

# *Development and Performance Analysis of Engine Operated Paddy Transplanter*

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**Abstract** — Transplanting is a key operation in paddy cultivation that directly influences crop yield. Compared to traditional manual methods, the use of a paddy transplanter increases efficiency and maintains uniform spacing between plants. The engine-operated transplanter is driven by a 52 cc petrol engine delivering 2 horsepower (1.5 kW). The energy produced by the engine is transferred through a chain and sprocket system, ensuring smooth and continuous functioning of the machine. The transplanter moves at an average speed of about 2 km/h and has a working width of 80 cm, making it suitable for wetland farming conditions. It can cover approximately 0.12 hectares per hour under field conditions. Seedlings grown in mat-type nurseries are picked by mechanical arms and placed into the soil at a consistent depth, maintaining a row spacing of 30 cm and plant spacing of 15 cm. This arrangement promotes proper crop growth and efficient use of available resources. A crank and linkage mechanism drives the picking arms in a synchronized manner, enabling continuous and precise transplanting. The machine is fitted with a float or base platform that distributes its weight evenly, preventing it from sinking in soft, muddy fields. The design also minimizes vibration and improves operator comfort during prolonged use.

**Keywords** — Engine Operated Paddy Transplanter, Agricultural Mechanization, Transplanting Mechanism, Mat-Type Nursery, Field Capacity, Uniform Planting.

## I. INTRODUCTION

Paddy cultivation is one of the most important agricultural practices, particularly in regions where rice serves as a staple food. Among the different operations involved, transplanting is a critical step that directly influences crop establishment, growth, and final yield. Traditionally, transplanting is performed manually, which requires significant labour, consumes more time, and often leads to uneven spacing and inconsistent planting depth. In recent years, increasing labour costs and the shortage of skilled workers have made manual transplanting less efficient and economically challenging for farmers. To address these issues, mechanization in agriculture has gained importance, leading to the development of engine-operated paddy transplanters. These machines are designed to perform transplanting operations more efficiently, ensuring uniform spacing, proper planting depth, and higher field capacity. The engine-operated transplanter uses a petrol engine as the primary source of energy, which is transmitted through a chain and sprocket system to drive the crank and linkage mechanisms. These mechanisms control the movement of picking arms that pick

seedlings from the tray and place them accurately into the soil. The use of mat-type nursery seedlings further enhances the efficiency of the machine by allowing continuous and smooth feeding of seedlings. The machine is also equipped with a float or platform that helps in maintaining stability and prevents sinking in waterlogged and muddy field conditions. The design ensures proper weight distribution, reduced vibration, and ease of operation for the user. In addition, the engine-operated paddy transplanter improves overall field performance by increasing the speed of operation and reducing human effort. It ensures better crop uniformity, which contributes to improved nutrient utilization, weed control, and irrigation management. The reduction in labour requirement not only lowers operational costs but also makes the transplanting process timely and reliable. This project focuses on the design, fabrication, and evaluation of an engine-operated paddy transplanter, aiming to provide a cost-effective, efficient, and farmer-friendly solution. The study highlights the importance of agricultural mechanization in enhancing productivity and supports the adoption of modern technologies in paddy cultivation for sustainable farming practices.

## II. LITERATURE SURVEY

Work on paddy planting lately has leaned into machines, aiming to speed things up, cut down on workforce needs, because human power isn't always available. Studies have looked closely at what tractors bring - both in money saved and daily function during sowing season. Machines that move themselves across fields, according to Rath et al. (2024), need fewer people, take less time, yet place seedlings more evenly than hand work does. During the same period, Vatta (2024) showed how Punjab turned toward automation when workers became scarce post-pandemic, relying heavily on planters to keep harvests stable. Meanwhile, data from Odisha gathered by Samal et al. (2024) revealed these tools cover ground quicker, handle larger areas per hour unlike older ways done by hand. Looking into how real-world farming settings influence planting machines reveals much about their effectiveness. Well-prepared fields - especially those properly puddled and leveled - help machinery work more smoothly, according to Joshi and Dhakal (2023). A step toward accessibility came with Pandit's (2022) hand-operated rice planter built light enough for one person, fitting smaller farms well. Machine design and operational mechanism matter too;

Mishra (2020) showed these design how well various paddy transplanter performance. When comparing traditional method against mechanical solutions, Vijay et al. (2020) observed transplanter row spacing, consistency, less physical strain in leaning in favor of machines. Despite earlier efforts, progress in rice transplanting technology has steadily grown. Through varied soil tests, Manikgam (2019) found that self-propelled units delivered stable outcomes regardless of terrain type. Cost-effective designs took center stage when Patel (2018), along with Yadav and Pund (2017), turned attention toward machinery accessible to smaller landholders. Field diversity shaped the work of Singh et al. (2016), whose assessments highlighted operational reliability under shifting environments. Meanwhile, human effort entered the picture as Gite and Agrawal (2015) analyzed how hand-operated tools affected user comfort during planting tasks. Looking at the drastically improvement in machinery have advanced in paddy transplanting process, Mehta and Sharma (2015) review the performance of the paddy transplanter. In similar contexts, work by Saha and Mohanty (2014), along with Rahman et al. (2013), showed that using multi-row transplanters or mechanical transplanting improved outcomes in wetland fields.

### III. COMPONENTS

The engine-operated paddy transplanter consists of several important components that function together to achieve efficient and uniform transplanting. The **frame** serves as the main structural support, holding all components in proper alignment and ensuring stability during operation in wet field conditions. The **engine** is the primary source of energy, supplying the necessary power to drive the entire system. This energy is transmitted through the **chain drive**, which ensures smooth and reliable transfer of motion to various working parts. The **crankshaft** is a key component that converts the rotary motion of the engine into reciprocating motion required for the transplanting action. The **crank plate** is connected to the crankshaft and helps in controlling and guiding the motion of the picking mechanism. **Bearings** are provided at different rotating points to reduce friction, support moving parts, and increase the life of the machine. The **flywheel** plays an important role in maintaining uniform speed by storing rotational energy and minimizing fluctuations during operation. The **tray** is designed to hold mat-type nursery seedlings and allows continuous feeding to the picking mechanism. The **picking arm** is responsible for carefully picking seedlings from the tray and placing them into the soil with proper depth and spacing. The machine includes a **control lever**, which enables the operator to regulate speed, direction, and overall operation of the transplanter. Some designs also incorporate a float or base platform to distribute the weight evenly, preventing the machine from sinking in soft muddy fields. All these components work in coordination to ensure smooth, continuous, and efficient transplanting, reducing labour effort and improving field productivity.

### IV. METHODOOGY

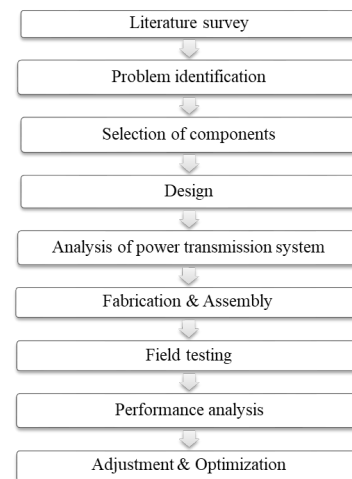
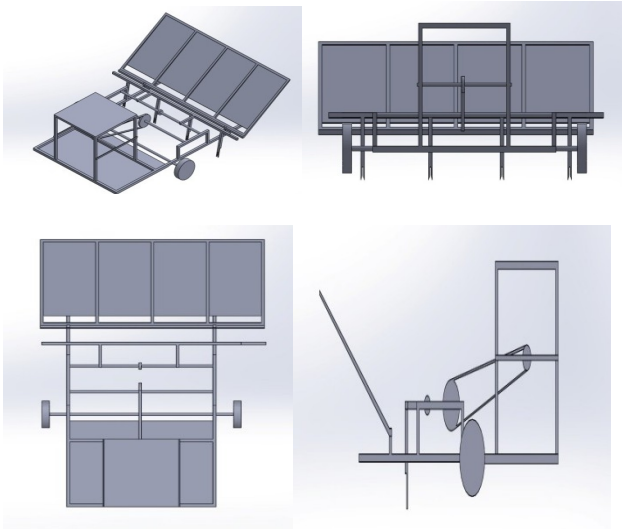


Fig No 1: Methodology

### V. WORKING PRINCIPLE

The engine-operated paddy transplanter performs transplanting through a well-coordinated sequence of mechanical actions. The engine generates energy, which is transmitted through the chain and sprocket system to the crankshaft. The crankshaft converts this rotary motion into reciprocating motion, which drives the crank plate and linkage mechanism connected to the picking arms. This conversion is essential for achieving the rhythmic back-and-forth movement required for accurate seedling placement. The seedling tray, positioned above the transplanting unit, continuously supplies mat-type seedlings. An adjustable feeding mechanism gradually moves the seedling mat toward the picking zone, ensuring uninterrupted operation. Guide rails and supports help maintain proper alignment of the tray, preventing misplacement or jamming during the process. The picking arms, equipped with fingers, gently separate individual seedlings and insert them into the soil at a consistent depth. The forward movement of the machine is maintained by ground wheels, which are designed to provide adequate traction even in waterlogged and slippery field conditions. The travel speed of the machine is synchronized with the motion of the picking arms, ensuring uniform spacing between seedlings both along and across the rows. This synchronization is critical for maintaining crop uniformity and improving overall yield. To prevent sinking in soft and muddy fields, the machine is fitted with a float or wide base platform that evenly distributes its weight. The flywheel helps maintain a steady speed by minimizing fluctuations in engine output, resulting in smooth and continuous operation. Vibrations are reduced through proper balancing of moving parts, which enhances machine stability and operator comfort. As the machine advances, multiple rows are transplanted simultaneously, significantly increasing field capacity and reducing the time required for operation. The continuous cycle of picking, placing, and returning ensures efficient transplanting without interruption. Overall, the integrated functioning of mechanical components enables precise, reliable, and high-speed transplanting, making the machine highly suitable for modern paddy cultivation.

**VI. DESIGN**



**Fig No 2: Design**

**VII. FABRICATION & ASSEMBLY**

The transplanter is developed through a systematic process of fabrication and assembly to ensure high strength, stability, and dependable performance under field conditions. The main frame is constructed using mild steel, which serves as the backbone of the machine by supporting all major components such as the engine, chain drive system, crankshaft, seedling tray, picking arms, ground wheels, and operator handle. Mild steel is selected due to its excellent strength, durability, ease of machining and welding, and cost-effectiveness, making it suitable for agricultural equipment. The fabrication process involves precise cutting, shaping, and joining of structural members. Welding is carried out using the Shielded Metal Arc Welding (SMAW) process to ensure strong and durable joints. Critical load-bearing areas, including engine mounting points and crankshaft supports, are reinforced using multi-pass welding techniques to withstand continuous operational stress. After welding, the entire frame is thoroughly inspected for proper alignment, dimensional accuracy, joint strength, and surface finish to ensure quality construction. During the assembly stage, the engine is carefully mounted on the frame and aligned accurately with the chain drive and crankshaft to ensure efficient transmission of energy. The chain and sprocket system is properly tensioned to avoid slippage and ensure smooth motion transfer. The crankshaft, drive plate, and linkage mechanisms are then installed to achieve synchronized movement of the picking arms. The seedling tray system is fitted above the mechanism in a position that allows continuous and uniform feeding of mat-type seedlings. Bearings are installed at all rotating and moving parts to reduce friction, enhance efficiency, and increase the lifespan of the components. Proper lubrication is applied to ensure smooth operation and minimize wear and tear. The picking arms are adjusted and aligned precisely to ensure accurate seedling pickup and placement. The ground wheels are then attached to provide mobility, while the operator handle is fixed to allow easy

control and maneuverability of the machine in field conditions.

**VIII. DESIGN CALCULATION**

S.No	Parameter / Component	Formula / Specification	Value
1.	Engine Power	1 HP = 746 W P = 2 × 746	1492 W ≈ 1.5 kW
2.	Mechanical Transmission Efficiency	$\eta_m = 85\%$ Effective Power = P × $\eta_m = 1.5 \times 0.85$	1.27 kW
3.	Working Width of Machine	Number of rows = 4 Row spacing = 0.20 m W = R × spacing = 4 × 0.20	0.80 m
4.	Forward Speed	Typical operating speed in puddled field	2 km/hr
5.	Theoretical Field Capacity	TFC = (W × S) / 10 = (0.8 × 2) / 10	0.16 ha/hr
6.	Field Efficiency	Assumed efficiency for paddy transplanter	75 %
7.	Actual Field Capacity	AFC = TFC × $\eta_f = 0.16 \times 0.75$	0.12 ha/hr
8.	Area Covered per Hour	1 ha = 10000 m <sup>2</sup> Area = 0.12 × 10000	1200 m <sup>2</sup> /hr
9.	Area Occupied by One Plant	Row spacing × Plant spacing = 0.20 × 0.15	0.03 m <sup>2</sup>
10.	Seedlings Transplanted per Hour	Plants = Total Area / Area per plant = 1200 / 0.03	40,000 plants/hr
11.	Seedlings per Minute	Plants/min = 40000 / 60	≈ 670 plants/min
12.	Seedlings per Second	Plants/sec = 670 / 60	≈ 11 plants/sec
13.	Floating Sheet Dimensions	Length = 0.65 m Width = 0.65 m Thickness = 0.002 m Steel density = 7850 kg/m <sup>3</sup>	–
14.	Volume of Floating Sheet	V = L × W × t = 0.65 × 0.65 × 0.002	0.000845 m <sup>3</sup>
15.	Weight of Floating Sheet	W = ρ g V = 7850 × 9.81 × 0.000845	65.1 N (≈ 6.6 kg)
16.	Buoyant Force	Fb = ρw g V = 1000 × 9.81 × 0.000845	8.3 N
17.	Floating Plate Area	A = 0.65 × 0.65	0.4225 m <sup>2</sup>
18.	Ground Pressure	P = Wt / A = 300 / 0.4225	710 N/m <sup>2</sup> (0.71 kPa)

**Table No 1: Design Calculation**

## IX. PROTOTYPE

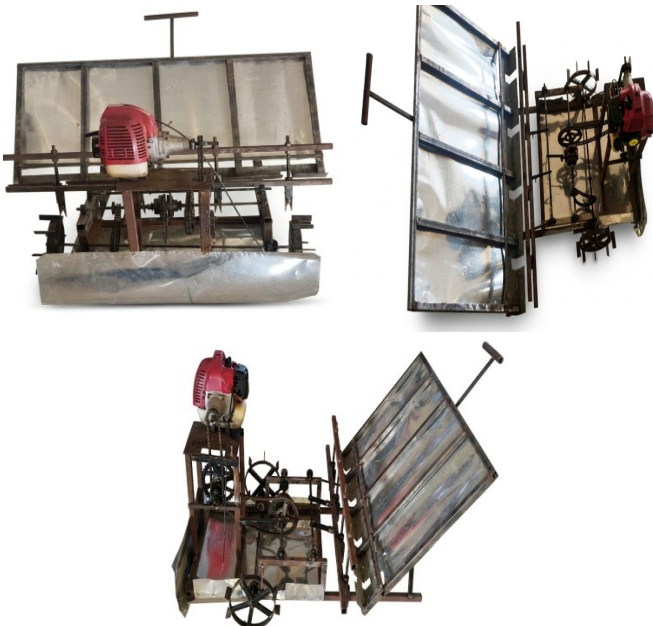


Fig No 3: Prototype

## X. TESTING AND PERFORMANCE ANALYSIS

Testing is carried out under varying field conditions to evaluate the performance of the transplanter during actual operation. Each trial is conducted in different soil and moisture conditions to observe how effectively the machine components function when the engine is running. These tests help determine whether the transmission system and planting mechanism are properly synchronized for accurate seedling placement. As the machine operates, the chain drive transmits energy to the wheels, enabling forward movement even in muddy fields. Proper coordination between wheel speed and picking arm motion ensures continuous and uniform transplanting. Key parameters such as planting depth, spacing, and overall consistency are measured throughout the trials. When adequate traction is maintained, the picking arms place seedlings into the soil at regular intervals. Despite variations in field conditions, the machine maintains stable and smooth operation, ensuring uniform row planting. The depth of planting remains nearly constant, and spacing between rows shows minimal variation due to the balanced movement of the picking arms. The crankshaft and its associated mechanisms operate steadily without vibration or misalignment. Engine performance is also evaluated under load conditions, with fuel consumption monitored over extended periods. The energy transmission system proves efficient, with no significant power loss or slippage. Field evaluations confirm that the structural frame, engine output, and transplanting mechanism work in coordination to achieve consistent and efficient planting. Overall, the tests demonstrate the reliability and effectiveness of the transplanter in delivering uniform performance under different operating conditions.

## XI. FIELD PERFORMANCE TEST

### A. Test Without Load

The process started with a simple test-no seedlings this time. The main goal was to see how the transplanter ran on its own. Everyone key parts like the crankshaft and chains, just making sure everything moved the way it should. The engine started up, the transmission worked as expected, and nothing seemed out of place from beginning to end. Rotations were steady-those balanced linkages kept everything running smooth, without any vibrations. All the planting mechanisms cycled through cleanly, and the timing was spot on from front to back. Every process happened uniformly like clockwork. The motions goes in order where the machine was active, showing a connection between the rotational drive and their movement. Power transferred smoothly through the chain and sprocket, keeping the crankshaft turning steady. The frame fixed solid, supported by the floating sheet and the wheel. The whole operation felt uniform. Performance pointed to the machine being ready for real work, dependable operation.

### B. Test With Load

In real field trials to put the transplanter to work with live paddy seedlings. Running at just about 2 km/h, things stayed steady from beginning to end. The planting mechanism kept at it, dropping seedlings in without interruption. Four rows moved forward at once, covering the full 0.8 m width every pass. Productivity per hour lined up pretty well with what we expected based on the machine's specs. During these tests, the transmission system didn't let up, even with the varying load. The crankshaft operates smoothly, and the arms placed the seedlings evenly. On muddy or slick spots, the wheels with deep treads gripped the ground, no slipping. The weight spread out thanks to hanging panels, which meant the machine didn't sink much in wet soil. Across waterlogged patches, stability came from the way everything was put together. Even with the machine under some real strain, the main parts held up-engine mount, transmission, planting module, chassis, all, no obvious wear. As we moved across the ground and different soil types, performance stayed well.

## XII. RESULT AND DISCUSSION

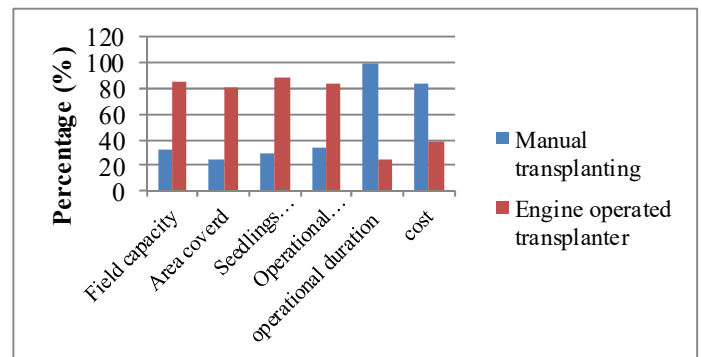


Fig No 4: Comparison chart

The engine-operated paddy transplanter plays a significant role in improving the efficiency of rice cultivation by reducing time, labour, and overall operational costs

compared to traditional manual transplanting methods. In conventional practices, transplanting requires a large number of labourers and considerable time, making it both expensive and difficult to manage, especially during peak agricultural seasons. With the introduction of engine-operated transplanters, labour dependency is drastically reduced, lowering labour requirements by more than 75 percent. In addition to saving labour, the cost of transplanting operations is significantly decreased, with reductions ranging from approximately 45 to 60 percent. This makes the machine highly economical and suitable for farmers facing labour shortages and increasing wage rates. The transplanter also ensures uniform spacing and consistent planting depth, which are essential for proper crop establishment and healthy plant growth. Uniform planting improves the efficient use of water, nutrients, and sunlight, leading to better crop management and higher yields. It also simplifies intercultural operations such as weeding, fertilization, and irrigation. Moreover, the machine enables faster completion of transplanting, ensuring timely crop establishment. Overall, the engine-operated paddy transplanter is an efficient, reliable, and cost-effective solution that supports modern agricultural practices and enhances productivity in paddy cultivation.

### XIII. CONCLUSION

The engine operated paddy transplanter shows the field results as the power came from a 52 cc petrol engine producing close to 2 horsepower - roughly 1.5 kilowatts - with around 1.27 kW actually reaching the planting system once drive friction. A chain-driven crankshaft transformed spinning motion into back-and-forth strokes that moved seedlings nonstop from mat tray to soil. As it moved forward at roughly 2 kilometers per hour, the unit covered a path just under one meter wide. Starting at roughly 0.12 hectares each hour, the working speed stayed steady in field effectiveness near 75 percent. Moving close to 40,000 seedlings into place every hour, it kept rows exactly thirty centimeters apart, individual seedlings fifteen. Because of the buoyant base plate, downward force on muddy field dropped, balance got better. In real farming situations, results showed consistent placement accuracy, less need for workers, smoother operation across wet fields.

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