ACHIEVING TARGETED GROWTH THROUGH MICRO IRRIGATION

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ABSTRACT

Micro irrigation in agriculture armed with knowledge and technologies with farmers as beneficiaries is one of the best approaches towards sustainable growth. The technology is enhancing water use efficiency with agriculture production and productivity. The technology is bound to maximize the synergistic interactions of improved seeds, water and fertilizer. Through micro irrigation, an evergreen revolution may be pictured to ensure the congruence of the sustainability, productivity, profitability and equity. Since micro irrigation greatly enhances water, fertilizer and energy use efficiency and promotes precision agriculture, the targeted growth could be achieved without the burden of environmental degradation.

INTRODUCTION

The technology of micro irrigation is rapidly increasing around the World, and this trend is expected to continue in the foreseeable future. With increasing demands on limited water resources and the need to minimize environmental consequences of irrigation, micro irrigation technology offers many advantages. It is an unique agronomic, water and energy conservation technology that address many of the challenges facing irrigated agriculture. Farmers and other micro-irrigation users are continually seeking new options, such as reuse of waste-water that will continue to provide new challenges for designers and irrigation managers. Micro irrigation is suitable for most agricultural crops, and more often used for high value products such as fruits, vegetables, nuts & flower. Furthermore, residential and commercial landscape systems such as Golf courses and home gardens are increasingly turning to micro irrigation technology.

TECHNOLOGY

Micro irrigation includes all methods of frequent water application, in small flow rates, on or below the soil surface. Ideally, the volume of water is applied directly to the root zone in quantities that approach the consumptive use of the plants. Through good management of the micro irrigation systems the root zone moisture content can be maintained near field capacity throughout the season providing a level of water and air balance close to optimum for plant growth. In addition, nutrient levels which are applied with water through the system can be

controlled precisely. During the dry season in humid areas, or in arid climate, micro irrigation has a significant effect on quality and quantity of yield, pest control and harvest timing.

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Micro irrigation management techniques such as drip irrigation and sprinkler irrigation systems are helpful not just in water management but also in labor resource management. In micro irrigation systems, water is distributed using an extensive hydraulic pipe network that conveys water from its source to the plant. Outflow from the irrigation system occurs through emitters placed along the water delivery (lateral) pipes in the form of droplets, tiny streams or miniature sprays. The emitters can be placed either on or below the soil surface. In general micro irrigation systems are classified by the type of emitter used in the system. These are drip, bubbler, spray jet and subsurface. Emitters can vary from sophisticated, constant-flow –rate at variable pressure types of devices (pressure compensating emitters) to very small, simple orifices. A large number of different types of emitters have been developed in attempts to find a perfect one. The main objective is to assure uniformity of water distribution. It is essential that the discharge from the emitter be uniform and that it not change significantly with small pressure variations in the system. Water flowing from emitters is distributed in the soil by gravity and capillary forces creating the contour lines. The exact shapes of the wetted volume and moisture distribution depends on soil texture, initial soil moisture and to some degree on the rate of water application.

1. Advantages

Micro irrigation systems have many potential advantages when compared with other irrigation methods. Most of them are related to the low rates of water application. Certain combinations of these advantages are responsible for uniqueness of micro irrigation in contrast to other systems.

(a) Water Savings

Irrigation water requirement is lesser with micro irrigation when compared with other irrigation methods. This is due to irrigation of a smaller portion of the soil volume, decreased evaporation from the soil surface and the reduction or elimination of the runoff. Since the micro irrigation system allows for a high level of water control application, water can be applied only when needed and deep percolation can be minimized or avoided.

(b) Smaller Flow Rates

Since the rate of water application in micro irrigation systems is significantly lower than in other systems, smaller sources of water can be used for irrigation of the same acreage. The systems operate under low pressure (5-30 psi) and require less energy for pumping than high pressure systems.

(c) Application of Chemicals

Micro irrigation systems allow supply of the exact amount of fertilizer required at a given time directly to the root zone and there is a reduction in the total quantity of fertilizer used.
Other chemicals, such as herbicides, insecticides, fungicides, nematicides, growth regulators etc can be efficiently applied through micro irrigation systems to improve crop production.

(d) Water Sources with High Salt Content

Water with relatively high salt content can be used by this system. For optimum plant growth a certain range of total water potential in the root zone is maintained, which is very difficult in dry soil. The total water potential in the root zone is a sum of the matric potential and osmotic potential. Since matric potential is close to zero under micro irrigation (high moisture content) the osmotic potential component can be a relatively large negative value, indicting high salt content, without harmful effect on plant growth. This is not true for other irrigation systems. Crops can be cultivated in saline and waste land, thereby increasing total acreage.

(e) Improved Quality and productivity of the Crop

The reduction of stress of moisture fluctuation due to micro irrigation, often resulting in larger quantity and better quality yield. In arid climates, or during dry seasons, the harvest timing can be controlled by proper water management.

(f) Adaptation to any Topography

Micro irrigation systems can operate efficiently on hilly terrain if appropriately designed and managed. Well managed micro irrigation system will not create runoff even on hilly terrain and undulating land.

Figure 1. Date Palm Field with Drip system.

(g) Reduction of Disease Infestation

During dry seasons or in arid climate disease and insect damage can be reduced under drip irrigation system since the foliage of the plant is not wetted. Since a small portion of soil surface being watered, field operations can be continued during irrigation and weeds are also reduced significantly.

Figure 2. Cotton field with Drip system.

(h) Operational Cost

Micro irrigation management techniques for drip irrigation and sprinkler irrigation systems are helpful not just in water management but also in labor resource management. This system can also be extensively automated in turn decreasing labor and operating cost. The reduced number of hours (4-5 hours) for irrigation saves electricity consumption.

The Government is promoting this technology since 1992 through one or the other integrated scheme. Since 2005-06 the Government is extending a quantum of subsidy to wiling farmers for establishing the systems under the Centrally

Sponsored Scheme of National Mission on Micro Irrigation (NMMI) implemented by Department of Agriculture and Cooperation, Ministry of Agriculture.

2. IMPACT OF DRIP AND SPRINKLER IRRIGATION

(a) Change in Cropping pattern

Cropping pattern has been changed after adoption of sprinkler & drip irrigation. Beneficiaries have adopted inter, mixed and double cropping system after installation of Micro irrigation system which account for 20-50%. The tendency of shifting to inter cropping specially with vegetable crop and pulses has increased.

(b) Cropping intensity

There is increase in the cropping intensity after installing the unit . In summer, groundnut, sunflower and vegetable crops were grown using the land more intensively. The increase in the cropping intensity ranges from 31% to 50% through sprinkler and drip irrigation.

(c) Saving in electricity

Electric supply for irrigation is available only about 4-5 hours daily (sometimes in night) Farmers revealed that there is a saving in number of hours of consumption ranging from ½ to 1 ½ hours a day. The electricity saving is 40% - 75%.

(d) Saving in Water

The saving of water after adopting sprinkler & drip irrigation is about 39% to 75%. This is based on reduction of number of hours to irrigate the same area or to irrigate about 30-40% more area during the same period. After adoption of micro irrigation in an hour only 1 feet of water goes down in the well as compared to 2-3 feet of water in flood irrigation.

(e) Change in water table

Most of the farmers are having bore wells and many use water from stream, river and with the adoption of micro irrigation there is an increase in water table.

(f) Extend of use of benefits

Farmers/ beneficiaries adopted this technology utilized the benefit from 40% - 75% with average utility of 54%.

(g) Improvement of soil health

Micro irrigation system resembles light rains at regular interval and it facilitates building good soil structure. Flood irrigation often damage soil structure due to trampling and excess water. But in sprinkler and drip system optimum water is provided at regular interval with no hazards on soil structure. Soil has become soft and friable and improves soil health by improving soil structure.

(h) Increase in area under cultivation

Patches of waste and sloppy lands were converted into green area by using micro irrigation. The sloppy lands which could not be irrigated earlier have now been irrigated. The area under cultivation increased by about 23%.

Figure 3. Chilly field with drip system

(i) Increase in income level due to increased production

There is an increase in production ranges from 20 to 50% which has proportionately increased income and fetched better return by around 10 to 20% and there is an increase in income by 36% and due to savings of cost on account of labour, electricity and fertilizer.

(j) Performance of irrigation system

The drip & sprinkler system is very convenient and efficient mechanism of irrigation. The system is a labour, water and electricity saving device. As observed in the field farmers are not facing any difficulty or problems in its operation and use.

(k)Economic Impact

Cost of cultivation varies and benefit cost ratio varies from crop to crop. The Gross Value Product (GVP) increased with adoption of micro irrigation. Pay back period on investment on micro irrigation is shortest in field crops like ground nut, potato, cotton and vegetables and relatively higher in fruit /orchard crops. Financial rate of return ranges from 30% to 50%.

(l)Social Equity

The interaction of different social groups on using of micro irrigation system brought farmers nearer and in turn improve social relations.

3. Initiatives by India

Government is promoting the Centrally Sponsored Scheme of National Mission on Micro Irrigation since 2005-06 of and providing assistance to all categories of farmers @ 60% for small & marginal farmers and @ 50% for general farmers alongwith technical support. Micro Irrigation technology is an important contributor to enhance food security of India by increasing water use efficiency (30-60%), productivity (30-100%) and income (20-50%) of agriculture force (60-65%). Water & fertilizer management in the crop field through this technology engage both farmers and the equipment manufacturers. This MI system implementation is the best example of public private partnership model with best return of end produce involving central and state Government assistance and investment of farmers. Since inception about ` 8000.00 crore has been invested for the scheme for implementation of Micro Irrigation System for various agriculture and horticulture crops, out of which, 50% is Government assistance including State Government (10%) and another `4000 crore investment has been made by the farmers with the active participation of equipment manufacturers. An area of 3 million ha achieved under micro irrigation within six years.

4. Summary and Conclusion

Micro Irrigation technology has been introduced in India during 1980. This technology has about 95% efficiency. It includes drip and sprinkler irrigation

system which involve frequent water application to agriculture field in small flow rates, on or below the soil surface. The volume of water is applied directly to the root zone in quantities required by particular flora, viz. sugarcane, cotton, mango, tomato, grapes, watermelon, potato etc. Fertilizer/nutrients are also applied with water through this system. The indispensible part of this system is the emitter through which water flows at variable pressure. The drip system involves technology for irrigating plants at the root zone through emitter filted on network of laterals (carrying water) installed at pre determined distance as per the flora. The sprinkler system discharged water under pressure in the air through a set of nozzles attached to a network of pipes stimulating like rainfall or mists.

The technology ensures increase in crop yield, higher quality of crops, less water and energy consumption, less chemicals and fertilizer use, reduced water leaching and run off, less weeds and less soil compaction. Increased yield, reduced harvesting time and economy in water use are the factors which promoted its adoption particularly in high value crops. With the launching of micro irrigation programme production of crops would be doubled within a decade without horizontal expansion of area.

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