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Potential role of micro irrigation for sustainable agriculture in India

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Abstract
Water is a renewable resource, its availability in appropriate quality and quantity is under severe stress due to increasing demand from various sectors. Agriculture is the largest user of water, which consumes more than 80% of the country's exploitable water resources. The decreasing availability of water to agriculture sector has become a serious limitation in many areas. The overall development of the agriculture sector and the intended growth rate in GDP is largely dependent on the judicious use of the available water resources. While the irrigation projects (major and medium) have contributed to the development of water resources, the conventional methods of water conveyance and irrigation, being highly inefficient, has led not only to wastage of water but also to several ecological problems like water logging, salinization and soil degradation making productive agricultural lands unproductive. It has been recognized that use of modern irrigation methods like drip and sprinkler irrigation is the only alternative for efficient use of surface as well as ground water resources. The term "micro-irrigation" describes a family of irrigation systems that apply water through small devices. At present, more than 60 percent of the area under drip irrigation can be attributed to orchids and plantation crops. The challenge lies in popularizing these technologies in major crops such as wheat, mustard, potato, cotton, alfalfa etc. One of the ways of doing this is through finding out the environmental and economic benefits of these technologies in saving water, fuel, power and fertilizer. This paper deals with the potential of micro-irrigation as an emerging tool for sustainable agriculture in India.

Keywords: Micro irrigation, advantage, disadvantage, sustainable agriculture

Introduction
Use of water in agriculture is very important for agricultural production and to decrease risk of drought. Global water use in agriculture is approximately 70% in not only Turkey but also in the world. The irrigation sector is under pressure to increase its efficiency since it is the major user of fresh water globally. This is exacerbated as water resources become scarcer due to climate change, increasing population and inappropriate irrigation applications, and as the competition for water from other economic and environmental uses. In the future, improved efficiency in the use of water for food production will become even more important. The amounts water used for industries and municipalities will increase while it for the agriculture decreases in future. Considering irrigation efficiency and environmental issues micro-irrigation, which is the precise application of water on or below the soil surface at low pressure using small devices that spray, mist, sprinkler or drip water, is becoming more attractive (Hla and Scherer, 2003) [1].

The term "micro-irrigation" describes a family of irrigation systems that apply water through small devices. These devices deliver water onto the soil surface very near the plant or below the soil surface directly into the plant root zone. Growers, producers and landscapers have adapted micro-irrigation systems to suit their needs for precision water application. Micro-irrigation systems are immensely popular not only in arid regions and urban settings but also in sub-humid and humid zones where water supplies are limited or water is expensive. In irrigated agriculture, micro-irrigation is used extensively for row crops, mulched crops, orchards, gardens, greenhouses and nurseries. In urban landscapes, micro-irrigation is widely used with ornamental plantings. In this article, the focus was laid on the effects of micro irrigation on sustainable agriculture, soil and water resources sustainability.

Advantages of micro irrigation
Some of the major advantages of micro irrigation (MI) are given below:

- **Affordability:** MI is available in affordable sizes from local suppliers at prices lower than other available irrigation systems.
- **Improved Yield:** Slow and regular application of water and nutrients uniformly to all plants improves product quality and uniformity, and increases yield.

- **Water Saving:** Water savings are 50%, compared to traditional irrigation methods. This means that when using MI, a farmer can irrigate more crop area per unit of water used.
- **Labor Saving:** Less labor is required for irrigation, weeding, and fertilizer application compared to traditional production methods.
- **Fertilizer Saving:** Fertilizer losses are minimized with MI, reducing fertilizer costs.
- **Energy Saving:** Most of the MI are gravity operated systems or operated with low horsepower pumps, reducing energy demand for irrigation.
- **Difficult Terrain:** MI can be used on undulated terrain (hilly areas) where irrigation by traditional methods is difficult.
- **Tolerance to Salinity:** Due to slow and regular application of water by MI, concentration of salts in the root zone is reduced and by micro-leaching salts are kept away from the root zone.
- **Improved Crop and Disease Control:** Regular irrigation ensures timely inter-culturing operations and spraying, allowing better control over potential crop diseases. It also reduces the incidence of diseases common with flood irrigation.
- **Reduced Cultivation Cost:** Slow and regular application of water keeps an optimum soil-water-air ratio in the soil which is essential for healthy plant growth. It also reduces the need for frequent inter-culturing, weeding, etc. Combined with the above-mentioned savings, cultivation costs on the whole are reduced.
- **Application to Variety of Crops:** A number of different crops can be irrigated using MI including vegetable crops, fruit crops, commercial cash crops, flowers, etc.

Type of Micro-irrigation

Micro Irrigation is classified into many types:

1. Drip Irrigation

Water supplied in the field by lateral (small pipe) distribution throughout the field and water supplied in the farm of drops through dippers or holes presents on the lateral.

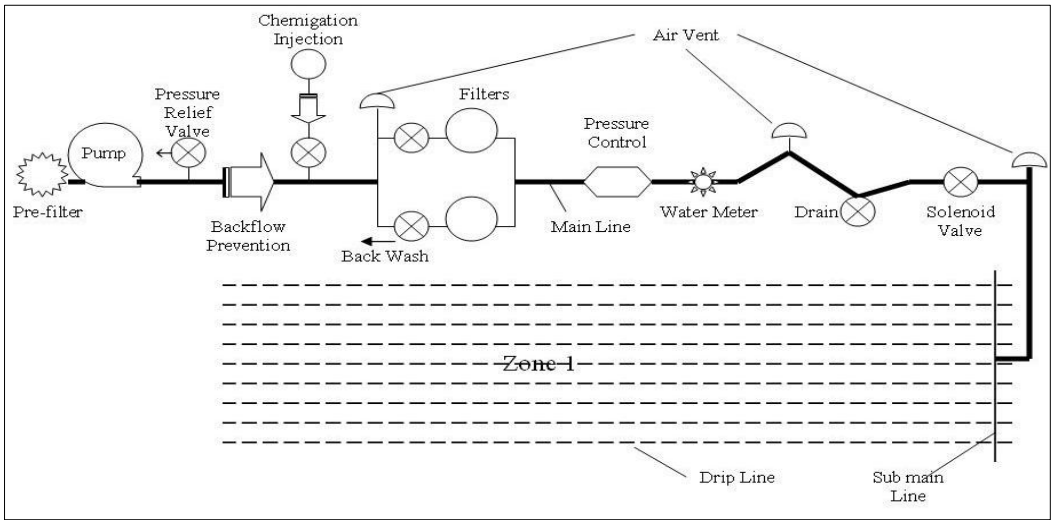

Fig 1: Components of drip irrigation

2. Sprinkle Irrigation

Water supplied in the form of sprinkles or in the form of rainfall with help of nozzle setups distributed over the field in some interval of distances and areas.

3. Central Pivot Systems

These are the traveler setup and travels throughout the filed by means of pneumatic wheels and have outlets in some height which sprinkles and distribute or broadcast the water.

Importance of micro irrigation in sustainable agriculture

Irrigation water requirements in micro-irrigation can be smaller when compared to the other irrigation methods. This is due to reduced wetted area; less water is lost to evaporation. These systems are also almost no surface runoff. Micro irrigation provides a constant supply of water in the crop zone and has been proven to provide a higher crop yield and increased water use efficiency over conventional irrigation methods. Micro irrigation is most effective method for increasing Crop Yield and Water Saving The studies on cotton in Harran Plain of Turkey showed that water requirement could be 1148 mm (Karaata, 1985) [3], 1113 mm (Kanber *et al.*1991) [2] and 937 mm (Cetin and Bilgel, 2002) [4] by furrow irrigation. Whereas, Cetin and Bilgel (2002) [4] showed that water requirement of cotton could be 619 mm by drip irrigation in order to approximately same yield. Accordingly drip irrigation resulted in not only higher cotton yield but also considerable water savings.

Drip irrigation is probably one of the most effective methods of water application. It generates a restricted root system requiring frequent nutrient supply. This may be satisfied by applying fertilizers with irrigation water by fertigation. A major innovation has been the development of fertilizer injectors which can be attached to micro-irrigation systems to allow for fertigation, thereby improving crop nutrient management. Micro-irrigation systems allow for a high level of control of chemical applications. Both water and fertilizer can be applied throughout the growing season in judicious amounts to match crop requirements. Additionally, other chemicals, such as herbicides, insecticides, fungicides, nematicides and growth regulators can be efficiently applied through micro irrigation systems to improve crop production.

Future Strategies

Micro-irrigation has been particularly successful for horticultural, ornamental and landscape applications and has been applied to a wide range of climatic conditions from humid to arid and semi-arid regions and all topographic

conditions. Its advantages with respect to water and energy savings, increased yields, improved fertilizer application, reduced the rate of salinization, eliminated wood and diseases, and reduced labor, are well recognized. Advances in emitter and dripper technology, the introduction of inexpensive drip tape, and the development of low-cost sand and screen filters have helped to expand acreage under micro-irrigation.

A significant challenge is to apply drip irrigation technology to the production of cereal crops, particularly in developing countries. In these parts of the world, there are several social, technical and institutional challenges which must be overcome. Education and knowledge transfer must be accelerated.

As a result, using the micro-irrigation systems will be vital important in terms of conservation or sustainability management of soil and water resources.

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