CHAPTER - I

INTRODUCTION

1.1 General

Agriculture is the backbone of Indian economy. India is a vast country with 329 million hectares geographical area, which contributes nearly 35 per cent to national income. Agriculture still is the main occupation of 70 per cent of the population. In the world, India accounts about 2.4 per cent of the geographical area and 4 per cent of its water resources but has to support about 17 percent of the world’s human population and 15 per cent of the livestock. Agriculture is an important sector of the Indian economy, accounting for 14 of the nation’s Gross Domestic Product (GDP) from which about 11 per cent contributes its exports. Also about half of Indian population still relies on agriculture as its principal source of income. In addition, it is a source of raw material for a large number of industries. India being a developing nation, agriculture and industries based on agricultural products have prime importance in the national economy. Majority of the Indian population depends on agriculture and agro-based industries and businesses. Therefore, it is not only to accelerate the growth of agriculture produce but also to achieve an overall GDP target of 8 per cent during the 12th Plan and meet the rising demand for food, and to increase incomes of those dependent on agriculture to ensure inclusiveness in our society (Anon., 2013).

The agricultural mechanization has been increasing during last four decades. The application of machinery in Indian agriculture has gained importance for increasing agricultural production, productivity and profitability by timely farm operations, labour saving, as well as maximizing input efficiency by effective and proper utilization. The newly developed appropriate technology of farm mechanization with improvement in existing design, newer material and production techniques will cater the needs of farms (Manian et al., 2002). Over the years, the shift has been toward the use of mechanical and electrical sources of power. In 1960-61 about 92.30 per cent farm power was coming from animate sources which reduced to about 11.80 per cent in 2013-14 and that of mechanical and electrical sources of power increased from 7.70 per cent to about
88.20 per cent. The country witnessed unprecedented growth in agriculture that helped the country to graduate from hunger to self-sufficient in food grains by increasing the food grain productivity from 0.636 t/ha in year 1965-66 to 2.11 t/ha in 2012-14, resulting for export with surplus. The cropping intensity increased with increase in per unit power availability. It was 114 per cent with power availability of 0.32 kW/ha during 1965-66 which increased to about 142 per cent with an increase in power availability of 2.02 kW/ha in 2013-14 (Kale et al., 2016). The growth in large scale adoption of agricultural machinery in the country has been possible due to efforts not only by organized sectors but also by village craftsmen and small-scale industries.

The ever-increasing human and animal population has put tremendous pressure on the natural resources, particularly land and water. The per capita availability of precious water has declined drastically in the past few years. Water supply is limited worldwide and there is an exigency to identify and adopt effective water saving and irrigation management strategies. The arid and semi-arid areas of the country usually face acute water scarcity. Therefore, judicious use of water will be a key point in agriculture development for future, both in irrigation and rain fed areas. This scarce water resource has to be put to use with highest efficiency. In this context, micro-irrigation system, particularly drip irrigation system is an answer to increase water use efficiency and crop production. Drip irrigation is one of the latest methods that can help in augmenting increase irrigation potential by optimizing the use of limited available water resources.

Water resources of a country continue one of its vital assets. India occupies only 329 M ha geographical areas, which forms 2.4 per cent of the world’s land area; it supports over 17.2 per cent of the world’s population. Total annual utilizable surface water and groundwater resources of India are estimated at 690 BCM and 433 BCM per year, respectively (CWCI, 2012).

In India, per capita surface water availability in the years 1991 and 2001 are 2309 and 1902 BCM respectively. Which is projected to reduce to 1401 and 1191 BCM respectively by the development and management of the greatest assets of the country, viz. Water and land resources for raising the standards of living of the millions of people, particularly in the rural areas (CWCI, 2012).
Water is becoming all the time scarcer worldwide and more than one-third of the world population would face absolute water scarcity by the year 2025 (Narayanmoorthy, 2004).

1.2 Drip irrigation system

Drip irrigation is the drop-by-drop application of water to the plant root zone. Drip irrigation method has little or no water losses through conveyance and the on-farm irrigation efficiency of a properly designed and managed drip irrigation system can be as high as 90 per cent, compared with 35 to 40 per cent efficiency of surface method of irrigation (Narayanmoorthy, 1997). It also provides many unique agronomic and water conservation benefits that address several challenges faced by irrigated agriculture. The Government of India has set up a task force on micro-irrigation for rapid expansion of area under micro-irrigation. In this connection, the technical knowledge of survey, design, layout and installation of micro-irrigation for efficient operation of the system is very essential.

Drip irrigation has several advantages over sprinkler and flood irrigation. Notables are higher water use efficiency and increase in yield. Besides water saving and increase in yield, there are several other reasons for bringing more and more area of agriculture under drip irrigation.

![Fig. 1.1: Status and growth in India area under micro irrigation (Mha), 2005-2015 (Anon., 2016b).](image)
Water resources of country are depleting at an alarming rate, growing population and changing lifestyles are putting more and more pressure on the available resources. Under the circumstances it is needed to popularize drip irrigation method in various states of the country through extension services that may give information about the technology needed and economic benefits of drip irrigation and help to reduce over exploitation of water resources of country.

Micro irrigation has seen a steady growth over the years. Since 2005, the area covered under micro irrigation systems has grown at a CAGR of 9.6 per cent geographically, states with the largest area under micro-irrigation include Rajasthan 1.68 Mha, Maharashtra 1.27 Mha, Andhra Pradesh 1.16 Mha, Karnataka 0.85 Mha, Gujarat 0.83 Mha and Haryana 0.57 Mha.

Majority of the area covered under micro irrigation system comes under sprinkler irrigation with 56.4 per cent, and 43.6 per cent for drip irrigation. The area under drip irrigation has shown higher growth in recent years, growing at a CAGR of 9.85 per cent in the 2012-2015 period, while sprinkler irrigation has grown a pace of 6.60 per cent in the same period. Overall, the area under micro-irrigation has grown at a CAGR of 7.97 per cent in this period (Anon., 2016a).

The scheme on micro irrigation in India was launched during the year 2005-06 and it has been upscaled to be implemented as the ‘National Mission on Micro Irrigation (NMMI)’ during the XI Plan period.

1.3 Type of drip irrigation system

1.3.1 Inline drip emitter

The inline drippers are fixed along with the line i.e. the pipe is cut and dripper is fixed in between the cut ends, such that it makes a continuous row after fixing the dripper. The inline drippers have generally a simple thread type or labyrinth type flow path. With the labyrinth type flow path, it is possible to have larger cross section area and turbulent flow of water to prevent clogging of dripper. The inline drippers are available with discharge of 2, 3, 4, 8 liters/hr. at 1 atm. pressure.
1.3.2 On line drip emitter

The on-line drippers are fixed on the lateral by punching suitable size holes in the pipe.

1.4 Components of drip irrigation system

The component required for drip system are generally more involved than those for other application system due to the need to filter the water supply and to maintain a specific pressure distribution throughout the system.

I. Main line
II. Sub main
III. Laterals
IV. Emitter
V. Flush valve

1.4.1 Laterals

The laterals distribute water to emitter, which delivers water directly to root zone. Laterals are small diameter in flexible pipes or tubing made of low-density polyethylene (LDPE) or linear low-density polyethylene (LLDPE) and having 12 mm, 16 mm, and 20 mm, diameter. They are colored black to avoid algae growth and minimize the damaging effect of ultraviolet radiation. They can withstand maximum pressure of 4 kg/cm$^2$. The pressure variation between two extreme points of a lateral should not be more than 10 per cent.

Laterals are laid down throughout the field such that each plant has an outlet (emitter) for providing irrigation to that plant. Once again after the crop is ready the laterals are to be collected and stented safety dry season and so on.

1.5 Drip line installer and retriever

A device or mechanism used to install and retrieve a drip line and making bundles can be termed as drip line installer and retrieve. Manual drip line retrievers are in use in agricultural the work of retrieving the line is highly combination and it needs
precision or it does not work well with ease while laying down. Also the time consumed in lying and retrieving the line of whole field can be minimized if some mechanical means / automate machine is used.

The collection and storage of drip lines can also be considered as important operation in maintenance of drip irrigation system. Drip lines are to be removed many times from the field to carry the different inter culture operations like wedding, harrowing etc, and drip lines are also removed at the time of harvesting of the crop.

1.6 Justification of research problem

Drip irrigation has advantages over other irrigation methods. It has been widely used in many applications throughout the world, resulting in increasing crop yield and minimizing the water conservation. Declining water supplies and environmental concerns have stimulated the development of drip irrigation technology and its use. (Bucks et al., 1974; Sammis, 1980; Hodgson et al., 1990; Camp et al., 1993; Hanson et al., 1997; Lamm et al., 1997).

Implements available in market have been improved considerably in the last 10 years; however, they are still expensive, difficult to operate, and labor intensive. Which may be due to complex mechanical designs. A single implement to install and retrieve drip line is preferred to reduce the capital Investment (Coates, 1985; Coates, 1986b).

However, the disadvantage of using surface drip irrigation is that drip line must be installed and wound according to crop, thus increasing labour cost. The device to install and retrieve drip line is crucial for the successful application of surface drip irrigation to rows. Very few drip line-handling implements are available to fulfil the irrigation technique for the growing market demand.

No. of manufacturers are producing retriever alone but none of them had come up with device that works in both ways i.e. installation and retrieval of drip line together.

So, as to overcome the lacking of the available device (manual winder) a device for the purpose is designed such that it uses the power from a min tractor, the speed of operation be governed by a hydraulic motor driver by hydraulic outlet and a regularity valve fitted additionally fitted to the tractor.
Therefore, development of as simple but slightly expensive than that available in the market, which serves the purpose of installation and retrieval of lateral both were kept in mind. The problem was formulated to minimize time, and easier handling, the research was designed with following objectives.

1.7 Objectives

The objective of this study are as follows:

1. To design and develop a mini tractor operated drip line installer and retriever.
2. To evaluate the performance of the developed machine.
3. To work out economics of the developed machine.