Design of Sprinkler Irrigation

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Abstract-

Irrigation in India

Irrigation in India includes a network of major and minor canals from Indian rivers, groundwater well based systems, tanks, and other rainwater harvesting projects for agricultural activities. Of these groundwater system is the largest In 2013-14, only about 47.7% of total agricultural land in India was reliably irrigated. The largest canal in India is Indira Gandhi Canal, which is about 650 km long. About 2/3rd cultivated land in India is dependent on monsoons. Irrigation in India helps improve food security, reduce dependence on monsoons, improve agricultural productivity and create rural job opportunities. Dams used for irrigation projects help produce electricity and transport facilities, as well as provide drinking water supplies to a growing population, control floods and prevent droughts.

India's irrigation covered crop area was about 22.6 million hectares in 1951, and it increased to a potential of 90 mha at the end of 1995, inclusive of canals and groundwater wells.

However, the potential irrigation relies of reliable supply of electricity for water pumps and maintenance, and the net irrigated land has been considerably short. According to 2001/2002 Agriculture census, only 58.1 million hectares of land was actually irrigated in India. The total arable land in India is 160 million hectares (395 million acres). According to the World Bank, only about 35% of total agricultural land in India was reliably irrigated in 2010.

The ultimate sustainable irrigation potential of India has been estimated in as1991 United Nations' FAO report to be 139.5 million hectares, comprising 58.5 mha from major and medium river-fed irrigation canal schemes, 15 mha from minor irrigation canal schemes, and 66 mha from groundwater well fed irrigation. India's irrigation is mostly groundwater well based. At 39 million hectares (67% of its total irrigation), India has the world's largest groundwater well equipped irrigation system (China with 19 mha is second, USA with 17 mha is third).

India has spent 16,590 crore on irrigation development between 1950 and 1985. Between 2000-2005 and 2005-2010, India proposed to invest a sum of 1,03,315crore and 2,10,326 crore on irrigation and flood control in India.

I. INTRODUCTION

Water is a key factor in increasing agricultural production. About 78% of India's water resources are used for agriculture out of this only 50% is actually used by plants and the remaining water resources are wasted either as deep percolation or as evaporation. Excess irrigation not only reduces crop production and damages soil fertility but also causes ecological hazards like water logging and salinity. With competitive use of water and its increasing scarcity, it has become imperative to economies water use for optimum productivity. This is possible only through improved water management and adopting advanced techniques of irrigation. One such method of modern irrigation is sprinkler irrigation system which is becoming more and more popular among the farmers across the country. Sprinkler irrigation system saves up to 50% of water compared to surface irrigation method and increases productivity by about 15-25 %. Until 1970, sprinkler irrigation system in India was used mostly in hilly area for plantation crops like tea and coffee. But thereafter it spread to other states like Haryana, Punjab, Rajasthan, MP, Maharashtra, U.P., Gujarat, Tamilnadu, Karnataka, etc. where there was shortage of ground water for irrigation. Today farmers in almost all the States in the country have progressively adopted this system and it is estimated that about 10 million ha can be brought under sprinkler irrigation system in India. Realizing the need for water use optimization in the context of water scarcity and increasing agricultural productivity, the Government of India encourages large scale adoption of this method.

II. TYPES OF IRRIGATION

This most commonly used irrigation system.

Drip irrigation: - Drip irrigation is defined as any watering system that delivers a slow moving supply of waterat a gradual rate directly to the root zone. Drip irrigation is a type of micro-irrigation that has the potential to save water and

nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface. The goal is to place water directly into the root zone and minimize evaporation.

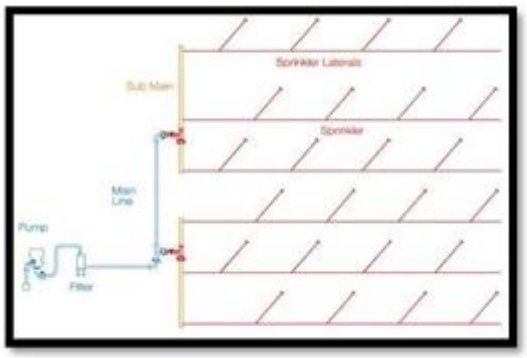
Sprinkler irrigation: - Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. An irrigation sprinkler is a device used to irrigate agricultural crops, lawns, landscape, golf courses, and other areas. Wateris distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground.

Flood irrigation: - Flood irrigation is an ancient method of Irrigating crop very simply; water is delivered to the field by ditch, pipe or some other means and simply flows over the ground through the crop. With flood irrigation it is generally assumed that only half of the water applied actually ends up irrigating the crop. Although flood irrigation will never be as efficient as other types of irrigation there are several techniques that can be used to improve its efficiency.

III. COMPONENTS

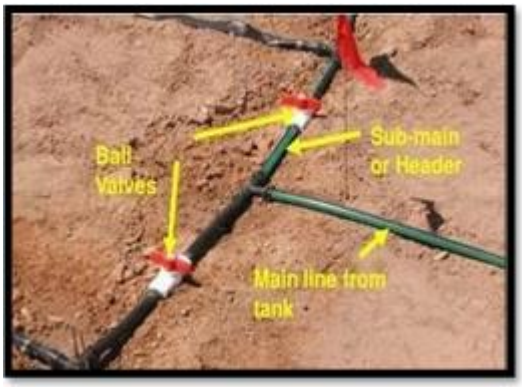
I. Mainline:

Mainline may be permanent or portable main. Permanent use where field boundary are fixed. Asbestos, cement PVC, and steel pipes are used to for these. Portable main use to where there are number of fields. Lightweight aluminum pipes with quick couplers are used for portable mainline.



2. Submainlines:-

The pipes which delivers water from the pump to the laterals. Tin some case these pipelines are permanent and laid on the soil surface or buried below ground. In other case they are temporary and can be move from field to field.



3. Lateral:-

The lateral deliver water from the mainlines or some mainlines to the sprinklers. They can be permanent but more often they are portable and made of aluminum alloy or plastic so that they can be moved easily. These are usually available in length of 5, 6 or 12 M.

4. Pumping set or Pumpingunit:-

The pumping set or pump is usually centrifugal pump which takes water from the source and provides adequate pressure for delivery into the pipe system.

5. Perforated pipe:-

Perforated pipe irrigated system consist of light weight quick coupling, and portable irrigated pipes with lines with lines of small perforation in the upper one third of the perimeter. The system provides irrigation at quite low pressure.


Fig: - Perforated pipe system

6. Debris screen:-

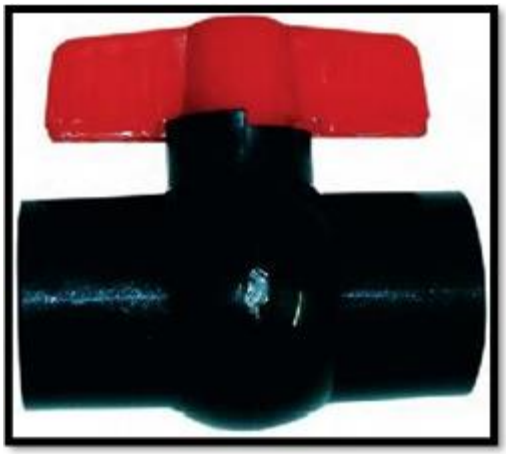
Debris screen are usually needed when surface water is used as the source of irrigation. The function of screens is to keep the system free of trash that might plug the sprinkler nozzles. They may also be required to prevent sticks, plants, plants stalks, and other large items of debris from entering the system.

7. Filter:-

The filter ensures that clean water enters the system. There are different types of filters - screen, media and disc. Different sizes of filters are available depending on the flow rate of water in the system.

8. Control valve:-

A valve made of plastic or metal to regulate required pressure and flow of water into the system. There are valves of various sizes depending on the flow rate of water in the system.



9. Pressuregauge:-

Instrument used to measure and display pressure in an integral unit are called pressure gauges. Pressure measurement is the analysis of an applied force by a fluid (liquid or gas) on a surface. Pressure is typically measured in units of force per unit of surface area.

IV. AREA CALCULATIONS

The total area is divided into two sections. The area is a rectangular on field. We will consider it is rectangular for calculation purpose.

(Section-1) = 60m x75m
= 4500 m^2
(Section-2) = 70m x75m
= 5250 m^2
Total area = 4500 + 5250
= 9750 m^2

Now, we have to consider the area in hectare. Now,

We know,

1Ha =10000m^2
9750m^2 =0.97Ha.

V. DESIGN OF SPRINKLER SYSTEM

A) Application rate of water Assuming,

Discharge of each minisprinkler = 540ltr/hr.

For this discharge, we will consider distance between sprinkler= 10m x 10m.

Application rate = Discharge of each sprinkler/distance between sprinkler
= 540/10 x 10
= 5.4mm/hr.

B) Shift Duration-

For finding shift duration, we will need crop water requirement of crop.

Hence, crop water requirement of groundnut = 8mm Hence,
Shift Duration = Crop Water Requirement/ Application Rate
= 8/5.4
=1.48 hr.

C) Total Flow Calculation-

Total Flow = Total Area x Application Rate
= 9750 x 5.4
=52,650mm/hr.
=52.65 m^3/hr.
Section 1 Flow =4500 x 5.4
=24300mm/hr.
=24.30m^3/h

Section 2 Flow =5250 x5.4
=28350mm/hr.
=28.35m^2/hr.

D) Number of Sprinklers Required

One sprinkler will wet area in diameter of 10m. Now,

(Section-1):-

The width of the 1st section is 60m.

Total no. of sprinklers in one row = Total dimension/Sprinkler spacing
= 60/10
= 6 No's

Now, length of 1st section is 75m.

Total no. of sprinklers in one column =Total dimension/sprinkler spacing
= 75/10
=7.5 No's

We will provide 8 No's of sprinklers. As it is necessary to wet all area the one extra sprinkler will irrigate extra 2.5(diameter) on both sides.

Hence ,
Total no. of sprinklers in one section = 6 x 8
= 48 No's
Now,

(Section-2):-

The width of section 2 is 70m.
Total no. of sprinklers in one row =Total dimension/sprinkler spacing
= 70/10
= 7 No's
Now, length of section 2 is 75m.

Total no. of sprinklers in one column=Total dimension/sprinkler spacing
= 75/10
=7.5 No's

We will provide 8 No.s of sprinklers. As it is necessary to wet all area the one extra sprinkler will irrigate extra 2.5(diameter) on both sides.

Hence,

Total no. of sprinklers in 2nd section=8 x7
=56No.s

VI. RESULT

1. Total amount to be invested = Rs.160835.18
2. Cost of 1 acre area = Rs.65115.45
3. Depth of source (well) =10m.
4. Power of motor =5HP.

VII. CONCLUSION

In this project, we have studied various aspects related with sprinkler irrigation. Considering all the factors related with sprinkler irrigation system, we have design a complete irrigation system. The overall cost of project is 160835.18 Rs. The per acre cost of project is 65115.45 Rs.

In this project we used mini sprinkler excepting overhead sprinkler. Overhead sprinkler are made up of metal material which is costly in market and the mini sprinkler which we used are made up of plastic material which is not costly as overhead sprinkler.

VIII. ACKNOWLEDGEMENT

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