip Irrigation:

In this system of irrigation water runs through the pipe and fall in drops, through the instrument attached to the pipe, without creating any holes in the soil and without soil erosion. Roots of the plant use the water completely. It is understood that it is best method than forms of irrigational methods.

History of Drip Irrigation:

The history of water irrigation is too interesting. It started in 1940. Sinkchablas an Engineer from Israel saw the tree beside a leading water tank growing prosperously than other frees. Placing this at the centre he become the creator of drip irrigation. Surprising with this he proved that watering the plants using drip irrigation, high yield production is possible keeping this stand point he framed drip irrigation system and also got recognition from the government.

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By 1948 the labourers of Green Houses of United Kingdom started using this system for the Tomato plants. In Israel this methods was adopted in 1960. Later in America, Australia and other countries come into being.

In our county in 1983 only 250 acres of land was under this kind of method of irrigation. It increased to 17,200 acres in 1989.

**Advantages of Drip Irrigation:**

1. 40% of water is saved.
2. There is no weeds problem in summer.
3. Fertilizer are not eroded.
4. 40% of labour is saved.
5. Watering can be made even at right time.
6. 15% high production is possible from the available water.
7. Use of drip irrigation in grape production saves 30% pesticides.
8. The duration of banana is reduced by 7% percent.

**Turning over Irrigation Management to Farmers:**

**Prospects and Constraints:**

9Performances of the irrigation sector in increasing agricultural productivity in India is observed to be, sub-optimal, inefficient and inequitable. Therefore, in recent years many organizational and institutional reform measures have been undertaken in irrigation sector to improve the system performance. It is emphasized that the water users within a canals command at tertiary level like minor/sub-minor

9 Kurukshetra June 2002, by Mamatha Swain P.4, 5, 6, 7.
should organize themselves and form water users Association (WUA) which should be formally responsibility to these WUA's which include distribution of canal water among water users, operation and maintenance of the canal and collection of water rates.

In recent year proper utilization of natural resources like land water has became a matter of grave concern for policy makers and planners (Vidhyanthan 1994).

To meet the swelling demand for food due to growing population and in the face of scarcity of cultivable land, huge public investments are made on irrigation sector which is land augmenting in nature. It needs no emphasis that irrigation is a critical and crucial input required for agricultural production in as much as availability of irrigation water enables the use of other yield enhancing inputs like high yielding varieties of seeds, chemical fertilizer, organic mature and above all adoption of improved agronomic practices. Irrigation crop yield, cropping intensity and making possible cultivation of high value and remunerative crops.

In India in the post-independent period, a major thrust has been given on creation of irrigation infrastructure by constructing big dams, reservoirs and canal networks. Through use of irrigation along with H.Y.V. seed and chemical fertilizer has considerably increased agricultural productivity and helped India in attaining self-sufficiency in food production. Overall performance of irrigation sector is fall short of expectations, irrigation canals have remained exclusively state owned, state funded and are bureaucratically managed by hierarchical government departments in a top-down approach.
Chapter IV

Under the World Bank Aided Water Resources consolidation project attempts are under way to form 723 WUAs of or pani panchayats in 33 major and medium irrigation projects covering 3,32,000 hactcrs command area under the farmers organization and turnover programme.

National water policy of India adopted in 1987 clearly envisages that farmers should be involved progressively in various aspects of management of irrigation system, particularly in water distribution and collection of water rates. Recognizing the need for systematic involvement, and participation of farmers in irrigation management. The government of Orissa in the state water policy, 1994 has incorporated the objective of ‘handing over of operation and maintenance of irrigation systems to the users in due course.’ Under the world bank assisted water resources consolidation project under implementation in Orissa attempts are under way to motivate farmers to form water user's association, so that the operation and maintenance of the downstream part of the system can be turned over to WUAs (Swain and Kar. 2000). The major functions of the WUAs will be to operate and maintain the distributory/minor canals, to ensure equitable water distribution among the WUA members, to collect irrigation fees and to advise the department on main system operation. To start with under the mandate of world bank few pilot projects had been undertaken by department of water esources in Rushikulya (Distributory No.11) Ghodahada, Derijang and Aunli irrigation commands to implement the system improvement and turnover (SIFT) programme.
Since 1996 Government of Orissa is taking steps to form 723 WUAs or Pani panchayats in 33 major and medium irrigation projects covering 3,32,000 hectares of these 161 pani panchayat covering 74,000 hectares in 14 major and medium irrigation projects have already been registered and the operation and maintenance of canals have been turned over to water users. The work of motivation and formation and panj panchayat's have been entrusted to Water and Land Management Institute, command area development agency, Nabakrushna Choudhary Centre for development studies and some NGO's.

In the era of liberalization delicensing and decontrol there is a growing realization that the unnecessary bureaucratic control in management of irrigation system at tertiary levels should be reduced to improve irrigation efficiency and to check corruption and rent seeking behaviour. Usually the farmers believe that the canals belong to the system. They do not have any role and responsibility in upkeep of the physical structures. In the changed institutional context irrigation will be considered as a common pool resource and will be managed by the farmers community (Sengupta, 1991; Singh 1994) and its maintenance and sustainability will be the required to raise funds for the purpose. As public canals will be managed by WUAs. It is some times termed as privatization as in Egypt.

The W.U.A. can raise funds by selling water, taking up commercial activities and from membership fees, share capital and subsidy.
Benefits of Farmer's Management:

Benefits that will accrue to farmers and irrigation agency due to farmers participation in irrigation management have been recorded by several authors (Singh, 1991, Maloney and Raju, 1994).

Benefits of Farmers:

- Better water management at the tertiary level.
- Farmers flexibility in use of water choice of crops and land use.
- More crop and more income.
- Optimal use of water in agriculture.
- Ensuring equity in water allocation.
- Helping to resolve disputes on water distribution.
- Encouraging community responsibility for the management of assets.
- Forum for facilitating effective communication between farmers and government department.
- Better collection of irrigation fees.
- More Economic use of water, less wastage.
- Better maintenance – reduction in the cost of irrigation.
- Encouraging collective management of agricultural input supply and marketing of agricultural produce.
- Less water logging because of careful use of water.
- Less opportunity for corruption.
- Better mutual trust and understanding between farmers and officers.
Benefits of Irrigation Agency:

- Improved relations with client farmers, less mistrust.
- Reduced complaints on inequitable distribution of water between head reach and tail end.
- Increase in irrigation efficiency, job satisfaction.
- More time to attend to technical matters and using their expertise.
- Less bothering about unauthorized outlets, obstructions and maintenance problem.
- Improvement of credibility of the irrigation agency and irrigation officers.
- Better collection of water rates and saving on maintenance cost.

With these overall irrigation to the problem let us more to the irrigation in Karnataka.