CHAPTER I

INTRODUCTION

Improved agricultural water use in irrigated and rainfed agriculture will play a key-role in coping with the expected water scarcity stress. Improving water use or water productivity is often understood in terms of obtaining as much crop as possible per volume of water - "more crop for the drop". Money-wise farmers may prefer to target a maximum income per unit of water - "more rupees for the drop", while community leaders and policy makers may aim for maximum employment and income generated through the agricultural sector - "more jobs for the drop". Thus in a broad sense, increasing productivity in agriculture can result in more benefit for every unit of water withdrawn from natural water sources. Thus, water is the most vital input in agriculture and has also made a significant contribution in providing stability to food grain production and self-sufficiency.

Since, agriculture is by far the biggest user of water accounting more than 70 % of water utilization world wide and 90 % of water utilization in the developing countries. As compared to the surface water, greater proportion of additional irrigation water comes from the ground water and this source is increasingly being exploited in an unscientific manner. In addition, the problem has been further aggravated by deterioration of water quality, thereby making utilisable water as a diminishing resource and with competitive demand from other user’s viz. industry and power, domestic and municipal sectors. Land and water are the basic inputs of agricultural and there by economic development. The use and demand of these resources is continuously increasing. Therefore, it becomes necessary to utilize these resources judiciously and effectively. One fifth of world’s area is still unirrigated. India ranks second having an area about 94 million hectare under irrigation, out of total 137 million hectares of cultivated land. In spite of having only 2.4 % geographical area and 4 % water resources, India has 17 % of its population and 15 % of its livestock.

Rain fed area of the Gujarat state is about 6.6 Mha and about 1.2 Mha area is affected by varying degrees of salinity and alkalinity. During last decade, Gujarat has witnessed an average agricultural growth of about 10.67 % as against the national average of 3.57 %. Saurashtra is functioning in a typical arid and semi-arid type of climate in the state. Hence, drought, erratic rainfall, low fertility and salinity ingress are
the major constraints limiting agricultural productivity. Therefore, improvement of irrigation water management in agriculture, which is the biggest water consumer, is necessary to enhance agricultural productivity in order to meet food demands of the growing population.

Also, the rising demand for urban and industrial water supplies in the world pose a serious threat to irrigated agriculture. The allocation of water for agriculture will come down to 50% from the present level of 70%. The major problem associated with decreasing amount of fresh water for irrigation is conveyance losses, reducing the net utilization of irrigation water to 46% only. The net utilization of irrigation water in drip system is 90% and through sprinkler system, it is 60-80%. In view of the same, micro-irrigation is having paramount importance with brighter future prospects. The demand of these resources is continuously increasing. Therefore, it becomes necessary to utilize these resources judiciously.

1.1 Trickle Irrigation

Water is often costly and limiting input in recent years due to low rainfall, expansion in cultivated area and poor recharge of ground water, particularly in the arid and semi-arid areas of country and needs judicious use to reap maximum benefit. Efficient use of water is the mainstay of irrigated agriculture. The conventional methods of irrigation i.e., flood irrigation, furrow irrigation have lower efficiencies in the range of 30 to 50% whereas the overall efficiency of modern methods of irrigation such as trickle irrigation and sprinkler irrigation is about 90% and 60%, respectively. The information on proper method of irrigation and its quantity is rather essential.

Efficient use of water is highly critical to sustain agricultural production, more particularly in the context of declining per capita land and water availability. Trickle method of irrigation also helps to reduce the over exploitation of ground water and environmental problems associated with the surface method of irrigation like water logging and salinity. Trickle irrigation system improves the WUE because of improving the yield and quality of produce (Singh et al., 2005). Irrigation scheduling based on climatological approach (IW/ETc ratio) is now considered as most scientific since it integrate all the weather parameters giving them natural weightage in a given climate-water-plant continuum. The average productivity of the fennel crop is low as compared to other parts of the country. The one of the reasons for low productivity may be poor water management practices. There is urgent need to work out optimum irrigation
schedule based on various IW/ET$_C$ ratios for optimum utilization of limited water resources.

1.2  **Fennel Crop** (*Foeniculum Vulgare* Mill.)

Fennel, (*Foeniculum vulgare* Mill.) commonly known as fennel is a well-known and important medicinal and aromatic plant widely used as carminative, digestive, lactogogue and diuretic and in treating respiratory and gastrointestinal disorders. Its seeds are used as flavorings in baked goods, meat and fish dishes, ice cream, alcoholic beverages and herb mixtures. It has an ability to exhibit antifungal, antibacterial, antioxidant, antithrombotic and hepatoprotective activities, lending support to the rationale behind several of its therapeutic uses (Manzoor *et al*., 2016). It may be used in diseases like cholera, bile, anti-inflammatory, nervous disorder, constipation, dysentery, diarrhoea and for diseases affecting chest, lung, spleen and kidneys. The leaves are reported to have diuretic properties, whereas, the root are purgative (El-Awadi and Hassan, 2011, Singh and Singh, 1996).

The crop has good economic value for farmers as it has culinary uses; for flavoring soups, pastries, cakes, sauces, confectionaries, bread rolls, liquors, meat dishes and in the seasoning of pickles. The oil is used as flavoring agent in culinary preparation, confectionary, and cordials and in liquors. In India, fennel seeds are chewed alone or in betel leaf. The fennel leaves are use in fish sauces and for garnishing and the leaf stalks are used in salad or as vegetables. It is also used in cosmetic and medicinal preparations like in infantile colic and flatulence and is considered as a good vermicide against hook-worm and it has insecticidal (Abramson *et al*., 2006; Hendawy and El-Din, 2010; Singh and Singh, 1996) and fungicidal properties (Singh *et al*., 2006). The seeds of fennel contain volatile oil ranged from 2.17 % to 2.60 % (Anon., 2006).

It is believed to native of Southern Europe, North America and coastal Mediterranean area of India (Tanira *et al*., 1996; Aprotosoaie *et al*., 2010). Which is commonly known as ‘Variali/Variari’ in Gujarati, where ‘Saunf’ in Hindi and considered as one of the important spices crop. (Kenneth, 1985). Our country is the leader producer of fennel as the crop is grown in about 54, 160 hectares and produces 70, 120 tonnes of seeds during 2013-14 (Anon., 2014). Gujarat and Rajasthan are the main fennel cultivating states. In the state, its cultivation is mostly confined to Kheda, Mahesana, Sabarkatha, and in some patches of Saurashtra. The total area under Fennel
in the state is 38,000 hectares with annual production of 55,000 tonnes of seeds during 2013-14 with the highest productivity of 1440 kg/ha (Meena et al., 2010; Anon., 2014).

1.3 Practical Utility of the Research Problem

The average productivity of the fennel crop is comparatively low in the state and country both, may be due to poor management practices including irrigation. The conventional methods of irrigation have lower efficiencies as compared to micro irrigation. The modern agriculture and irrigation practices can play a key role in alleviating rural poverty. This way the system helps in maintaining the congenial soil moisture regime in soil root zone to achieve increase in yield and water use efficiency.

Fennel crop being a remunerative crop, is moisture stress sensitive hence, to maintain congenial soil moisture content through the season is very crucial for crop performance. This can be possible by determining the actual irrigation requirement of the crop. Also the optimum frequency of irrigation can decide exact time of irrigation supply. The best combination of irrigation regimes and frequency will provide the ready information for irrigation scheduling of fennel crop. Hence, any misuse of water can be mitigated and proper demand and supply at appropriate time will result in higher productivity, good quality of product with enhanced water use efficiency. Also, the techno-economic feasibility of trickle irrigation for fennel crop gave the idea for future use of the system in better way. In order to encounter the above issues the research work was conducted with following specific objectives.

1.4 Objectives

1. To determine the optimum irrigation regime for fennel crop under trickle irrigation.
2. To study the effect of trickle irrigation scheduling on growth and yield of fennel crop.
3. To study the techno-economical feasibility for fennel crop cultivated under trickle irrigation.