

Design and Fabrication of Multi-Tasking Agricultural Machine

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Abstract: *This project presents the design and fabrication of a multitasking agricultural machine capable of performing multiple essential field operations such as ploughing, seed sowing, water sprinkling, and pesticide spraying, all in a single pass. The main objective is to create a compact, cost-effective, and efficient farming tool that reduces manual effort, saves time, and increases productivity for small-scale farmers.*

The developed machine is built on a mild steel frame and powered by two 12V DC motors in a two-wheel drive configuration. A 12V rechargeable battery serves as the main power source for movement and control. All operations, including forward/reverse motion, seed dropping, and pesticide spraying, are controlled wirelessly through a remote-control. The machine also integrates a 20-liter multi-use tank that serves both pesticide spraying (via a DC pump) and water sprinkling (manually through gravity flow). Seed hoppers are mounted and controlled with a servo or rotary mechanism for accurate, uniform dispensing.

Overall, this project demonstrates that a single, versatile machine can replace multiple conventional tools, helping reduce operational costs and dependency on labor. It represents a significant step forward in rural mechanization, with potential for further improvement through solar integration, automation upgrades, and precision farming features.

Keywords: agricultural machine

I. INTRODUCTION

Agriculture is the backbone of India. Paddy and Wheat is one of the new targets in agriculture where still, not many researchers and manufacturers participate. This field faces some problems such as how to maximize the profit, how to increase productivity and how to reduce the cost. In India, two types of agricultural equipment are used, manual method (conventional method) and mechanized type. Mechanization involves the use of a hybrid device between the power source and the work.

This hybrid device usually transfers motion, such as rotary to linear, or provides ample of mechanical advantages such as increase or decrease or leverage of velocity. Agricultural machinery is machinery used in farming or other agriculture. Mechanized agriculture is a process of using agricultural machinery to mechanize the work of agriculture, increasing farm worker productivity. In modern times, powered machinery has replaced many farm jobs formerly conducted by manual labor or by working animals such as oxen, horses, and mules. The entire history of agriculture contains many examples of the use of tools, such as the hoe and the plough. But the ongoing integration of machines since the Industrial Revolution has allowed farming to become much less labor intensive. The biggest profit of automation is that it saves the Labour. However, it also saves energy and materials and to improve the quality, accuracy, and precision. The seed feeding, pesticides sprinkling and crop cutting are the important stages in the agriculture field. The design of multipurpose agro equipment machine will help Indian farmers in rural side and small farm. It will reduce the cost of seed feeding, pesticides sprinkling and crop cutting the field and will help to increase economic standard of an Indian farmers.

To address these challenges, this project presents the design and development of a multitasking agricultural machine capable of performing ploughing, seed sowing, water sprinkling, and pesticide spraying using a single, compact, and portable unit. The machine is powered by two 12V DC motors in a two-wheel drive configuration, and all major



functions are controlled remotely using a wireless system. This remote capability enables ease of use, especially in uneven or hard-to-access field areas.

A 20-liter central tank is integrated into the system, serving dual purposes: water sprinkling through a gravity-fed outlet, and pesticide spraying using a 12V DC pump mechanism. The seed sowing system is synchronized with the ploughing blades to ensure uniform seed placement. The entire setup is powered by a rechargeable 12V battery, making the unit both energy-efficient and field-ready without dependence on fossil fuels or heavy machinery.

This approach promotes low-cost mechanization and can help reduce dependency on manual labor, improve operational efficiency, and boost productivity for small and marginal farmers [2][3].

It represents a practical step toward sustainable, accessible, and semi-automated farming solutions tailored to grassroots needs.

II. PROBLEMS IDENTIFICATION

Limitation of manual seed sowing

Traditional sowing methods have following limitations:

- In manual seeding, it is not possible to achieve uniformity in distribution of seeds.
- A farmer may sow at desired seed rate but inter-row and intra-row distribution of seeds is likely to be uneven resulting in bunching and gaps in field.
- Poor control over depth of seed placement. Labor requirement is high because two persons are required for dropping seed and fertilizer.
- The effect of inaccuracies in seed placement on plant stand is greater in case of crops.
- Performing each task separately with different tools or by hand consumes excessive time during critical stages of cultivation.
- Hiring labor or renting machinery for each operation increases overall farming expenses, which is not sustainable for low-income farmers.
- Manual or poorly controlled applications of seeds, water, and pesticides often result in wastage and uneven distribution, affecting crop quality and yield.
- Prolonged manual work under extreme conditions leads to physical stress and exposure to harmful chemicals during pesticide spraying.

Hand operated sprayers are for small plant treatments. It involves applying water or liquid chemicals in a small land area. Hand operated sprayer works through an air pump. The pump compresses air into the tanks and pressurizes the liquid content. The spray pattern from the nozzle increases with a higher pressure. Once the pressure in sprayer decreases, the spray pattern is slow.

III. OBJECTIVES

Introducing low-cost manual automation was to overcome problems with the current manual traditional method. The concept of the work is following:

1. To Design a Compact, Multipurpose Machine: Develop a single unit capable of performing multiple agricultural tasks such as ploughing, seed sowing, water sprinkling, and pesticide spraying.
2. To Reduce Labor Dependency: Minimize the need for manual labor and animal-driven tools by mechanizing routine farming operations.
3. To Ensure Cost-Effectiveness: Fabricate the machine using low-cost, locally available materials and components to make it affordable for small and marginal farmers.
4. To Save Time and Improve Efficiency: Integrate multiple operations into one system to reduce field operation time and increase productivity.
5. To Provide Remote Control Functionality: Incorporate a wireless control system to allow farmers to operate the machine from a distance, ensuring convenience and safety.



6. To Optimize Power Usage: Utilize a 12V battery-powered system to ensure energy efficiency and compatibility with battery charging or off-grid conditions.
7. To Enhance Precision and Uniformity: Ensure uniform seed spacing and consistent spraying coverage through controlled mechanisms.
8. To Build a User-Friendly Interface: Design the machine with simple controls and easy-to-understand functions suitable for rural and low-literacy users.

IV. WORKING OF PROJECT

The multitasking agricultural machine developed in this project integrates multiple farming operations—ploughing, seed sowing, fertilizer application, and water sprinkling—into a single, compact manual and automated system. The design focuses on cost-effectiveness, ease of use, and suitability for small-scale farmers.

1. **Frame and Structure** : The main structure is built from a rectangular MS (mild steel) pipe frame. It supports all functional components, including the seed and fertilizer dispensing units, ploughing tines, water tank, and the sprinkler system. The setup is mounted on two durable rubber-tired wheels for field mobility.
2. **Ploughing Mechanism** : At the base of the frame are three curved ploughing tines (shovels) fixed to metal brackets. As the machine moves forward, these tines penetrate the soil, breaking and loosening it to create furrows. The spacing between the tines is uniform, ensuring parallel furrow lines for sowing.
3. **Seed Sowing System** : Above each tine, there is a funnel-shaped seed hopper connected to a delivery pipe. Seeds stored in a PVC pipe (serving as a seed reservoir) are gravity-fed into each hopper. As the soil is tilled, seeds drop into the open furrows through these chutes. The seed flow rate can be adjusted by controlling the hopper outlet.
4. **Pesticide Sprayer and Water Sprinkling System**: The multitasking agricultural machine is equipped with a dual-purpose liquid system that enables both pesticide spraying and water sprinkling using a common storage tank. This integration not only simplifies the design but also reduces weight and cost by avoiding separate containers.
The pesticide sprayer setup consists of: A mini-DC pump (powered by battery or solar cell).
5. **Common Storage Tank** : A single high-density plastic tank is mounted centrally on the frame and serves as the reservoir for both pesticide and water. The tank is filled either with plain water or diluted pesticide, depending on the operation mode.
6. **Manual Water Sprinkling System** : The water sprinkling system works independently and manually, without requiring electrical components. A manual control valve or handle is used to release water, allowing gravity-fed sprinkling. This system is ideal for post-sowing moisture maintenance in dry soil conditions. Since the water release is manual, the operator can selectively irrigate specific rows.
7. **Transmission System** : The transmission system is based on a two-wheel drive (2WD) configuration, which provides both propulsion and control. The setup consists of two individual DC gear motors, each directly coupled to chain drive, enabling precise movement and remote-controlled operation.
8. **Remote Control System** : This agricultural machine integrates a remote-control system to manage key operations such as forward/backward movement, pesticide spraying, and seed dropping, making it semi-automated and user-friendly for precision farming.
9. **Power Supply** : The entire transmission system is powered by a 12V rechargeable lead-acid or lithium-ion battery mounted on the frame. The battery supplies current to both motors and the control circuit, ensuring field operability without external power sources.

V. ADVANTAGES

1. **Multifunctional Operation**: Combines ploughing, seed sowing, water sprinkling, and pesticide spraying into a single machine.
2. **Cost-Effective**: Reduces the need for multiple expensive machines, making it affordable for small and marginal farmers.



3. Timesaving: Performs multiple tasks in a single pass, significantly reducing time and labor in the field.
4. Remote Controlled System: Enhances operator convenience and safety by allowing wireless control of movement, seed dropping, and spraying functions.
5. Manual and Automated Hybrid: Integrates manual systems (like gravity-based water sprinkling) with electrical automation (pesticide spraying, motorized movement).
6. Improved Accuracy: Controlled seed dispensing improves uniformity and minimizes waste.
7. Eco-Friendly Design: Reduces fuel-based equipment usage and promotes sustainable farming practices.

VI. DISADVANTAGES

1. Limited Payload Capacity : The machine has a fixed tank capacity (20 liters), which may not be sufficient for larger fields or longer operational periods without refilling.
2. Battery Life Constraints : Since the machine operates on a 12V rechargeable battery, its usage time is limited by battery life, which may require frequent recharging for extended operations.
3. Terrain Limitations : The two-wheel drive configuration may struggle on very rough, hilly, or muddy terrain, limiting the machine's effectiveness in diverse field conditions.
4. Weather Dependence for Spraying : Water sprinkling and pesticide spraying might be less effective in windy conditions, as it could result in uneven distribution or loss of material.

VII. APPLICATIONS

1. Small-Scale Farming : The machine is ideal for small and medium-sized farms, where space and resources are limited, and it can assist in performing essential operations efficiently.
2. Sustainable Agriculture : By reducing the need for multiple large machines and manual labor, the machine promotes sustainable farming practices by saving fuel and minimizing the carbon footprint.
3. Organic and Precision Farming : The controlled dispensing of water and pesticides can be particularly useful in organic farming, where precision is required for minimizing chemical exposure to crops.
4. Field Trials and Research : The machine can be used in agricultural research, experimental farms, or government-run farm extension programs to test new farming methods and technologies.
5. Remote-Controlled Operations in Difficult Terrain : With its remote-controlled functionality, the machine can be particularly useful in hard-to-reach or uneven areas, reducing physical strain for farmers.
6. Multiple Agricultural Operations in One Pass : The ability to perform different tasks (sowing, spraying, watering) in a single operation makes it an efficient solution for increasing farm productivity in less time.

VIII. CONCLUSION

The design and fabrication of the multitasking agricultural machine successfully demonstrate an innovative, low-cost solution for small and medium-scale farmers. The machine efficiently integrates essential farming operations such as ploughing, seed sowing, water sprinkling, and pesticide spraying into a single compact unit. Operated by a 12V battery and controlled remotely, it offers improved ease of use, reduced manual labor, and enhanced precision in fieldwork. Its hybrid mechanism—combining manual and automated systems—ensures flexibility and adaptability across various farming conditions. Overall, this project contributes to promoting mechanization in agriculture in a sustainable, affordable, and user-friendly manner.

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