

# *Rain Gun Irrigation: A Simple and Movable Solution for Efficient Farm Watering*

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## **ABSTRACT**

Water scarcity and rising cultivation costs have increased the need for efficient irrigation methods in Indian agriculture. Conventional surface irrigation practices such as flood, basin, and furrow irrigation often result in low water-use efficiency, uneven water distribution, and soil-related problems. In this context, rain-gun sprinkler irrigation offers a practical and efficient alternative for irrigating large agricultural fields. A rain-gun system applies water in the form of artificial rainfall through a high-pressure rotating nozzle, enabling uniform water application over a wide area within a short time. The system consists of key components such as pipelines, connectors, valves, filters, and a tripod-mounted rain gun, and may be used in portable or fixed form depending on field conditions. Rain-gun irrigation is suitable for crops like sugarcane, maize, cotton, groundnut, pulses, vegetables, and fodder, particularly in medium to large fields with sandy loam and loamy soils. Field experiences indicate improved water-use efficiency, reduced labour requirement, and better coverage compared to conventional surface irrigation. Although adoption is influenced by factors such as energy requirement and wind sensitivity, government support through subsidy schemes and growing awareness of water-saving technologies highlight the potential of rain-gun irrigation for sustainable water management in Indian agriculture.

## INTRODUCTION

**W**ater is one of the most critical inputs in agriculture. For generations, farmers have practiced conventional surface irrigation methods such as flood irrigation, basin irrigation, and ridge and furrow irrigation. These methods operate primarily on the principle of gravity flow and require minimal infrastructure and technical expertise, making them widely adopted in traditional farming systems. However, such irrigation practices often result in low water-use efficiency due to excessive runoff, deep percolation losses, and non-uniform distribution of water across the field. Prolonged use of these methods can also lead to soil erosion, nutrient leaching, salinity build-up, and waterlogging, which adversely affect soil health and crop productivity. In the context of increasing water scarcity and rising costs of cultivation, there is an urgent need to adopt scientifically designed, efficient, and user-friendly irrigation systems that ensure optimal water utilization.

In India, the use of modern micro-irrigation systems such as drip and sprinkler irrigation has been increasing, supported by government subsidy programmes like Pradhan Mantri Krishi Sinchayee Yojana. States such as Karnataka, Maharashtra, Andhra Pradesh, and Tamil Nadu show comparatively higher adoption of sprinkler and drip systems, while many other states are progressively expanding micro-irrigation coverage. This trend reflects growing farmer interest in water-efficient irrigation methods.

### **What is Rain gun sprinkler Irrigation system?**

A rain gun sprinkler irrigation system is a type of sprinkler irrigation in which water is applied to crops in the form of artificial rainfall, similar to natural rain. In this system, water is supplied under high pressure through

a single large nozzle known as a rain gun, which is mounted on a movable stand or trolley. The rain gun rotates slowly and sprays water uniformly over a large circular area, making it suitable for large fields and widely spaced crops.

This system is commonly used for crops such as sugarcane, maize, potato, groundnut, vegetables, fodder crops, and plantations. Owing to its high discharge capacity and wide coverage, a single rain gun can irrigate a large area in a short period of time. As a result, it reduces labour required for installation, shifting, and operation, and saves time compared to conventional surface irrigation methods.

A rain gun system consists of a giant sprinkler (mega sprinkler) capable of discharging up to 500 litres of water per minute and spraying it over a radius of about 90 feet or more. The sprinkler usually has one main large nozzle and a smaller auxiliary nozzle. The main nozzle throws water to longer distances, while the auxiliary nozzle sprays short-range water to ensure even coverage near the sprinkler base. This helps eliminate under-irrigated zones (pattern gaps) within the spray area and improves uniform water distribution.

Rain guns are available in two main types: gear-driven type, which provides smooth and uniform rotation through an internal gear mechanism, and hammer action type, where rotation occurs due to the impact of a hammer arm on the water jet. Depending on crop requirements and field layout, the rain gun system may be used in either portable or fixed form.

### **Components of a Rain-Gun Irrigation System**

A rain-gun irrigation system consists of several interconnected components that work

together to convey, control, and apply pressurized water uniformly over the field. These components together make the rain gun a complete irrigation system. Depending on field layout and crop requirements, the system may be used in either portable or fixed form.

1. **Main Line:** The main line carries water from the source or pump to the irrigation system. It is usually made of PVC, plastic, flexible hose, or iron pipe.
2. **Sub-main Line (Lay-flat Hose):** The sub-main line supplies water from the main line to the rain gun and is commonly made of lay-flat hose or PVC pipe.
3. **Rain-Gun Connectors:** These are irrigation fittings used to connect the rain gun to the main or sub-main line and ensure smooth flow of pressurized water.
4. **Tees and Elbows:** These PVC fittings are used to join pipes and change the direction of water flow in the system.
5. **Valves:** Valves regulate, control, or stop the flow of water to different sections or to individual rain guns.
6. **Filters:** Filters remove sand, debris, and impurities from water, preventing clogging of the nozzle and protecting the system.
7. **Hold-down Pegs:** Pegs are used to anchor hoses and pipelines firmly to the ground during operation.
8. **Tripod:** The tripod supports the rain gun in an upright position and provides stability during



*Source: Raingun Irrigation System (2025).*



*Source: Remocal et al. (2021)*



*Source: veggieconcept (2022)*

### Working Mechanism of Rain Gun Irrigation

In a rain gun irrigation system, water is supplied under pressure using a pump set and conveyed through pipes to the rain gun nozzle. When water passes through the nozzle, it emerges as a high-velocity jet. This jet breaks into small water droplets due to the combined effect of air resistance and the rotating movement of the rain gun head.

Two opposing forces act during this process:

1. Surface tension, which tries to keep the water jet together, and
2. Air resistance (drag force), which breaks the jet into droplets.

The rotation of the rain gun helps in spreading these droplets uniformly over the field, ensuring even distribution of water. The falling droplets gently wet the soil surface, it resembles like a natural rainfall and it will minimize soil erosion. This mechanism makes rain gun irrigation an efficient and effective method for uniform application of water in field crops.

### **Suitable Crops and Field Conditions for Rain Gun Irrigation:**

Rain-gun irrigation is especially useful for field crops that grow over large areas and do not require precise watering. It works effectively where sprinkling of water over the leaves of crop and helps to retain soil moisture and supports healthy crop growth.

Rain guns are widely used for irrigating many types of crops, particularly:

- **Field crops such as maize, pulses, and cereals:** These crops benefit from broad water coverage across open fields, and rain guns can deliver water uniformly over such land.
- **Cash crops like cotton and sugarcane:** These crops grow over larger areas and are well suited to high-volume sprinkler irrigation.
- **Groundnut and other oilseed crops:** Rain guns are effective where crops are not planted very closely and can tolerate overhead watering.
- **Vegetable crops:** Many vegetables can be irrigated with rain guns, especially where uniform soil moisture is needed across a field.

**Suitable Field Conditions:** Rain gun irrigation performs best under these conditions:

- **Medium to large open plots:** Rain guns cover wide areas (often up to 0.5–2.5 acres per unit), so they are ideal where crops are spread over a large field.
- **Flat or slightly uneven lands:** Uniform water distribution is achieved when the land surface is flat or slightly uneven.
- **Soils with moderate infiltration:** Soils like sandy loam and loamy soils are well

suitable for rain gun irrigation it allows a proper infiltration effectively and without causing excessive runoff.

- **Areas facing limited water availability:** As rain gun utilise lower amount of water, it is useful in areas where water resources are limited.

### **Scope of Rain-Gun Irrigation usage in Indian Conditions**

Although rain-gun irrigation has not yet been widely adopted across Indian agriculture, its potential for expansion is significant. Increasing water scarcity, changing climate patterns, and growing government support for modern irrigation technologies indicate strong scope for the wider use of rain-gun irrigation systems in India.

**1. Water-Efficient Alternative to Traditional Irrigation:** In India, conventional irrigation methods such as canal and flood irrigation often result in substantial water losses due to runoff and deep percolation. Modern pressurized systems like rain guns help reduce these losses, improve irrigation efficiency compared with surface irrigation methods. These systems can achieve water distribution uniformity and use water more effectively, which is important in regions with **declining water supplies**.

**2. Successful Farmer Adoption Shows Benefits:** There are farmer success stories in states like Tamil Nadu and Karnataka where rain-gun irrigation was tried and showed good results. For example, sugarcane farmers found that rain guns allowed them to irrigate more area using the same amount of water and doubled irrigation coverage per day compared with conventional irrigation systems. This shows that with **institutional support and awareness**, rain guns could have a broader role in Indian fields.

**3. Government Support and Subsidy Policies:** The Indian government has included rain guns under **minor and micro-irrigation subsidy schemes** along with drip and other sprinkler systems. This policy support reflects official recognition of rain-gun irrigation as an effective and viable technology for Indian farming conditions

**4. Applicability Across Different Crops and Regions:** Rain-gun systems are suitable for a range of crops grown in Indian conditions including cereals, pulses, sugarcane, cotton, and vegetables and are adaptable to climates ranging from tropical, sub-tropical and moderate climatic regions. The portable nature of rain-gun systems allows easy movement between fields, making them useful for different crops and seasonal needs.

#### Advantages of Rain gun Sprinkler System

- 1. No land levelling is necessary:** This saves considerable initial and maintenance costs of levelling.
- 2. Saving of water:** Compared to surface irrigation, rain gun can save up to 25% of water by minimizing losses due to seepage and deep percolation
- 3. No construction of channels:** Since water is conveyed through pipes, there is no need to construct irrigation channels, resulting in savings on capital and maintenance expenses.
- 4. Large area cultivated:** In Surface irrigation, about 9-10% of the land is lost due to channels and bunds. Rain gun irrigation avoids the losses, allowing a larger area to be brought under cultivation.
- 5. High plant density:** Unlike surface irrigation, seeds sown are not washed away

from soil therefor high plant density is obtained

- 6. Reduced labour:** Labour is mainly required for shifting pipes and fixing the raingun, leading to significant savings in labour and operational effort.

#### Disadvantages of Rain-Gun Sprinkler System

- 1. Water loss due to wind and heat:** Rain guns spray water high into the air, and under hot or windy conditions, a portion of the water may evaporate or drift away before reaching the soil.
- 2. High energy and pressure requirement:** Rain guns require high operating pressure, which means larger pumps and higher fuel or electricity consumption.
- 3. Not suitable under strong wind conditions:** Strong winds disturb the spray pattern, leading to uneven water distribution and reduced irrigation efficiency.
- 4. Higher evaporation losses compared to drip irrigation:** Since water is applied above the crop canopy, evaporation losses are higher than in drip or subsurface irrigation systems.
- 5. Risk of runoff and soil erosion:** The forceful spray may cause surface runoff or soil erosion, especially on sloping lands or in compact soils with low infiltration.
- 6. Wet foliage may increase disease incidence:** Overhead irrigation keeps crop leaves wet for longer periods, which can encourage fungal and bacterial diseases in certain crops.
- 7. Maintenance and handling issues:** Rain guns are relatively heavy and require proper handling, regular maintenance, and some technical skill for efficient operation.

## CONCLUSION:

Rain-gun sprinkler irrigation is a simple and efficient method for irrigating large agricultural fields within a short time. Compared to conventional surface irrigation methods, it ensures more uniform water distribution, reduces water losses, and minimizes problems such as waterlogging and soil erosion. The system can be portable or fixed depending on field conditions, and its tripod-mounted design allows easy shifting, saving labour and time.

Rain-gun irrigation is suitable for crops such as sugarcane, maize, cotton, groundnut, pulses, fodder, and vegetables, especially in medium to large fields with suitable soils. Field experiences show that it can irrigate a larger area using the same amount of water, making it a valuable option for improving water-use efficiency and supporting sustainable irrigation practices in Indian agriculture.

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