CHAPTER : THREE

WATER MANAGEMENT PRACTICES

3.1 WATER MANAGEMENT PRACTICES : (SOME INSTANCES AT THE INTERNATIONAL PLANE AND THE SITUATION IN INDIA)

Since the inception of irrigated farming, different water management practices in one or the other form, mostly in traditional forms, have remained in force. Although with the renovation of several old canals and the development of new canal projects, no major change is found in the traditional water management practices.

The practices of watering a cultivated farm are mainly found to be of two types, (1) Surface watering practices and (2) Sub surface watering practices.

1. Surface water Irrigation Practices :

The surface water irrigation practices are further divided into three types viz., (i) uncontrolled or wild flooding (ii) controlled flooding and (iii) furrows.
(i) Un-controlled or wild flooding:

In such practices, water is applied from the field ditches without any borders to regulate the water flow or to restrict it. It is largely practised where water is abundant and inexpensive. Under the situation, the practice so followed is found to be economical. Of course, the system is not without drawbacks, the important among them are as under:

(a) Water in excess of the required quantum is likely to percolate into the soil when the water is made to flow excessively over the surface.

(b) The waste will result from percolation beyond its rootzone when water remains flowing on the soil surface for too long.

(ii) Controlled flooding:

Controlled flooding can be practised in three different ways viz., border strip flooding, check flooding and basin flooding.
(a) Border strip flooding:

The border strip practice is suitable to soil of wide variations in texture. For border irrigation a study of the physical soil properties well in advance of preparing land is essential. In this practice a farm is divided into strips with the size of nearly 9-18 meters of width and 100 to 200 meters of length separated by low borders. Water is turned from the supply ditch into these strips along which it flows slowly towards the lower end, saturating the soil as it advances.

(b) Check flooding:

To assure satisfactory growth of crops the border should not rise over 25 to 30 cms height and at the base its width should be 2 to 3 meters in size. To prevent excessive losses near the supply ditches through deep percolation, the check flooding is suited to much permeable soils. This practice consists of large streams running comparatively into relatively levelled plots surrounded by borders.
(c) Basin flooding:

In this practice water is conveyed to the basin from the supply ditch in two ways; (i) water may be turned directly from the ditch into each basin and (ii) by flowing through one basin into another basin.

(iii) Furrow method:

In comparison with the above mentioned surface practices, in furrow irrigation the entire land surface is not wetted and hence the losses of water through evaporation are found to be relatively low. Through furrow method usually all the crops sown in the rows can be irrigated. Besides, 20 to 30 cms deep furrows can control the percolation of water into the soil of low permeability.

2. Sub-Surface Watering Practices:

The practice in which the application of water to the soils directly under the surface in a highly permeable loam or sandy loam surface uniform topographic conditions and moderate slopes is known as sub-surface irrigation. The merits of this method lies in (i) economical use of water and (ii) high
crop yields and low labour cost in irrigation which can be achieved with the proper control of alkali accumulation and prevention of water logging.

MODERN WATER MANAGEMENT PRACTICES:

Among the recent developments in the field of practising water use, the innovation of sprinkler and drip irrigation methods are of vital importance. These practices of water management aim at substantial economy in water use as also reduction of labour cost. However, the capital investment required is found to be substantial. At present such practices are receiving increasing attention. In respect of India where water is becoming a scarce commodity, the methods like these, although involving huge costs deserve wide application. Generally sprinkler irrigation is considered to be more suitable for closely spaced crops like cotton, groundnut, sugarcane, millets and pulses while the drip irrigation is considered to be more suitable for widely spaced high value crops like coconut, banana, grapes, lime, orange etc.

The development of sprinkler irrigation was found to be very much limited till about 1946. In 1967,
about 2.6 million hectares were irrigated with sprinklers in Europe. In other countries sprinkler irrigation is under varying degrees of development. In Israel about 90 per cent of the area is under this system of irrigation. In Tunisia, Libya and Turkey, a number of installations of sprinkler sets have been put to operation. In 1952, experimental units of sprinkler methods were installed in Taiwan for irrigating sugarcane with encouraging results. In Italy and Greece sprinkler irrigation is widely adopted. In Australia sprinkler irrigation is introduced on a large scale in the orchards and for fodder crops.

A group of thrifty water management techniques which are collectively known as micro irrigation practices has rapidly expanded over the last decade for fruit, vegetables and orchard crops. In micro irrigation the most common method is drip irrigation which is also known as trickle irrigation, which keeps evaporation and seepage losses extremely low. To provide sufficient water to a crop, in comparison with the system of conventional sprinklers drip systems may apply 20-25 per cent less water to a field.²

By the mid-seventies, in the countries like the United States, Australia, Israel, Mexico and South Africa substantial areas were found irrigated by drip methods. In
1974 the world wide total irrigated area under drip methods were about 56,000 hectares and since then increasingly more areas have been covered under this system (table 3.1).

The U.S.A. has evolved water management techniques to solve the complicated problem of water inadequacy. It developed the proper relationship between water supply and its distribution, drainage and soil conditions, methods of cropping and climatic conditions etc., all involving modern management techniques. The area under sprinkler irrigation is about 30 to 40 per cent in the U.S.A. In this country the share of the total irrigated area by the mid-seventies was quite negligible. In 1974, this area was 29000 hectares while in 1983 the use of this method has substantially expanded and covered more than 1,85,000 hectares. In the world as a whole the area of more than 4,16,000 hectares has been irrigated through micro irrigation systems which show an impressive eight times increase since the year 1974 (table 3.1).

There are a number of advantages in adopting the modern practices of irrigation water management. In respect of sprinkler system of irrigation the merits are:
### TABLE 3.1

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>1974</th>
<th>1981-82</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>29,000</td>
<td>185,300</td>
</tr>
<tr>
<td>Israel</td>
<td>6,070</td>
<td>81,700</td>
</tr>
<tr>
<td>South Africa</td>
<td>3,480</td>
<td>44,000</td>
</tr>
<tr>
<td>France</td>
<td>-</td>
<td>22,000</td>
</tr>
<tr>
<td>Australia</td>
<td>10,120</td>
<td>20,050</td>
</tr>
<tr>
<td>Soviet Union</td>
<td>-</td>
<td>11,200</td>
</tr>
<tr>
<td>Italy</td>
<td>-</td>
<td>10,300</td>
</tr>
<tr>
<td>China</td>
<td>-</td>
<td>8,040</td>
</tr>
<tr>
<td>Cyprus</td>
<td>160</td>
<td>6,600</td>
</tr>
<tr>
<td>All other</td>
<td>7,480</td>
<td>27,470</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56,310</strong></td>
<td><strong>416,660</strong></td>
</tr>
</tbody>
</table>

1 Includes primarily surface and subsurface drip methods and microsprinklers.

(i) In surface irrigation, it is not possible to apply water uniformly to all spots of a farm. Sprinkler irrigation system makes uniform distribution possible. Consequent upon the adoption of this system the irrigated area is likely to expand by one and a half to two times with the same quantity of water.

(ii) The sprinkler sets make irrigation possible even on uneven lands.

(iii) The problem of soil erosion does not arise under this type of irrigation.

(iv) Soil moisture is maintained at the optimum level by sprinkler irrigation, and hence higher yields are obtained for all crops suitable to this system. The analysis of the benefits of sprinkler and flow irrigation by tubewells reveals that after the installation of sprinkler sets the efficiency of irrigation has increased by three times.

(v) Sprinkler irrigation system enable fertilizers and pesticides to mix with water, while the application thus made helps improve the efficiency of these inputs for crop production.
(vi) The runoff losses can be eliminated through the sprinkler irrigation system, because water under this system can apply at a rate which is less than the infiltration rate of the soil.

(vii) Substantial economy can be exercised under this system. In one study it is reported that about 50 per cent water can be saved if this irrigation practice is followed.

Though there is more saving of water in the use of sprinkler irrigation, there are some demerits of the system, which are as below:

(i) Some crops which are in the close vicinity of the nozzles do not get water.

(ii) The land between the crop lines also gets irrigated though not required.

(iii) There is a greater loss of water through evaporation.

(iv) Sprinkler irrigation involves knowledge about hydraulics which the irrigator has to acquire or has to consult other technicians often.

(v) When weed growth can not be eliminated between the main plants of a crop this system should not be applied.
Drip irrigation is another important irrigation method that makes small measured amount of water available to the rootzone of plant at regular intervals in optimum quantities. It saves time, saves fertilizers and water and increases yields. Due to the adoption of drip irrigation the area under irrigation has substantially increased on account of savings in water. For coconut orchards it has been observed that the area covered under drip system yielded better quality nuts in terms of size, copra contents and the quality.

The study on the experience of the drip system in comparison to the surface irrigation system in respect of three orange growers from Akola and Amaravati districts of Maharashtra reveals that due to drip irrigation the average quantity of water required for a unit area of orange orchard was observed to be reduced by 60 per cent. Even when the ground surface is steep or un-even, water is scarce and saline and where crops are widely spaced as in orchards, vine yards etc, with specially designed dripper, water and fertilizers can be supplied up to the direct absorption point of the rootzone. Thus, the water is carried through plastic pipes and is delivered drop by drop through drippers.
The main objective of drip irrigation is to achieve more production with minimum quantity of water. A comparison of the productivity of oranges under the drip irrigation with that under the traditional source of underground water resource (open well) and the source of water developed through bore well showed that the productivity of oranges under the drip irrigation system increased by 37 per cent over that under traditional sources. Besides, it has been found that the yield of orange orchard under drip irrigation is more profitable than that under traditional irrigation system.

By adopting this method the use of water can be economised through close monitoring of water supply, depending on the quantity and timing. Consequently more area can be irrigated by a unit volume of water. Thus, the command areas of projects can be extended by deploying this method on a substantial scale.

The effect of different practices of water management viz., the border strip, check basin, furrow alternative strip, and sprinkler etc, on yield and water use efficiency have been detailed which is analysed here below.

1. During 1982-83 1984-85, a study in Rahuri reveals that in comparison with the border and check basin systems the water use efficiency in sprinkler irrigation method
was nearly two times more and it gave significantly higher pod yield of groundnut over the border and check basin. Further, the study has noted that on an average of the three years the saving in irrigation water with sprinkler in groundnut was 23 per cent over border strip method. While in the case of chilli the yield was higher with sprinkler as compared to that with furrow irrigation system in all the three years.

2. The experiment in Pusa during 1981-82 to 1983-84 shows that because of the alternative strip irrigation on an average 36 per cent irrigation water can be saved over the fully irrigated strip. Here the adopted stream discharge rate was lower than that in the practice of canal irrigated areas. Among the different surface water application practices furrow irrigation is one of the important practices. In this regard the water use efficiency was found to be the higher in the case of alternative and strip furrows than that in the case of all furrow irrigation. 10

3. The effect of sprinkler irrigation with check basin irrigation system of surface method in groundnut in Madurai district during 1984-85 reveals that in the first year of experiment it has been found that the pod yield of groundnut was about 19 per cent higher and the saving
of irrigation water amounted to 25 per cent over the check basin method of irrigation.\textsuperscript{11}

3.2 WARABANDHI SYSTEM OF WATER MANAGEMENT:

Despite some specific benefits, the above mentioned water application methods are not suited to all crops in agriculture. Besides, these methods are very expensive in nature. Their application on a wide scale would take much time. There is therefore the need for a practice generally suited to all crops. Besides solving the problems of over-use of water, making available water in time etc, warabandhi system is such a system which provides fairness in the distribution and assures timely supply of water. It also solves quite a number of other problems of water use at the farm level. The working of this system of water management is analysed here:

3.2 (a) DEFINITION:

"Warabandhi is a system of equitable water distribution by turns, according to a pre-determined schedule specifying the day, time and duration of supply to each irrigator in proportion to land holdings in the outlet commands"\textsuperscript{12}. The essential features of a good warabandhi system are equity in the distribution and assured timely supply of water.
3.2 (b) **THE NEED FOR IMPLEMENTATION OF WARABANDHI SYSTEM:**

In the medium and major surface irrigation projects, water is brought to the field by diversion from a river or from accumulated water stored in the constructed dams. The accumulated water is to be utilised by all potential users equitably. In the canal system, some farmers get excessive irrigation water while others starve of water for their farms because many a time the water supply is exploited preemptively by some socio-politically influential people. Besides this, the farmers who have their land near the outlet also get over irrigation. Consequently, due to the development of the adverse effects of water logging and salinity, the loss of production and even of productivity takes place. In this regard, it is essential that water should reach every plot in the area under irrigation on the basis of an equitable distribution by turns and for this purpose warabandhi system is highly suitable. For, if imposes some kind of discipline and fair play in the use of water.

For quite a long time, in all surface irrigation commands, the introduction of warabandhi has been under consideration by the states as also the central Government in India. It may be noted here that this system is not totally new to our country. The origin of warabandhi is found in North-Western India. After its introduction in
this part of the country, the system has been put to operation in a number of other Indian States by different names. In the State of Maharashtra warabandhi is known as 'block' and 'Shejpali' systems. Of course, till recently its operation has been on a limited scale. After drawing up a detailed programme by the State Govt. and Union Territory Administration, for formulation and enforcement of warabandhi the Union Government is providing assistance in the form of grant to the States and Union Territories for putting this system into operation. The World Bank is also very keen in its adoption and experiments are under way in its assisted projects.

In warabandhi system there are possibilities to have un-gated and fixed discharge outlets through which water has to run in a water course in a fixed quantity and for a fixed period of time. Hence, the distributory can run concurrently with full discharge and therefore the chances of absorption losses and silting up are also minimised. The other important changes likely to be observed in this system are as under:

1. The overall position of tail-enders gets improved with warabandhi system. Through this system, tail-enders themselves feel more secured in getting sufficient water and there is thus an increase in the reliability of water supply under this system.
(ii) In the development of any project, water courses occupy a key position. The work of the construction of water courses remains the responsibility of the farmers. In many irrigation projects based on warabandhi system, the farmers have undertaken the work of construction of water courses at their own cost. Such an experience contributes significantly to the success of warabandhi system.

(iii) In this system, the wastage of water takes place during the night flow. In this regard, it is suggested that water distribution during night is either based on mutual adjustments or the influence of the head reachers/tail enders.  

(iv) In India, the size of an average holding is small. Hence for efficient irrigation, farmers are required to be clubbed together to share the minimum water which can be permitted in a water course. Such practices may end in conflicts which get minimised in warabandhi system.

(v) Lastly, whenever the supply of water falls short of demand, rationing of water can be resorted to with a warabandhi system with least resistance.
In warabandhi system, distribution of water is a two-tier operation. The upper tier is managed by the state while the second tier which is the distribution of water flowing in a watercourse is managed by farmers. Between the two tiers, outlet being the border. In the roaster, from head to downwards the turns of irrigators are fixed on the basis of first come first served. In warabandhi system tail-end farmers act as a watchdog on those in the upper reaches, and as such, the operation of the roaster is self-policing.

In the method of distribution of water, a certain rate of flow is allocated to each unit of culturable command area. In warabandhi system, after considering the factors like rainfall, soil, the water requirements of the cropping pattern and sub-soil water level at the time of preparation of the project etc., the rate of flow per unit of land and its frequency are judiciously determined. In this system the allocation of water is made for a voluntarily determined notional cropping pattern. Watercourses which are fitted with un-gated and fixed discharge outlets can concurrently run for at least seven days, because a distributory is operated for eight day period from the head. Farmers are getting water on the
basis of their farm holdings over one week as a base and frequency of all distributories is adjusted with the requirements of a crop at different stages like sowing, growing and the maturing periods. A typical canal water distribution system can be understood by the figure ('Appendix: I), which shows that through the main canal, branch canal, minors etc, water is released to the distributories. In this system of water distribution, the responsibility of the State for the maintenance and operation is limited up to and including the distributory only, while the responsibility of the farmers or farmers' organisations is for the distribution of water below the outlet.

A pre-requisite for a successful 'warabandhi' is based on adequate communication facilities along with the water control and measurements devices at the appropriate locations which control and measure the flow of water into and along the main canal, the branches, the minors, the distributories etc.
NOTES AND REFERENCES

1. Under the area of orange orchard the cost of labour was reduced by about Rs. 500 per hectare by using drip system of irrigation in comparison to that by surface irrigation system. See Mahalle Y.P., Bhole B.D. and Bidwai P.N.; "Economics of Drip Irrigation system - A case study", Indian Journal of Agricultural Economics, Vol.XLIV, No.3, July-Sept, 1989, p. 285.


5. The two periods data that is for the year 1980-81 and 1988-89 representing without sprinkler irrigation and with sprinkler irrigation respectively, indicate that in the Bhiwani district of Haryana which is the arid part of the State, the percentage of net irrigated and gross irrigated area went up


10. The study related to the suitable furrow irrigation practices for winter maize crop from 1981-82 to 1984-85 in pusa included different modes of irrigation viz., irrigation in each furrow, alternative furrow, paired rows and strip furrows.


14. The outlet is the structure which acts as a water measuring or controlling device. It is that border at which the management of Government ends and the management of farmers begins, as through the outlet, water is admitted from the public distributory into farmer's private water course. In distributing water under warabandhi system the outlet plays a pivotal role.