Development Of Multi-Purpose Mini Power Tiller

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Abstract- India is an agriculture-based country. The backbone of the Indian economy is the Indian farmer. Around 90% of Indian farmers own very small portions of land, and that too is not in one place but divided into scattered plots. These fragmented and small-sized (in terms of length and width) lands create difficulties when using large tractors for farming operations such as plowing, tilling, and ridge formation. Large tractors are not suitable for working efficiently in such small fields. Moreover, owning a tractor or even a pair of bullocks is financially burdensome for devolvement small-scale farmers. The maintenance cost of a tractor is also unaffordable for them. On the other hand, using bullocks for farming requires a lot of time and manual labor. Considering all these challenges, we have designed a Mini Power Tiller that can perform multiple farming operations. Compared to a tractor, the cost of the mini power tiller is significantly lower. This machine can done operation like ploughing, weeding, soil cultivation and rotating Fan. It offers reduced maintenance complexity and lower operational costs. This machine is specially designed to address the needs of small and marginal farmers by providing an efficient, cost-effective, and user-friendly solution for their daily agricultural tasks. Multipurpose mini power tiller offers flexibility, saves time and labor, and promotes mechanization even in small fragmented lands, ultimately contributing to increased productivity and improved livelihoods of small farmers in India.

***Keywords*: - Agriculture, Devolvement of Small-Scale Farmers, Cost-Effective, User-Friendly, Multipurpose Power Tiller, Saves Time, Flexibility, Ploughing, Weeding, Soil Cultivation and Rotating Fan.**

INTRODUCTION

The multi-purpose mini power tiller is an essential piece of agricultural machinery designed to enhance productivity, especially for small-scale farmers. Unlike larger tractors, mini power tillers are compact, cost-effective, and suitable for small plots of land, making them an ideal choice for farmers who cannot afford expensive machinery.

These versatile machines are designed to perform multiple functions, including tilling, ploughing, weeding, and soil cultivation, thereby reducing the need for manual labour and increasing operational efficiency. The primary objective of a mini power tiller is to minimize labour dependency, addressing the challenges posed by the scarcity of agricultural workers and the rising cost of manual farming. By reducing the time and physical effort required for land preparation, mini tillers offer a significant advantage over traditional methods, which often rely on human labour or draft animals. This not only improves productivity but also makes farming more sustainable and less labour-intensive.

Mini power tillers are often equipped with attachments such as cultivator blades, rotary hoes, and ridgers, enabling them to handle various tasks. Toothed cultivators, for example, are commonly used for shallow soil cultivation and weed control. They function near the soil surface, loosening the soil while effectively managing weeds. In contrast, heavier implements like chisel Plows are designed for deep soil penetration to break up compacted layers, though they require more power.

For small-scale gardening and market farming, single-person-operated toothed cultivators and rotary tillers are commonly used. These tools are lightweight and easy to man ever, making them suitable for household gardens and small commercial plots. The rotary tiller, in particular, combines the functions of both ploughing and harrowing, preparing a fine, loose seedbed ideal for planting. However, for precise row-wise weed control, toothed cultivators are more effective.

Mini power tillers can be either self-propelled or attached to two-wheel or four-wheel tractors. On two-wheel tractors, they are usually fixed and powered through mechanical couplings to the tractor's transmission. Four-wheel tractors, on the other hand,

often use a three-point hitch system connected to a power take-off (PTO) for operation. In some regions, especially in developing countries, draft animals are still used for cultivation, although this practice is declining in more industrialized areas.

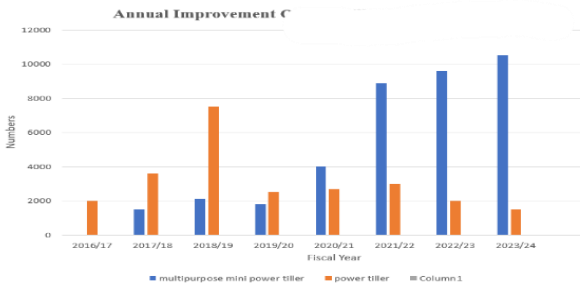


Fig 1: - Annual improvement of mini-tiller &power tiller

Beyond their mechanical applications, the term "tiller" also refers to a type of stem produced by grass plants. These side shoots, known as tillers, grow from the base of the parent plant and play a vital role in vegetative propagation and seed production. The process of tillering, common among grasses in the Pinaceae family, allows plants to form dense clumps with multiple seed heads. The rate of tillering is influenced by soil moisture, with drier conditions often inhibiting lateral root growth and reducing tiller production.

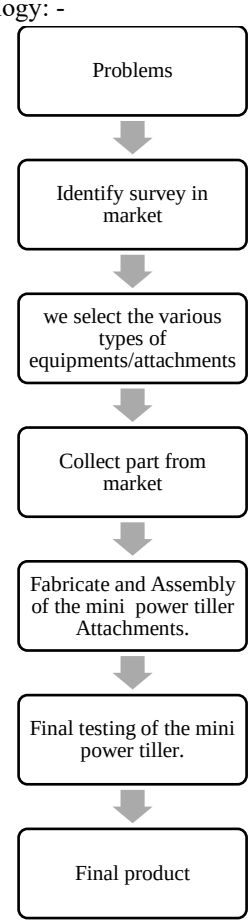
In small gardens, mini power tillers are capable of both primary and secondary tillage. For instance, rotary tillers efficiently perform both plowing and harrowing, preparing the soil for planting. However, for tasks that require precise weed control between rows, single-person toothed cultivators are more suitable. With their versatility, efficiency, and ease of use, multi-purpose mini power tillers have become invaluable tools in modern agriculture, catering to the diverse needs of farmers worldwide.

Fig 2: - multipurpose mini power tiller

- Problem Statement: -

  On the basis of our survey, it is found that the present Tillers in the market is of single attachment only and multiple operations cannot be done and the width of Tiller is more and it is not suitable for inter cultivation purpose.

- Methodology: -



- Objective: -

1. One machine can be produced multiple operations in single machine.
2. Reduce labour cost and time of farmer.
3. Fabricate the compact and highly efficiency machine

- Various Attachments: -

1. Rotating Fan

A rotating agricultural fan mounted on a power tiller is used primarily for crop protection and field maintenance. As the power tiller moves, the fan rotates to generate strong airflow. This airflow helps in spreading pesticides or fertilizers evenly across crops, improving coverage and reducing labour. It can also

aid in drying crops or soil, especially after rain, to prevent fungal infections. Additionally, the fan improves ventilation in dense crop fields, lowering humidity and temperature, which benefits plant health. This setup is efficient, cost-effective, and ideal for small to medium-sized farms looking to enhance productivity.[1].

Fig 3: - Rotating Fan

2. Rotary Tiller Blades

rotary tiller blades, commonly used in agriculture for soil preparation. These blades are attached to a power tiller or cultivator to break up hard soil, mix organic matter, and improve aeration. Their rotating motion helps loosen compacted soil, making it easier for plant roots to grow and absorb nutrients. They are also effective in weed control, reducing manual labour and enhancing farming efficiency. The curved blade design ensures deep tillage, improving soil texture and moisture retention. These tools are essential for efficient land preparation, leading to higher crop yields and healthier plant growth.[2]

Fig 4: - Rotary Tiller Blades

3. Plow attachment/Adjustable Ridger:

Plow attachment, commonly used in agriculture for soil preparation. This tool is mounted on tractors or power tillers to break and turn over soil, improving aeration and making it ready for planting. It helps in weed control by uprooting unwanted plants and burying crop residues, enhancing soil fertility. The Plow is essential for loosening compacted soil, allowing better water infiltration and root penetration. It is widely used in traditional and modern farming for primary tillage, ensuring better crop growth and higher yields by creating an optimal seedbed for planting.[3].

Fig 5: - Plow attachment

4. Weeder Cultivator:

a cultivator or three-tine tiller, a commonly used agricultural tool for secondary tillage. It consists of three curved tines with sharp tips, which help in loosening and aerating the soil. This implement is typically attached to a tractor, power tiller, or other mechanical equipment to break up compacted soil, remove weeds, and prepare the land for planting. The cultivator helps in improving soil fertility by mixing organic matter and fertilizers into the soil, ensuring better water absorption and root penetration. It is widely used for weed control between crop rows and for maintaining soil moisture. With its simple and durable design, this tool is essential for efficient and cost-effective farming, especially in small to medium-scale agricultural operations.[4].

Fig 6: - Weeder Cultivator

➢ Testing And Result: -

Fig 7: - Rotating fan testing

Fig 8: - Ploughing

Fig 9: - Rotavator

➢ Benefits for Multipurpose Mini Power Tiller

1. Affordable & Cost-Effective – Mini power tillers are much cheaper than large tractors, making them ideal for small-scale farmers with limited budgets.
2. Multi-Functional – They can be used for plowing, tilling, weeding, ridging, and even irrigation, reducing the need for multiple machines.
3. Saves Time & Labor – Reduces the manual effort required for soil preparation, helping farmers work faster and cover more land efficiently.
4. Easy to Operate – Lightweight and simple controls make it user-friendly, even for farmers with little machinery experience.
5. Fuel & Energy Efficient – Consumes less fuel compared to large tractors, lowering operational costs.
6. Ideal for Small & Uneven Lands – Works well in small fields, hilly terrains, and narrow farm spaces where big tractors cannot operate.
7. Improves Soil Health – Enhances aeration, breaks compacted soil, and improves water absorption, leading to better crop growth.
8. Reduces Dependency on Manual Labor – Helps farmers manage farm work independently, especially in areas with labor shortages.
9. Increases Productivity & Yield – With efficient soil preparation, crops grow healthier, leading to better harvests and increased income.

➢ Future Scope

1. Electric and Hybrid Power Sources
   - Transition from fossil fuels to electric or hybrid engines to reduce carbon emissions and fuel costs.
   - Integration of solar-powered charging systems for off-grid rural usage.
2. Compact and Ergonomic Design Improvements
   - Further reduction in size and weight for easy transport and operation on small farms or hilly terrain.
   - Improved safety and user-friendly ergonomics for prolonged usage.
3. Cost Optimization and Mass Production
   - Exploring low-cost manufacturing techniques and materials.
   - Government and NGO partnerships for mass production and subsidized distribution to small-scale farmers.
4. Multi-Crop and Multi-Season Adaptability
   - Designing attachments tailored for different

crops and agricultural seasons.
- Incorporating features like interchangeable blades and tilling depth adjustments.

5. Export and Rural Entrepreneurship
   - Potential to manufacture for export markets in developing nations with similar agricultural profiles.
   - Encouraging rural entrepreneurship by enabling local manufacturing, maintenance, and leasing businesses.
6. Enhanced Versatility and Modular Design
   - Development of more sophisticated, easy-to-attach/detach modular tools (e.g., seeders, sprayers, weeders, harvesters).
   - Tool customization based on crop type and soil condition.
7. Automation and Smart Technology Integration
   - Incorporating IoT (Internet of Things) and sensors for real-time data collection (e.g., soil moisture, temperature).
   - GPS and AI-based route planning for autonomous operation in fields.
   - Remote control or smartphone app-based control systems.

ACKNOWLEDGMENTS

It is with great pleasure that we present this project report on “Development of Multi-Purpose Power Tiller”. On this project report number of hands helped us directly and indirectly. Therefore, it becomes me duty to express my gratitude towards them.

We are deeply grateful to our project Guide. Prof. Nitin S. Mali (HOD/Vice principal) of Mechanical Engineering Department, for helping and giving proper guidance. Their timely suggestions made it possible to complete this report. All efforts might have gone in vain without their valuable guidance.

CONCLUSION

The Multi-Purpose Mini Power Tiller offers a practical, low-cost, and efficient solution to support small-scale farmers by combining multiple essential farming operations—such as plowing, weeding, and soil aeration—into a single compact machine. Powered by a BLDC motor and equipped with a microcontroller-based automation system, the tiller ensures energy efficiency, ease of operation, and adaptability to different soil conditions. The modular design and lightweight construction enhance portability and usability in confined agricultural spaces.

Experimental testing and performance analysis confirm that the system significantly reduces manual labor, operational time, and overall farming costs. Its multi-functionality, smart automation, and cost-effectiveness make it an ideal tool for modern sustainable agriculture. This innovation addresses the financial and operational challenges faced by small and marginal farmers, providing a scalable and impactful contribution to agricultural mechanization.

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