



Water economy through drip irrigation

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THE TOTAL CULTIVATED land in India is of the order of 180 million hectare, about 75 million hectare is irrigated at present, by major, medium and minor irrigation projects by both surface and ground water. The annual rainfall varies from 10 cms to 100 cms in various parts of the country. The average agricultural land holding in the country has declined from 2.28 hectares in 1970-71 to 0.68 hectares in 1985-86, although it varies further among various states. Agriculture contributes to nearly 30% of net domestic product and provides livelihood to about 70% of the labour force. The total food-grain production during 1992 was about 146.2 million tonnes, the per capita production being 203kg based on all India average. The production per hectare is about 1368kg. Steady growth is being achieved though improved agricultural technology, implements and practices. The area under non-food crops is approximately one third of that under food crops.

About 40% of the country consists of non agricultural land, which is generally barren and not under forest cover. However all types of land is prone to drought as well as flood, in addition to soil salinity and degradation into semi-arid dryland in the country.

About 175 million hectare of land is threatened by degradation like saline, alkali soil, water logged areas, ravinous and gullied lands, areas under revages of shifting cultivation desertification etc. About 8000 hectares of good arable land are being lost annually due to ingress of ravine. The total flood prone area is about 260 million hectare. The food grain requirement of the country's estimated population of one billion by 2000 A.D. is about 225 million tonnes. Both national and institutional agencies are engaged in formulating various strategies for achieving this target. Optimisation of water use in agricultural activity is a major yardstick in achieving the desired production.

The role of drip irrigation

Drip irrigation is thought of as not so much an irrigation system as a total plant support system meaning that water, fertilizer and other necessities are delivered over quite different situations, namely, a large system suitable for a large grower or corporate farmer, a smaller system which could be used by a reliable operation in a low capital, low agronomic skill environment which may exist at a village level in a lesser developed country.

The basic system consists of polyvinyl chloride hose or tube in which the emitters are installed as per spacing provided during manufacturer. Fertilizers and sanitation agents are kept in specified vessels.

The circulating mains consist of 20-25mm PVC pipe extending from fertilizer vessels and run past every in field valve and then vessel. Also passing through every in field valve in the system in conjunction with fertilizer mains in a high pressure clear water main connected to a pressure system, which does not circulate. Injection of fertilizer can be done as per requirement of crop in the field, at single point as well as multiple points. The advantages of the system can be summarised as under:

1. *Saving of water*

Due to localised application of water to the root of the plant, surface evaporation is reduced, run off is decreased and deep percolation loss is avoided resulting in upto 60% saving in water used in conventional irrigation.

2. *Better yield of crop*

Increase in root length as well as crop yield has been experienced due to slow and frequent supply of water.

3. *Saving in labour and energy*

Scientific design of the system using principle of hydraulics would require labour only to start and stop the operation and less energy for pumping less water at lesser pressure than open field system.

4. *Suitable for poor soil*

Both light and heavy soils difficult for ordinary irrigation system can be successfully irrigated by this system.

5. *Weed growth minimised*

Growth of weeds is reduced due to partial wetting of soil.

6. *Convenient for cultural practices*

The field is always accessible for spraying, weeding and harvesting

7. *Less soil erosion*

8. *Use of saline water*

Due to frequent watering, the soil moisture always remains high thereby salt concentration remains below harmful level.

9. *Improve efficiency of fertilizers*

Due to reduced loss of nutrient through leaching and run off water and localised application of fertilizers, the efficiency is greatly increased.

Description of the drip system

Depending upon the situation the main water pipe is laid out along or perpendicular to length of farm. Sub-main runs perpendicular to the main and laterals and laid

perpendicular to the submain along the row of plants. The mainline and submain pipes are buried at about 30 cms below the ground. The water supply rate is matched to suit the evaporation rates and the type of motor and pump is designed to deliver required quantity of waste to the system at a pressure of about 1-1.5kg/cm². Addition of a filter system either of gravel type or volume type along with the stainless steel wiremesh is necessary to avoid clogging of the emitters. The main waterline is usually chosen of PVC depending on the quantity of water to be handled. The submains are generally of HDPE tubes of 16mm diameter, on which the dripper or emitters are fixed with the help of black LLDPE thin tubings of 4mm internal diameter. One end of the micro tube is attached to lateral and other to dripper. The dripper or emitters are mainly of two types, threaded and pressure compensated. The threaded type dripper helps to maintain uniform pressure and ensures equal supply of water to every plant. The other type ensures uniform supply of water to all plants even in slopes with high gradients even if there is variation in water line pressure. The other components for assembling the system are gate valve, hose collar, start connectors reducers and plugs for main, submain, laterals etc. The system is varied in design such as biwall, plastic emitter, non plastic emitter, microtube etc. without much variation in water use efficiency.

The drip irrigation system ranges are commonly classified as

a) Surface drip irrigation system

- i) Microtube system
- ii) Pressure compensating drip system
- iii) Non-pressure compensating drip system
- iv) In line drip system

b) Sub surface drip irrigation system

- i) Biwall system
- ii) Turbotape system
- iii) Typhoon system

The selection of emitter is based on the following characteristics

- a) should be compact, serviceable and inexpensive to keep the system cost low;
- b) should have relatively a low discharge to keep the system cost low;
- c) should not vary significantly with pressure and this will give good uniformity of distribution;
- d) should have a relatively large cross sectional area to avoid clogging problem.

These will help in achieving high system efficiency by means of high emission uniformity, easy flow management and keeping initial and annual cost to a minimum.

Periodic preventative maintenance is the key for the successful working of microirrigations system. The general maintenance includes regular cleaning of filter, check-

ing of emitter functioning, wetting pattern and zone, leakage of dripper in proper position and so on.

The design of the system is based on engineering survey of terrain, assessment of water resources, agronomical details, climatological data for computation of evapotranspiration requirements and analysis of soil and water sample. The system design provides mainline design, submain design, lateral design, dripper details, filtration requirement and maintenance schedule etc. Thus each system has to be location specific for deriving maximum benefit, while the components can be selected from the range available in the market.

Experience of drip irrigation in India

An indication of area covered under drip irrigation is presented in Table 1.

The system was introduced in seventies and was standardised as well as popularised among farmers during eighties, while the coverage grew from 1500 ha in 1985 to above 25000 ha to the present days. An analysis of drip development in the States of Maharashtra and Tamil Nadu indicate that irrigation water scarcity as well as subsidy provision have contributed significantly to adoption of drip irrigation. Scarcity of labour has also played a significant role in its popularisation in Maharashtra. Propagation of this requires evenly paced development in all spheres namely research, extension, raw material availability and processing, fabrication and services sector etc. Keeping this in view, a National Committee on the use of plastics in agriculture was established in 1981, as a Central Coordinating body for propagation of relevant plasticulture applications in the country, which identified Drip irrigation as one of the major thrust areas. The Committee has projected 2 mil ha under drip system by the year 2000, subject to a concerted effort by the implementing agencies including the Government of India, State Government and financial institutions. In the eighth Five Year Plan period the institutional financing has been estimated to Rs.5,1190 mills.

Table 1

Sr. No.	State	Area under drip irrigation (in ha)
1.	Maharashtra	15000
2.	Tamil Nadu	3000
3.	Karnataka	2500
4.	Andhra Pradesh	2000
5.	Gujarat	500
6.	Kerala	500
7.	Other States	1000
Total		24500

Cost benefit of the system

The cost of drip supply has been estimated to be at the rate of Rs.20000 per ha. This can be set off against the benefit in irrigating 18 lakh ha of command area in a major ongoing project as follows:

Possible savings	Rs.million
1. Cost of network of field channels	9,000
2. Cost of land	2,000
3. Saving for filling agricultural fields	1,000
4. Land levelling and drainage	3,000
5. Survey of Net Work	700
6. Saving in cost of main land	10,300
7. Saving in cost of Branch land	7,900
8. Saving in cost of distributaries	1,000
Total	35,800

This is claimed to be same as the cost of supply of drips to cover the area.

The benefit of drip irrigation applied to individual crops has been derived through prolonged field investigation. The finding including saving in water has been presented in Table 2.

However it is advisable to adopt specified system for deriving maximum benefit at a particular condition, which should be recommended by the designer or supplier of the system. Some of the circumstances commanding the suitability of a particular type are indicated below:

A) Surface drip irrigation

- 1) Pressure compensating system - Recommended under drip (Approx all conditions cost Rs.37,000/ha)

- 2) Partial pressure system - As above compensating drip turbo drippers (Approx. cost Rs.36,000/ha)
- 3) Microtube irrigation system - Flat lands (Approx. cost Rs.32000/ha).

B) Subsurface drip irrigation

- 1) Biwall irrigation system - Morechoking was observed in biwall (Approx. cost Rs.35000/ha).
- 2) Turbo-tape irrigation system -Recommended in fine textured soil with proper care (Approx. cost Rs.38000/ha).

Inspite of the above findings, the constraints such as high initial cost, non availability of subsidy in all states, high import duty on raw material, lack of awareness, lack of research and development absence of countrywide network for manufacturing and distribution etc. are hampering the growth of adoption of this system. Recently Government of India has announced 50% subsidy in all cases of adoption of drip system, which is likely to make it probable to achieve the projected coverage.

Table 2

Crop	Yield		
	Drip	Conventional	% inc.
Pomegranate	109000	75000 nos.	45
Grapes	3250/ha	264 Q/ha	23
Sugar cane	1000/ha	720 Q/ha	38
Banana	825 Q/ha	400 Q/ha	100
Tomato	480 Q/ha	320 Q/ha	50