SPRINKLER IRRIGATION SYSTEM

Chapter I

Requirements for formulation of a model scheme by Banks

1. 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 economise 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 upto 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. Realising the need for water use optimisation in the context of water scarcity and increasing agricultural productivity, the Government of India encourages large scale adoption of this method.

2. Sprinkler Irrigation System

Sprinkler irrigation method distributes water to crops by spraying it over the crop area like a natural rainfall. The water under pressure flows through perforations or nozzles and sprays over the area. The pressure is provided by a pump of suitable capacity and horsepower. With careful selection of nozzle sizes, operating pressure and spacing, the actual water required for maintaining the soil moisture at field capacity is applied uniformly at a rate to suit the infiltration rate of soil thereby obtaining efficient water application.

It is estimated that the sprinkler irrigation system substantially reduces the use of water and the crop productivity also increases.

Suitability

The sprinkler irrigation system is a very suitable method for irrigation on slopy lands and on shallow soils. It is best suited to coarse sandy terrain where the percolation loss is more and where as a consequence, the frequency of irrigation required is more. The sprinkler irrigation system is also suitable in undulating terrain where land shaping is expensive or technically not feasible. The removal of fertile soil cover by land shaping is not advisable. Sprinkler irrigation system can also be adopted in hilly regions where plantation crops are grown.

Crops suitable

Nearly all crops are suitable for sprinkler irrigation system except crops like paddy, jute, etc. The dry crops, vegetables, flowering crops, orchards, plantation crops like tea, coffee are all suitable and can be irrigated through sprinklers.

Other advantages

1. Fertilizers and pesticides can be effectively applied in split doses through sprinklers at little extra cost. This facilitates uniform fertilizer application and effective pest control.

2. The overall cost of labour is generally reduced.
3. Erosion of soil cover which is common in surface irrigation can be eliminated.

3. Type of Sprinkler Systems

There are many types of Sprinkler systems available in the market. On the basis of the arrangement for spraying irrigation water, sprinkler systems are classified as :

i) Rotating head system

ii) Perforated Pipe system

The rotating head system is more versatile and popular.

Table-1.1: *Classification of rotating head sprinklers, their characteristics and adaptability*

Type of sprinkler	Gravity fed under tree sprinkler systems	Normal under tree sprinkler systems	Permanent overhead systems	Small overhead systems	Low pressure systems	Intermediate pressure systems	High pressure systems
Pressure range	0.7 to 1.0 kg/sq.cm.	1 to 2.5 kg/sq.cm.	3.5 to 4.5 kg/sq.cm.	2.5 to 4 kg/sq.cm.	1.5 to 2.5 kg/sq.cm.	2.5 to 5 kg/sq.cm.	5 to 10 kg/sq.cm.
Sprinkler discharge	0.06 to 0.25 li/sec.	0.06 to 0.25 li/sec.	0.2 to 0.6 li/sec.	0.6 to 2.0 li/sec.	0.3 to 1 li/sec.	2 to 10 li/sec.	10 to 50 li/sec.
Diameter of nozzles	1 to 6 mm	1.5 to 6 mm	3 to 6 mm	6 to 10 mm	3 to 6 mm	10 to 20 mm	20 to mm
Diameter of coverage	10 to 14 m	6 to 23 m	30 to 45 m	25 to 35 m	20 to 35 m	40 to 80 m	80 to 140 m
Range of sprinkler spacing (square)	--	--	18 to 30 m	9 to 24 m	9 to 18 m	24 to 54 m	54 to 100 m
Recommended speed of sprinkler rotations	--	0.5 to 1 rpm	1 rpm	0.67 to 1 rpm	0.5 to 1 rpm	0.7 rpm	0.5 rpm

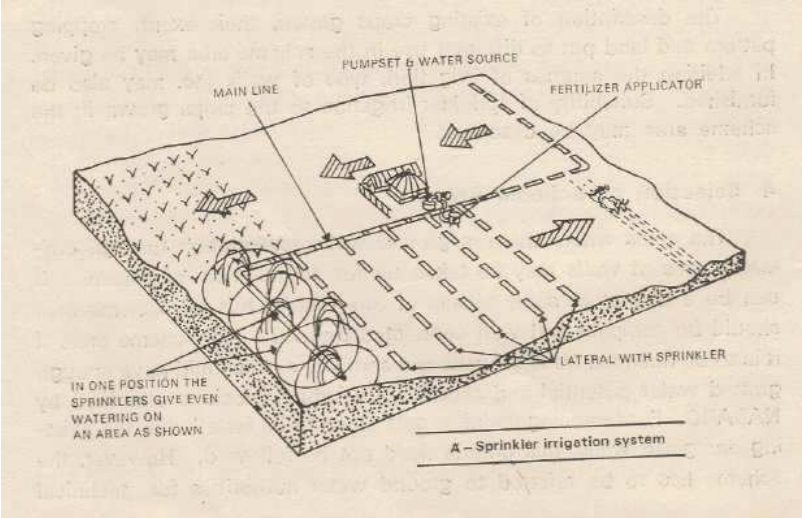
4. Components of Sprinkler irrigation system

1. Water source - open well / tube well / bore well / canal etc.
2. Pumping unit - centrifugal, submersible
3. Sprinkler - main and lateral pipe lines, riser pipe, sprinklers (nozzles)
4. Other minor accessories / fittings like reducers, elbows, valve opening tees, end tees, regulators and gauges, valves, filters, etc.

5. Fertilizer applicator

The selection of pump, pipe line, dia, length, number of sprinklers, their design depend upon soil, topography, climate, cropping pattern and command area.

Figure 1.1



The component wise details of the sprinkler irrigation system are as follows.

Pumping Unit

A pump is required to carry water from the source through the main line and laterals upto the sprinkler or nozzle from where it is sprayed and applied to the crops. In areas where the land topography allows to develop enough pressure at nozzle or sprinkler head under gravity a separate pump may not be necessary. But in most cases it is necessary to pump water and carry it under pressure through the system. The pump is normally a centrifugal pump or a submersible pump fitted with usual accessories. If the water is pumped from a well or a tube well, and the capacity and horse power of the existing pump is sufficient to provide the desired pressure at the nozzle or sprinkler head, a separate pump may not be necessary for the system. But, in case the existing pump is not

sufficient to provide the required pressure for the sprinkler system, a separate booster pump has to be provided depending upon the field situation after taking into account frictional losses in the main, laterals and risers and nozzles. The pumps selected must be as prescribed under IS 10804(1994) standard.

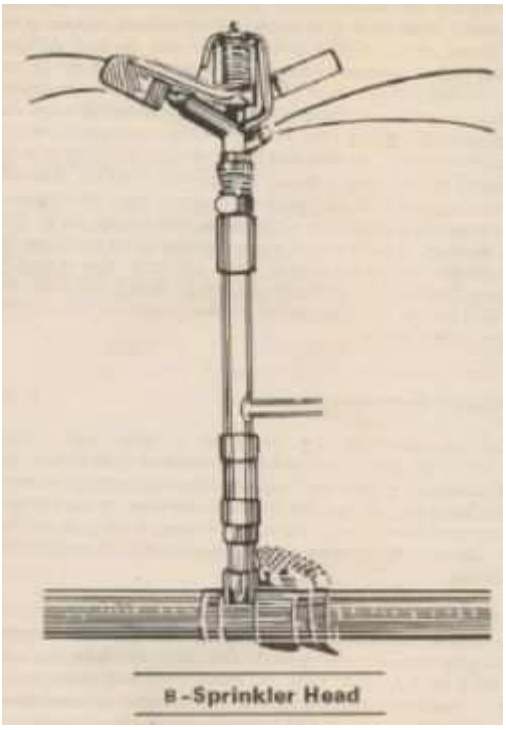
Main Lines

Main line pipe is either of HDPE or Aluminium conforming to BIS specification viz., IS 7092 for aluminum pipes and IS 14151 (with IS 7328) for HDPE pipes. In cases where a portable system is proposed lightweight aluminum pipes are used for main line. The main pipeline carries water from the pumping unit to the various parts of the field. Main line may be permanent or portable. Permanent main line is advantageous where field boundaries are fixed and where crops require full season irrigation. Portable main lines are more economical when a sprinkler system is used for different fields or let out on hire to other farmers. Main line pipes are often buried so that they do not come in way of other agricultural operations.

Lateral Lines

Lateral lines carry water from the main line to sprinklers or nozzles. Lateral lines are usually of aluminium or HDPE pipes with quick couplings. Lateral pipes are normally available in 5m, 6m, 12m lengths. Each length has quick couplings. All couplings are provided rubber gaskets in female portion, which tightens the coupling and makes it, leak proof. Lateral pipes should be of good quality and must conform to the respective prescribed standards. Number of laterals on a main pipe line vary depending upon the crop geometry, water requirement of crop, area required to be wetted etc., so that the total frictional head losses are not very high as that would require a very high capacity pump.

Figure 1.2



8-Sprinkler Head

Nozzle/Sprinkler Head

Sprinkler heads are the most important component of the sprinkler system. Their operating characteristics under optimum water pressure and climatic conditions, mainly wind velocity, will determine their suitability and the efficiency of the system. Most agricultural sprinklers are the slow rotation type. They may range from small single nozzle sprinklers to multiple nozzle sprinklers that operate at high pressure. The combination of pressure and rotation results in the jet of water being thrown to a considerable distance.

Riser

The riser pipe connects the rotating sprinkler head to the lateral. Usually the pipe diameter varies from 12 mm to 75 mm with standard pipe threads. Riser with height 10 cm for small sprinklers and 1 m on large sprinklers give best results. In orchard and other crops the riser length could be 4-5 m for tree sprinkling. Sprinkler should stand slightly away from the crop so that the foliage does not interrupt its jets. High risers should be avoided unless necessary except for crops like sugarcane, banana, maize where height of the plant is high.

Other Accessories

Other accessories used in the sprinkler system are:

1. **Reducers** : Where more than one pipe size is used on the sprinkler line, a reducer is necessary for coupling pipes of different diameters. However, it is recommended that same diameter pipes are used everywhere.
2. **Elbows** : These are used at joints for changing the direction of water flow. It is also used for reducing the pipe size. Valve opening elbows are used which fit over the take off valves on the mainline and allow a lateral to be connected.
3. **End plug Tees** : These are placed at the end of a line so that the water feeds into them and the run of each tee points directly across the line. Therefore, two branches could be attached 180 degrees from each other.
4. **Regulators and Gauges** :These include pressure regulators installed below the sprinkler to keep a constant pressure applied to the sprinkler regardless of whether the pipeline is laid up slope or down slope. Flow regulators are installed to control the flow and pressure of water flowing in the sprinkler. Pressure gauges are used to know the pressure at the pumpset or at the sprinkler. It is desirable to install gauges on each lateral.
5. **Valves** :Valves are used to control the flow of water. Screw type valves are common. Drain valves are needed at valley portion of the land. Other

valves are conventional pressure relief valves, check valves, outlet valves, air relief valves etc.

6. Filters :Sprinkler nozzles are prone to blockage if water carries silt or is saline. In order to stop entry of dirt, sand weed or other suspended material in water flowing through the system, it is necessary to install filters placed on suction side of the pump and at vulnerable places.

Fertilizer Applicator

This device is used for fertilizer application through the system instead of direct application. Only soluble fertilizers can be applied this way. Phosphorous fertilizers are not readily soluble and hence not applied through the system. When the fertilizers are applied through the system it is desirable to operate the system for long time to wet the soil and plant foliage and then inject the fertilizer in the system

5. Scheme Requirements:

Scheme formulation for adopting of sprinkler irrigation system with bank loans requires appropriate technical and financial details. Some of the most important points that should be included in a scheme are briefly given below:

TECHNICAL ASPECTS

Map of the area:

It is important that a map/ sketch of the area is prepared with sufficient accuracy to show all dimensions and showing all relevant elevations with respect to water supply, pump location, and critical elevations in the field to be irrigated.

Type of crops:

Type of crops to be grown in the field concerned must be indicated since consumptive use of water, effective root zone depth, evapotranspiration, etc. differ from crop to crop. Other than Rice and Jute which require large amounts of water, sprinkler irrigation system is adaptable to all crops. It is ideally suited to

crops with restricted root systems such as lettuce, sugarbeet, potato which require light and frequent application of water with close control over moisture level. Sprinklers are also successful in wheat, sugarcane, cotton, vegetables, citrus, lucerne and other fodder crops. Extremely heavy soils with low intake rates cannot be effectively irrigated through sprinklers, especially in hot and windy climates. The sprinkler system should be designed accordingly.

Soil:

The water holding capacity of soils is different for different soils. Thus, type of soil determines the type of sprinkler, irrigation schedule, size and type of equipments, etc. The general nature of the soil and its characteristics should be given in the scheme. Design of Sprinkler system also depends upon the infiltration rate of soil. It is, therefore, essential to have a fair idea about the characteristics of various soils.

Table -1.2*: Infiltration Rate of Some soils*

Sr.No	Soil Type	Infiltration Rate (cm/hr)
1	Coarse sand	2.0 to 2.5
2	Fine sand	1.2 to 2.0
3	fine sandy loam	1.2
4	Silty Loam	1
5	Clay loam	0.8
6	Clay	0.5

Available water:

Soil moisture between field capacity and permanent wilting point is the available water. Different soils have different water holding capacities.

Table -1.3:*Range of available water holding capacity of soils*.

Soil type	Field capacity	Permanent wilting point	Depth of available water per unit of soil

			(in cm/m depth of soil)
Find sand	3 - 5	1 - 3	2 - 4
Sandy loam	5 - 15	3 - 8	4 - 11
Silt loam	12 - 18	6 - 10	6 - 13
Clay loam	15 - 30	7 - 16	10 - 18
Clay	25 - 40	12 - 20	16 - 30

Climate :

Climatic conditions like temperature, humidity, wind velocity of a place has great influence on the consumptive use of a crop. Sprinkler system should be designed for the peak rate of consumptive use of crops to be irrigated by it. In areas where wind velocities and temperatures are high, heavy evaporation losses from the sprinkler sprays significantly reduces the saving of water. The wind also influences the spacing of sprinklers. Therefore, it is essential to know the velocity of wind and its direction. For wind velocities over 16 km/hour, sprinkler system becomes unsuitable.

Table-1.5: *Sprinkler overlap under different wind conditions*

Sr.no.	Average wind speed in km/hr	Maximum spacing of sprinklers
1	No wind	65% of the diameter of the spread area of a sprinkler
2	0-6.5	60% - do -
3	6.5-13	50% - do -
4	Above 13	30% - do -

Depth of irrigation:

On the basis of available moisture holding capacity of the soil in its different layers and soil moisture extraction pattern of the crop in its root zone depth, the depth of irrigation may be calculated.

Irrigation interval :

It is the length of time allowed between successive irrigations during peak consumptive use of the crops. It can be calculated from the available moisture for the soil-crop system and the rate of consumptive use of the crop.

Well Capacity:

The source of water should be indicated. If the source of water is a groundwater structure, the diameter, depth and well yield together with HP of the pump set already installed may be given. This is necessary to decide the discharge available from the well and its optimum utilisation. In case the existing pump is not sufficient, a booster pump may have to be provided to create adequate pressure for proper functioning of the sprinkler system.

Water quality:

Surface irrigation methods are more suitable in the cases where irrigation water contains heavy silt concentration along with substantial salt solution. Otherwise, nozzle may be damaged by coarse silt. Presence of salt solution beyond a limit makes sprinkler unsuitable.

FINANCIAL ASPECTS

Unit Cost:

The unit cost of sprinkler irrigation system includes the cost of all components required for the system and depends upon location of the well, type of sprinkler, discharge, land holding, cropping pattern, topography and the total head. State level unit cost committees finalise average unit costs for sprinkler systems, which are also regularly revised However, these may vary as per the actual site conditions and banks must finance the actual costs required for the sprinkler system.

Time and labour required to operate the system:

The adoption of sprinkler irrigation system reduces the amount of time and labour required by manifolds. Unlike the conventional method of irrigation, it does not require continuous supervision during irrigating the field.

Costs and benefits:

Sprinkler entails high initial cost in comparison to surface irrigation methods. However factors such as - optimum water use from a limited water supply source (leading to higher cropping intensity) , achievement of significant saving of financial resources by obviating the necessity of land levelling and other labour costs, besides increased productivity /yield of crops - tend to tilt the case in favour of sprinkler system. These aspects may be quantified and indicated in the scheme.

Economics:

The economics of investment should be given in detail. The scheme should also give details about repayment scheduling, rate of interest, subsidy available etc.

6. Operation and Maintenance of Sprinkler Systems

Operation :

Proper design of a sprinkler system does not in itself ensure success. The system should be operated in keeping with good irrigation practices. It should be ensured that the prime mover and the pump are in alignment. For these the drive shaft as well as the pump shaft should lie at nearly the same height to prevent too great an angle on the universal shaft. Service and installation procedures in respect of the pump and power units should be strictly observed.

While laying the main and lateral pipes, always begin laying at the pump. This necessarily gives the correct connection of all quick coupling pipes. While joining couplings, it is ensured that both the couplings and the rubber seal rings are clean.

In starting the sprinkler system, the motor or engine is started with the valves closed. The pump must attain the pressure stated on type-plate or otherwise there is a fault in the suction line. After the pump reaches the regulation pressure, the delivery valve is opened slowly. Similarly, the delivery valve is closed after stopping the power unit.

The pipes and sprinkler-lines are shifted as required after stopping. Dismantling of the installation takes place in the reverse order to the assembly described above.

Maintenance :

A sprinkler system, like any other farm equipment, needs maintenance to keep it operating at peak efficiency. Parts of the system subject to the most wear are the rotating sprinkler heads, the pumping set, the couplers and the pipeline. General principles regarding the maintenance of the pipes and fittings and sprinkler heads are given below :

i. *Pipes and fittings*

The pipes and fittings require virtually no maintenance but attention must be given to the following procedures:

(a) Occasionally clean any dirt or sand out of the groove in the coupler in which the rubber sealing ring fits. Any accumulation of dirt or sand will affect the performance of the rubber sealing ring.

(b) Keep all nuts and bolts tight.

(c) Do not lay pipes on new damp concrete or on piles of fertilizer. Do not lay fertilizer sacks on the pipe.

ii. Sprinkler heads

The sprinkler heads should be given the following attention:

(a) When moving the sprinkler lines, make sure that the sprinklers are not damaged or pushed into the soil.

(b) Do not apply oil, grease or any lubricant to the sprinklers. They are water lubricated and using oil, grease or any other lubricant may stop them from working.

(c) Sprinklers usually have a sealed bearing and at the bottom of the bearing there are washers. Usually it is the washers that wear and not the more expensive metal parts. Check the washers for wear once a season or every six months - this is especially important where water is sandy. Replace the washers if worn.

(d) After several season's operation the swing arm spring may need tightening. This is done by pulling out the spring end at the top and rebending it. This will increase the spring tension.

In general, check all equipment at the end of the season and make any repairs and adjustments and order the spare parts immediately so that the equipment is in perfect condition to start in the next season.

Storage :

The following points are to be observed while storing the sprinkler equipment during the off season:

(a) Remove the sprinklers and store in a cool, dry place.

(b) Remove the rubber sealing rings from the couplers and fittings and store them in a cool, dark place.

(c) The pipes can be stored outdoors in which case they should be placed in racks with one end higher than the other. Do not store pipes along with fertilizer.

(d) Disconnect the suction and delivery pipe-work from the pump and pour in a small quantity of medium grade oil. Rotate the pump for a few minutes. Blank off the suction and delivery branches. This will prevent the pump from rusting. Grease the shaft.

(e) Protect the electric motor from the ingress of dust, dampness and rodents.

Trouble Shooting :

The following are the general guidelines to identify and remove the common troubles in the sprinkler systems:

i. Pump does not prime or develop pressure

(a) Check that the suction lift is within the limits. If not get the pump closer to the water.

(b) Check the suction pipeline and all connections for air leaks. All connections and flanges should be air tight.

(c) Check that the strainer on the foot valve is not blocked.

(d) Check that the flap in the foot valve is free to open fully.

(e) Check the pump gland (s) for air leaks. If air leaks are suspected tighten the gland (s) gently. If necessary repack the gland (s) using a thick grease to seal the gland satisfactorily.
(f) Check that the gate valve on the delivery pipe is fully closed during priming and opens fully when the pump is running.
(g) Check that the direction of rotation of the pump is correct.

ii. Sprinklers do not turn

(a) Check pressure.
(b) Check that the nozzle is not blocked. Preferably unscrew the nozzle or use a small soft piece of wood to clear the blockage. Do not use a piece of wire or metal as this may damage the nozzle.
(c) Check that the sprinkler bearing is quite free and smooth. During operation, the sprinkler can usually be pushed down towards the riser pipes so that the water pressure flushes out the bearing. If the bearing is still stiff dismantle and then clean it. Do not use oil, grease or any lubricant.
(d) Check the condition of washers at the bottom of the bearing and replace them if worn or damaged.
(e) Check that the swing arm moves freely and that the spoon which moves into the water stream is not bent by comparing it with a sprinkler which is operating correctly. If it is bent then very carefully bend it back into position.
(f) Adjust the swing arm spring tension. Usually it should not be necessary to pull up the spring by more than about 6 mm.
iii. Leakage from coupler or fittings
The sealing rings in the couplers and fittings are usually designed to drain the water from the pipes when the pressure is turned off. This ensures that the pipes are automatically emptied and ready to be moved. When the pump is first started and before the pressure has built up in the system the seals may give a little

leakage. With full pressure in the system the couplers and fittings will be effectively leak-free. If, however, there is a leakage, check the following:

(a) There is no accumulation of dirt or sand in the groove in the coupler in which the sealing ring fits. Clean out any dirt or sand and refit the sealing ring.

(b) The end of the pipe going inside the coupler is smooth, clean and not distorted.

(c) In the case of fittings such as bends, tees and reducers ensure that the fitting has been properly connected into the coupler.

Chapter II

Illustrative Model For Sprinkler Irrigation Scheme

2.1 Introduction

Formulation of a scheme for sprinkler irrigation is explained in the following paragraphs through an illustrative example of a block situated in the central Indian plateau.

2.2 Climate

The local economy of the scheme area to a large extent depends on monsoon rainfall. The normal annual rainfall is about 1350 mm and most of the rainfall occurs during July to September. The climate of the area is characterized by hot summers with maximum temperature above 440 C. May is the hottest month and January is the coldest month, with daily minimum temperature reaching 140 C. The Indian Meteorological Dept.(IMD) data reveals that the frequency of moderate to severe drought in the state is around 6 to 7 years and the recurrence of drought on a lower scale is in every 3 to 4 years.In view of recurrence of droughts, it is essential to develop ground water resources through construction of dug wells and bore wells to provide irrigation for sustainable agriculture. Also there is need to conserve and use ground water resource efficiently by installation of sprinkler irrigation system for long-term sustenance of the resource.

2.3 Cropping Pattern

Paddy is the main crop in the State. Apart from Paddy, farmers also grow cereals such as maize, pulses and oil seeds. There is a tendency among the local farmers to take mono crop (single crop) i.e. only paddy in kharif. However, due to the interventions of the State Government, the area under rabi crop is increasing where irrigation facilities are available.Under crop rotation programme, the State Government has been encouraging the farmers to grow Irrigated Dry (ID) crops like wheat, ground nut, gram, soybean, sunflower, etc.,which has resulted in increase in the area of ID crops. Post development cropping pattern has been accordingly proposed.

2.4 The Sprinkler Scheme

The system mainly consists of a main line and a lateral line with sprinkler Nozzles.The lateral line is shifted from one place to another in an orderly manner and accordingly the entire field is covered. The system is fitted to an existing delivery pipe of the pumping system, with no extra requirement for pumping capacity.

The scheme envisages financing of sprinkler irrigation system in the area with main emphasis on rain shadow areas,where suitable cropping pattern is being adopted and the ground water development is high.In general,the local topography is plain with gentle regional slope towards North-West and North direction.The area is covered predominantly by sandy silts, sandy loam and clayey soils and generally the soils of the area are fertile in nature.Therefore, the area is considered favorable for installation of sprinkler irrigation systems.

The objective of the scheme is as follows.

- To utilize ground water resources judiciously.
- To bring more area under irrigation
- To increase crop productivity
- To introduce mechanization in agriculture thereby to reduce dependence on labour.

2.5 Unit Cost

The design and unit cost as worked out for various models of Sprinkler irrigation system are given in Annexures –II and III respectively. Further, the following should be ensured.

a. The bank should insist upon the installing agency to prepare layout plan and design of the system and also indicate cost of each item separately.

b. The sprinkler Irrigation system components to be installed should conform to the prescribed B.I.S Specifications.

2.6 Security

The financing bank may take a decision on security against the loan as per RBI guidelines.

2.7 Rate of interest for ultimate borrowers

Banks are allowed to decide the rate of interest within the overall RBI guidelines. For the purpose of working out repayment from the farmer, an interest rate of 12% has been adopted in this scheme.

2.8 Subsidy

At present no subsidy is available for sprinkler irrigation scheme in the state and hence no provision has been made in the scheme.

2.9 Rate of interest on NABARD refinance

As per circular of NABARD issued from time to time.

2.10 Repayment period

For the purpose of this scheme,9 years repayment period has been adopted including the usual one year grace period.

2.11 Economics

Pre and post development farm income for 1.0 ha sprinkler irrigation model are indicated in Annexure IV, and the economics worked out in Annexure-V. The following values of the parameters can be observed therefrom.

BCR : 1.73

IRR : 33%

Debt Service Coverage Ratio(DSCR) : 2.05.

All the other models suggested have also been found to be economically viable.

2.12 Physical and Financial Programme

As per the demand survey in the service area,the following physical programme alongwith its financial outlay is proposed to be financed under the scheme.

Name of district/ block	Physical/ financial programme	1 ha model	2 ha model	3 ha model	4 ha model	Total	Bank Loan @ 95% (Rs. lakhs)	NABARD Refinance @ 95% (Rs. lakhs)
	Physical	50	50	25	25	150	41.301	39.235
	Unit Cost (Rs.)	17,100	28,000	37,000	46,700			
	Financial outlay (Rs. lakhs)	8.550	14.000	9.250	11.675	43.475		

The details of components required alongwith their cost for the above four models are given in Annexure III.The actual cost of components required for the individual farms shall,however,be financed to the farmers.

ANNEXURE I

CHECK LIST FOR SPRINKLER IRRIGATION SCHEME

(To be completed by the Officer forwarding the scheme)

Note : Ticks in boxes to signify that the details of relevant information as per guidelines circulated by NABARD are furnished in the scheme on the following aspects :

1	Specification of types of development in the scheme area.	
2	Financing bank and its branch / network in the scheme area.	
3	Implementing agency	
4	Background information on land use pattern, sources of irrigation, crop	

	pattern, yield rates per acre, cultural practices, size-wise distribution of agricultural holdings, in the scheme area.	
5	Detailed representative cost estimates	
6	Year-wise physical programme and financial outlay.	
7	Availability and arrangements for procurement and distribution of materials	
8	Financial returns on investments with reference to representative size of	
	holdings in different agro-climatic zones in the scheme area.	
9	Lending terms : rate of interest, loan maturities (inclusive of grace	
	period),down payment , nature of security source and extent of subsidy, if any, available	
10	Agencies providing crop loans and adequacy.	
11	Supervision and monitoring arrangements.	
12	Technical guidance in specifications and designs, selection of pump/equipment, etc	
13	Infrastructure facilities:	
	a. Extension guidance	
	b. Availability of improved seeds/fertilisers, pesticides and adequacy of distribution arrangements	
	c. Storage, processing and marketing	
14	Government Support	
	a. Extension on guidance and technical support	
	b. Whether necessary budget provision has been made/proposed, if any, required?	
15	Technical Aspects:	
	a. Existing ground water development - Dug Wells, filter points, tubewells & others	
	b. Availability of dealers for sprinkler sets and facility available for after sales	
	service.	
	c.Nature of rock formation.	
	d. Cultural practices - Soil condition, cropping pattern, irrigation practices, crop	
	varieties, yield rate	
	e. Chemical quality of underground water.	
	f. Design and specification of sprinkler machinery.	

Annexure II Design of Sprinkler Irrigation System

Basic Data		Based on the field observations and also data collected from varioussources like Agril Dept., IMD, Banks etc.,									
a. Topography		:	Area in general plain with 5 to 7% slope								
b. Climate		:	September to Febraury is considered as the main Crop Period of Gram								
			During this period the climate is moderate-Humid to Moderate-Dry.								
c. Soils		:	Medium Textured loams, characterised by moderate infiltration rate i.e							18 mm per day	
	d. Wind Velocity	:	Within the permissioble limits								
e. Crop		:	Horse Gram (Chana)								
f. Effective Root Depth of crop			560	mm							
g. Growing Season		:	Late Kharif and Rabi (For designing, Rabi requirement is taken)								
h. Moisture holding Capacity of loams					92	mm					
I . Available Moisture for 56 cm Root depth:							51.52	mm			
j. At MAD 50 percent							25.76	mm			
			Say		26						
Therefore	26	mm is the irrigation requirement.									
Considering Irrigation Efficicency at 80 %, gross irrigation requirement works out to		32.2	Say	32							
	Irrigation Interval		26/5.5 mm per day			4.7		Say	5	days	
Selection of Sprinkler Model and No. of Nozzles											
The infiltration rate of soils is 18 mm per day. From the manufactures chart 5.55 mmX3.17 mm model is found to be suitable.											
The specifications of the model are:											
a . Terminal pressure required				2.46 kg/ sq cm							
b. Dia of Spray				32	m						
c. Discharge				0.69	l/s						
d. Spacing				12 m X 12 m		Area of spread		144	sq m		
e. Rate of application				18	mm per hour						
f. Operating time at one place				32/ 18 mm per hour				106.67	minutes		
							Say	1 hour 47 minutes			
g. Time required for arranging second shift					10 minutes						
h. Time required for one shift					1 hour 57 minutes			120	minutes		
I. Power availability per day				8	hours per day			480	minutes		

j. No. Of shifts possible per day		4				4	4	Shifts per day	
k. Area covered in 4 shifts by one Nozzle(Area covered in a day)						576	sq m		
l. Area covered in 5 days by a Nozzle		576 sq.m X 5				2880	sq m		
0.8 ha Model									
For 0.8 ha area (8000 sq.m) no of Nozzels required would be				(2.0 acres)	8000		2.78	4Nozzels	
Length and dia of lateral line and main line									
From the layout length of lateral				36	m	6 Pipes			
Discharge though lateral				0.69 X 4	2.76	l/s			
Dia of lateral line would be					50 mm			15 Pipes	
Length of main line				90 m					
Dia of Main line would be				50 mm					
1.0 ha Model									
For 1.0 ha area (10000 sq.m) no of Nozzles required would be				(2.5 acres)	10000		3.47	5 Nozzles	
Length and dia of lateral line and main line									
From the layout length of lateral				48	m	8 Pipes			
Discharge though lateral				0.69 X 5	3.45	l/s			
Dia of lateral line would be			50 mm						
Length of main line				108 m		18 Pipes			
Dia of Main line would be				50 mm					
Note: In the farm model above, 1 extra nozzle has been provided.									

Annexure III Unit Cost of Sprinkler System

S No	Item	1.0 ha (50 mm dia)			2.0 ha (63 mm dia)			3.0 ha (75 mm dia)			4.0 ha (75 mm dia)		
A		Qty.	Unit Price	Cost	Qty.	Unit Price	Cost	Qty.	Unit Price	Cost	Qty.	Unit Price	Cost
1	HDPE pipes with quick action coupler (2.0 to 2.5 kg/sq.cm) of 6 m long	26	456	11856	39	480	18720	44	520	22880	56	520	29120
2	Sprinkler coupler with foot batten assembly	2	360	720	7	380	2660	11	410	4510	14	410	5740
3	Sprinkler nozzles	5	260.6	1303	7	276.6	1936.2	11	310	3410	14	310	4340
4	Riser pipe 20 mm dia x 75 cm long	5	58.8	294	7	58.8	411.6	11	72	792	14	72	1008
5	Connecting nipple	1	200	200	1	220	220	1	245	245	1	245	245
6	Bend with coupler 90	1	280	280	1	300	300	1	320	320	1	320	320

	degrees												
7	Tee with coupler	1	320	320	1	340	340	1	360	360	1	360	360
8	End plug	2	60	120	2	80	160	2	100	200	2	100	200
	Total System Cost			15093			24747.8			32717			41333
B	Sales Tax @ 8 percent	0.08		1207.44			1979.82			2617.36			3306.64
C	Transportation and Installtion charges @ 5 percent	0.05		754.65			1237.39			1635.85			2066.65
	TOTAL COST			17055.09			27965			36970.2			46706.29
	Rounded to			17100			28000			37000			46700

Annexure IV Pre & Post Development Incomes/ Farm budget - for 1.0 ha Model

Season	Crop	Area (ha)	Yield in qtl/ha	Total yield(qtls)	price/qtl	Total income (Rs)	Cost of cultivation/ ha	Total cost of cultivation(Rs)	Net income(Rs)
Without project									
Khariff	Paddy	0.8	48	38.4	550	21120	12000	9600	11520
Rabi	Pulses	0.7	11	7.7	1400	10780	4000	2800	7980
Cropping Intensity		150	Per cent						19500
						Less- Interest on S T loan		1736	
						Land revenue		300	
						Net Surplus	17464		
With Project									
Khariff	Pulses	1	12	12	1600	19200	6500	6500	12700
Rabi	Wheat	0.5	38	19	600	11400	8500	4250	7150
	Horse Gram	0.5	12	6	1500	9000	6000	3000	6000
Cropping Intensity		200	Per cent						25850
						Less- Interest on S T loan		1925	

						Land revenue		300	
						Net Surplus	23625		
						Net Incremental Income			6161

Annexure V Economics of Sprinkler Irrigation System

Techno-economic parameters adopted :											
(1 ha model)											
1. Economic life of the project investment(years)*					9						
2. Margin money(%)					5						
3. Rate of interest for borrower(%)					12						
4. Repayment period(years)*					9						
5. Capital recovery Factor					0.1876789						
6. Investment Cost (Rs.)					17100						
7. Annual Incremental Income (Rs.)					6161						
8. Discounting rate					15%						
9. Special cash flows pertaining to Other income indicated at S. Nos. 5 in the table below,have been taken as follows .											
(a) Replacement cost of pumpset at 9 years*					0						
(b)(i) Salvage value at 9 years					0						
(i)Salvage value at 9 years					855						
* Cash flows projected accordingly											
Discounted Cash											

Flow :												
S.No.	Particulars						End of year					
			0	1	2	3	4	5	6	7	8	9
	Investment Cost	(Rs.)	17100									
2	Other Cost	(Rs.)										0
3	Total Cost (A) (1+2)	(Rs.)	17100	0	0	0	0	0	0	0	0	0
4	Incremental Income	(Rs.)		6161	6161	6161	6161	6161	6161	6161	6161	61
5	Other Income	(Rs.)										85
6	Total Benefit (B) (4+5)	(Rs.)	0	6161	6161	6161	6161	6161	6161	6161	6161	70
7	Net Benefit (C) (6-3)	(Rs.)	-17100	6161	6161	6161	6161	6161	6161	6161	6161	70
8	NPV of Total Costs	(Rs.)	17100.00									
9	NPV of Total Benefits	(Rs.)	29640.77									
10	BCR		1.73									
11	NPV of Net Benefits	(Rs.)	12540.77									
12	IRR	(%)	33%									
13	Equal Annual Repayment	(Rs.)		3048.84	3048.84	3048.84	3048.84	3048.84	3048.84	3048.84	3048.84	30
14	DSCR			2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.
15	Average DSCR		2.05									