THE POTENTIAL CONTRIBUTION OF LOW COST DRIP IRRIGATION TO THE IMPROVEMENT OF IRRIGATON PRODUCTIVITY IN INDIA

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Since 90% of the fresh water diverted for human use in India goes to irrigation, improving irrigation efficiency is the most direct way to address growing sectoral and regional water shortages. The most efficient irrigation method, drip irrigation, represents less than 1 % of irrigated acreage in spite of relatively rapid adoption curve over the past 10 years. The key constraint to its wider adoption is that it costs too much to install, especially for the 80% of Indian farmers who cultivate less than two hectares. To address this constraint, IDE, an international development organization, has developed, field tested, and initiated rural mass marketing of low cost drip irrigation systems that start at 180 Rs for a home garden bucket kit. Crops with one meter spacing like cotton, sugar cane, and vegetables cost 9-10,000 Rs/acre compared with 23,000 Rs/acre for conventional drip systems in India.

The use of drip irrigation in India increased rapidly from the time of initial testing at Tamil Nadu University in Coimbatore in 1970, to 55,000 hectares under drip in India by 1992.[3] and is now estimated to be 225,000 hectares[4]. Studies of comparative crop yield and water use for surface and conventional drip irrigation of different crops carried out at agricultural universities in India have consistently found water savings of 30-60% and yield increases of 20-40 % favoring drip irrigation over surface methods. There are some 100 private companies producing and marketing drip irrigation systems in India[5]. The Indian Committee on Irrigation and Drainage estimates a potential for drip irrigation in India of 10.5 million hectares[6].

To stimulate its wider adoption, the Government of India has provided subsidies for drip irrigation in the sixth, seventh, and eighth five year plan. While the subsidy has encouraged some farmers to install drip systems, it has had paradoxical results. For example, delays as long as one year in releasing subsidy payments to manufacturers produce paradoxical price increases for subsidized equipment. . Changing the design of effective drip systems so that they can be sold profitably by the private sector at a price lower than the existing subsidized price opens up the possibility of replacing subsidies with an alternative that produces the intended impacts without the disadvantages.

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[3] Sivanappan, R. K., Rao, A. S., and Dikshit, N.K., *Drip Irrigation in India,* Indian National Committtee on Irrigation and Drainage, Jolly Reprographics, New Delhi- 110 008, 1994.
[4] Proceedings of the National Seminar on Micro Irrigation and Sprinkler Irrigation Systems, Delhi, April 28-30, 1998.
[5] Proceedings of the National Seminar on Micro Irrigation and Sprinkler Irrigation Systems, Delhi, April 28-30, 1998.
[6] Sivanappan et al, op cited, P88.

Method and Cost

International Development Enterprises, a non–profit organization specializing in affordable small-scale irrigation, has developed and field tested a variety of low cost drip systems for small farmers. The investment in plastic pipes was reduced by making it possible for each plastic pipe (lateral) to serve 4-10 rows of plants instead of one. The cost was further reduced by replacing emitters with microtubes or baffled holes, which also are easier to unplug. This in turn made it possible to use simpler lower cost filters, and to lower system pressure. Cost for a stationary microtube system for crops like cotton and vegetables with one meter spacing is 9-10,000 Rs /acre, compared with 23000 Rs for conventional systems, with comparable results in the field. Finally, the low cost system is designed to be incremental, allowing small farmers to start with a drum kit that irrigates 125 sq. meters at a cost of 800 Rs, and expanding the low cost drip system with profits derived from the crop.

Application and Suitability

Each low cost drip system is suitable for small-scale farmers cultivating sugar cane, cotton, vegetables and horticultural crops on small plots in semi-arid or hill areas. With drip irrigation, water sources previously considered too small for irrigation can now be utilized, and the same amount of water from a limited supply like a hand dug well in Rajasthan can be used to irrigate twice as much land as is possible under flooding in the dry season.

System and Elements

1. **Bucket kits for Home Gardens** derived from the Chapin Bucket system start at $5 and consist of an ordinary 20-liter household bucket installed on a pole at shoulder height. The bucket is fitted with a 10-meter lateral line and is filled 2-4 times a day. The lateral line has 26 microtubes attached, each of which waters 4 vegetable plants, enough to provide vegetables for a family of 6).

2. **Shiftable Drip Systems.** Conventional drip systems require a plastic pipe (lateral line) for each row of plants. The shiftable drip system first developed in Nepal substitutes low cost labor for capital by making lateral lines shiftable, so that each line is capable of irrigating ten rows of plants instead of one[7]. An off the shelf plastic tank placed 2-4 meters above the field with a simple cloth filter provides the pressure needed by the system. Water drips out of baffled holes or curled microtubes inserted into holes in the lateral line. This system works well for closely spaced low growing crops like many vegetables, in areas with low labor costs, and costs 1800 Rs ($50 US) for a 1200 sq. meter plot.

3. **Non Shiftable Microtube Systems**

[7] Polak, Paul, Nanes, Bob, and Adhikari, Deepak. A Low Cost Drip System for Small Farmers in Developing Countries. Journal of the American Water Resources Association, Vol 33, #1, Feb/97.

- **The Drum Kit** uses a 200 liter drum made of steel (400 Rs) or plastic (250 Rs) with a simple filter from which extend five 10m lateral lines, each fitted with 26 microtubes. The drum kit irrigates a 125 sq. m plot and costs 900 Rs. For an additional investment of 400 Rs, it can be extended to cover 250 sq. m

- **The Non-Shiftable Microtube System** can be used on small or large plots, ranging from 1/16 of an acre to 2 acres. Microtubes are installed into holes in plastic lateral lines, with each microtube irrigating four plants. By extending microtubes out on both sides, each lateral line irrigates four rows of crops instead of one. The system is pressurized by a concrete tank with a low cost filter 4 meters above the field, or adapted to an existing electric or diesel pump using a bypass valve. At a cost of
  8-10, 000 Rs / acre (4000 sq. m) for crops with one meter spacing like cotton and vegetables, the non shiftable microtube systems is approximately 1/3 the cost of comparable conventional drip systems.

Test Results

Field tests comparing side by side 2000 sq. meter plots irrigated by flood and low cost stationary microtube drip were carried out in Rajasthan and Mahdya Pradesh on sugar cane and cotton respectively. In addition, side-by-side mulberry plots irrigated by flood, conventional drip, and low cost drip were evaluated in Karnataka. The tests confirmed previous studies in India that showed significant water saving and crop yield advantages for drip over flood irrigation. There were little or no significant differences between low cost drip and conventional drip systems. For example, cottonseed plots irrigated by low cost drip used 56% less water than flood irrigated cotton, and produced 34% more seed. Previous studies of cotton irrigated by flood and by conventional drip at Coimbatore found water savings ranging from 43% to 79%, with yield increases of 25% to 40%.

Grass Roots Private Sector Dissemination

IDE and its private sector partners have initiated private sector manufacture and distribution of low cost drip systems through a system of private sector manufacturers, distributors, and installers, stimulated by donor investment in increasing marketplace demand by small farmers through rural marketing and promotion initiatives. Three hundred initial low cost drip systems have now been sold and installed on farmer's fields. Similar efforts are being launched for low cost shiftable sprinkler systems.

Limitations and Future Outlook

Uniformity of flow from microtube is approximately 5% less than from emitters in conventional drip systems, and some low cost drip systems require more labor than conventional systems. Bucket kits and drum kits provide affordable entry points for small farmers to irrigate horticultural crops with drip irrigation, opening the option of using profits from initial crops to expand their low cost drip irrigation system. The combination of $5 bucket kits with water and sanitation initiatives has strong potential for improving food security for poor families. The introduction of drip systems at one third the cost of conventional drip irrigation with comparable results in water saving and improved crop

yield opens up the possibility of rapidly increases in the adoption of drip irrigation in India. This in turn would generate significant improvements in irrigation productivity.