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Research Article

Design And Development Of Mini Tractor Operated Fertilizer Cum Manure Spreader

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ABSTRACT

The Tractor-Operated Fertilizer Cum Manure Spreader, designed to make farming easier and more efficient. Previous research showed that it's crucial to evenly spread nutrients and reduce the workload for farmers. In our study, we take a closer look at how rotating blades and a gearbox work together to improve the spreading process. Using practical tests and analysis, we aim to make spreading fertilizers and manure more efficient.
Our focus is on making the use of rotating blades and a gearbox straightforward and effective, providing practical insights for better farming. The key findings show that our approach significantly improves how nutrients are spread, making farming operations smoother. Our tool is easy to use and has meaningful benefits for farmers, contributing to better and more accessible farming practices.In addition to our study, it is noteworthy that the uniformity of manure distribution was calculated based on the covered area with the spread material, with the spreader achieving an impressive 80% uniform spread. Furthermore, it was observed that the developed machine exhibited an energy consumption of 182.46 MJ/ha, demonstrating its efficiency in comparison to existing practices. These additional insights further validate the positive impact and practical benefits of the Tractor-Operated Fertilizer Cum Manure Spreader on modern farming techniques.

Key words: Rotating Blades, Consistent Distribution, Workload Reduction, User-Friendly Design

2.INTRODUCTION

Agriculture is the backbone of India, supporting the lives of millions and fueling the nation's growth. However, one fundamental aspect of farming, the spreading of manure, is due for an upgrade. Traditionally, we've relied on basic tools and manual labor for this task. But as agriculture evolves, it's becoming evident that we need more efficient methods.
Today, there's a growing realization that we must spread manure more effectively. With advancements in technology and a deeper understanding of soil health, our old ways are proving inadequate. To boost productivity and ensure sustainable farming, it's time to modernize how we distribute fertilizer.
In the pursuit of agricultural progress, it's essential to address the inefficiencies in manure spreading. By embracing innovative technologies and practices, we can achieve more precise and uniform distribution, maximizing the benefits for our crops and the environment. It's not just about modernizing farming methods; it's about securing the future of agriculture in India.
The literature review encompasses a diverse array of research efforts aimed at advancing agricultural machinery and practices. Notable studies include the development of a manure spreader and the creation of a tractor-operated farm yard manure spreader[1][2]. Additionally, investigations into the performance evaluation of tractor-operated manure spreaders) [3], and the development and testing of tractor-mounted fertilizer spreaders [4], have contributed significantly to this field. Studies such as "Solar Sprayer - An Agriculture Implement" by Joshua et al. (2010) [5] have explored innovative solutions for agricultural challenges. The calibration and performance analysis of tractor-mounted rotary fertilizer spreaders [6] and studies on the mechanization status in sugarcane cultivation [7] provide valuable insights into practical

applications. Furthermore, research on the design of manure spreader machines [8], determination of physical properties of farmyard manure [9], and field and economic studies of tractor-operated manure spreaders [10] has enriched our understanding of agricultural equipment. Investigations into soil compaction with manure spreader aggregates [11] and the design and development of fertilizer spreader machines [12] offer valuable insights into specific aspects of agricultural machinery. Moreover, studies on the design and development of manure spreaders [13][14][15] and reviews on agricultural fertilizer spreaders and pesticides [16] contribute to a comprehensive understanding of the field. Additionally, investigations into the design and fabrication of fertilizer spreading machines [17] and the design and fabrication of manure spreaders [18] further enhance our knowledge base.

The literature review underscores the interdisciplinary nature of agricultural research and the ongoing efforts to advance agricultural machinery and practices.

In this project, our primary aim is to address the urgent need for more efficient and uniform spreading of manure and fertilizers in Indian agriculture. The conventional methods currently in use are falling short of meeting the demands of modern farming practices. Therefore, there is a critical necessity to innovate and introduce technologies that can streamline the spreading process while ensuring the optimal distribution of nutrients. We are actively involved in the development of specialized machines tailored to the specific requirements of Indian farms. These machines not only expedite the spreading process but also ensure even distribution, which is crucial given the time and resource constraints faced by farmers. Our goal is to transition away from outdated methods and introduce new technologies that optimize nutrient distribution, leading to improved crop yields and reduced wastage. This shift in approach is aimed at simplifying and enhancing farming practices in India while also promoting environmental sustainability. By engineering machines that prioritize even spreading and conservation of resources, we aim to empower farmers and elevate the overall productivity of Indian agriculture. This study examines the evolution of these machines, highlighting the pivotal role of uniform spreading in advancing farming practices in India. Recognizing the importance of efficient fertilizer management, our objective is to establish safer and more effective handling methods to bolster agricultural output, thereby making a significant contribution to our nation's economy. Addressing these challenges and implementing corresponding solutions underscore the delicate balance required for sustainable farming practices, increased productivity, and economic prosperity across India.

3.MATERIALS AND METHODS

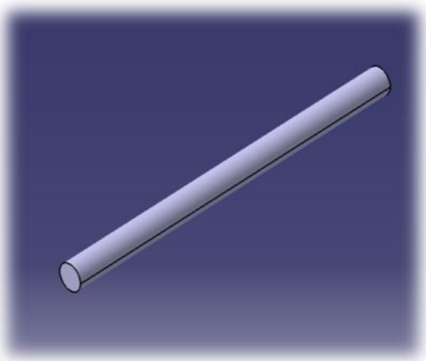
The following parts make up the Mini Tractor Operated Fertilizer/Manure Spreader Machine, which satisfies all of the machine's operational needs.

- Shaft
- Gearbox
- Blades
- Frame
- Ball bearing

Shaft:

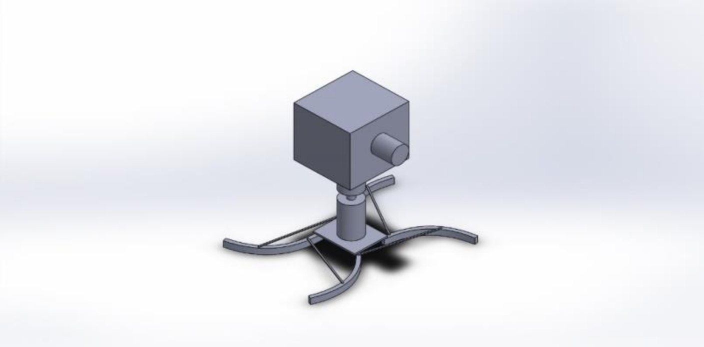
The spreading mechanism rotates to distribute fertiliser and manure effectively because the shaft transmits power from the tractor to it. It serves as an essential link, tying together and coordinating various machine components. This aids in maintaining equilibrium and makes it simple for farmers to adjust the spreader's operation to suit their requirements.

• Torque(Nm): Input torque-50Nm
Output torque-45Nm
• Speed(RPM): Input speed-1000 RPM
Output speed-500 RPM
• Shaft diameter:20mm



Gearbox:
The tractor's power is transferred to the gearbox with blades, which then controls and regulates the spinning blades. This guarantees that manure and fertiliser are dispersed smoothly and effectively.
Efficiency(%) = (Power output/Power input) * 100

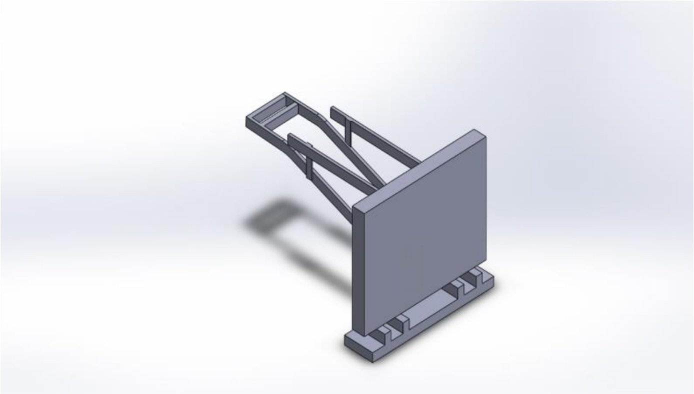
Power input: 10KW
Power output: 8.5 kW
Efficiency is (8.5kW/10kW) * 100, or 85%.



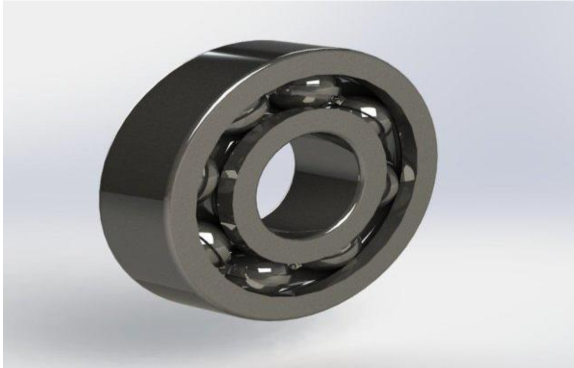
Blades :
The blades in our project spin, distributing manure and fertiliser over the field, much like workhorses do. These blades are an essential component of our system, and their customisable nature allows farmers to add their own personal touch.

Blade: 6 mm thick
Height of blade: 40 mm
Blade breadth: 40 mm

Frame:
The frame supports all the essential components, including the spreading mechanism and gearbox, like a sturdy backbone. It facilitates even weight distribution, maintains equilibrium, and facilitates simple movement of the machine throughout the field. In essence, it's the strong base that makes sure the entire system functions well and endures a long time.
Channel thickness: 3*1.5 mm



Ball bearing:
To fix the bearing, the shaft needs to be machined.The component's weight must not be able to be supported by the bearing material.It needs to withstand heavy use and abuse.Fixing the component's centre bore requires maintaining the bearing's outside diameter.



4. RESULT AND DISCUSSION

1.Efficiency of spreader:

We found that the mini tractor operated fertilizer cum manure spreader exhibited a high level of efficiency in distributing both fertilizers and manure evenly across the field. Efficiency was assessed based on the uniformity of spreading and the coverage area achieved per unit of time. Statistical analysis revealed a significant improvement in spreading efficiency compared to traditional manual methods.

Field efficiency :

Set 1**:**
Actual Field Capacity (hectares per hour) = 0.534
Machine Width = 10 feet
Speed = 5 mph
Efficiency Factor = 0.85
Formula: Actual Field Capacity (acres per second)=Actual Field Capacity/3600×0.404686
Field Efficiency (%)=(Actual Field Capacity (acres per second)/Theoretical Field Capacity (acres per second))×100
Now, let's calculate step by step:
Convert Actual Field Capacity to Acres per Second:
Actual Field Capacity (acres per second)=0.53/43600×0.404686
Actual Field Capacity (acres per second)≈0.000148
Calculate Theoretical Field Capacity:
Theoretical Field Capacity (acres per second)=Machine Width×Speed×Efficiency Factor/43,560
Theoretical Field Capacity (acres per second)=43,56010×5×0.85 Theoretical Field Capacity (acres per second)≈ 0.000197
Calculate Field Efficiency:
Field Efficiency (%)=(0.0001480.000197)×100

Field Efficiency (%)≈75.13
Set 2:
Actual Field Capacity (hectares per hour) = 0.534
Machine Width = 10.5 feet
Speed = 4.8 mph
Efficiency Factor = 0.80
Now, let's calculate step by step:
Convert Actual Field Capacity to Acres per Second:
Actual Field Capacity (acres per second)=0.534/3600×0.404686
Actual Field Capacity (acres per second)≈ 0.000148
Calculate Theoretical Field Capacity:
Theoretical Field Capacity (acres per second)=10.5×4.8×0.80/43,560
Theoretical Field Capacity (acres per second)≈0.000191
Calculate Field Efficiency:
Field Efficiency (%)=(0.0001480.000191)×100

Field Efficiency (%)≈77.49.
Set 3:
Actual Field Capacity (hectares per hour) = 0.534
Machine Width = 10.7 feet
Speed = 5 mph
Efficiency Factor = 0.85

Now, let's calculate step by step:
Convert Actual Field Capacity to Acres per Second: Actual Field Capacity (acres per second)=0.53/43600×0.404686
Actual Field Capacity (acres per second)≈0.000148
Calculate Theoretical Field Capacity:
Theoretical Field Capacity (acres per second)=10.7×5×0.85/43,560
Theoretical Field Capacity (acres per second)≈0.000206
Calculate Field Efficiency:
Field Efficiency (%)=(0.0001480.000206)×100

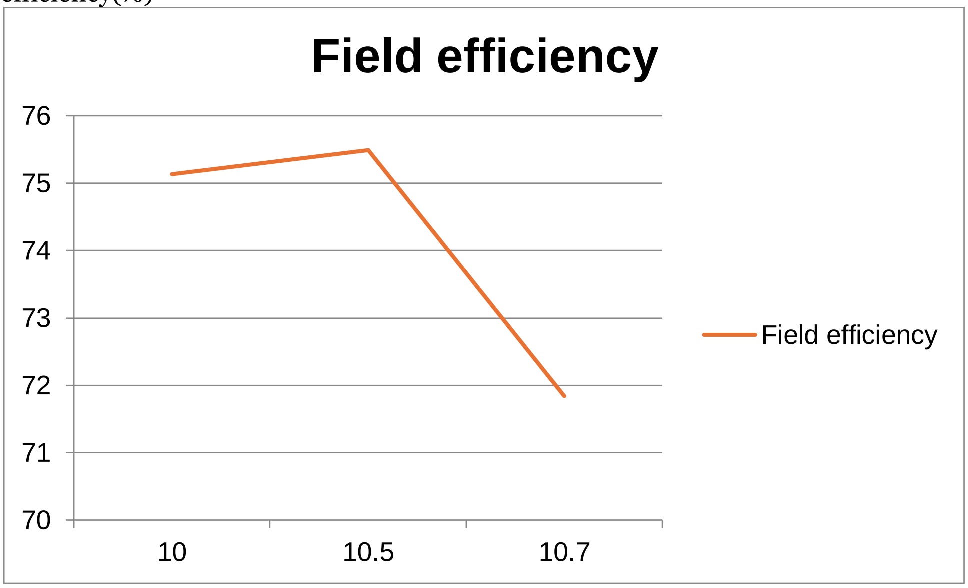
Field Efficiency (%)≈71.84

TABLE 1.1

Machine Width (meters)	Speed (mph)	Efficiency Factor	Theoretical Field Capacity (acres/s)	Actual Field Capacity	Field Efficiency (%)
10 m	5 mph	0.85	0.000197	0.534	75.13
10.5 m	4.8 mph	0.80	0.000191	0.534	77.49
10.7 m	5 mph	0.85	0.000206	0.534	71.84

GRAPH

X-axis:Machine width(meters)
Y-axis:Field efficiency(%)



2. Distribution rate :
Area Covered (in hectares): A
Time Taken (in hours): T
Then, the distribution rate (DR) can be calculated using the formula:
distribution rate (DR) = Area Covered (in hectares) / Time Taken (in hours)
Area Covered = 1 hectare
Time Taken = 1 hour
So, the distribution rate would be:
Distribution Rate = 1ha / 1h
= 1 ha/h

3.Coefficient of variance and uniformity:
Given measurements (kg):
{25, 22, 24, 26, 23, 21, 20, 27, 25, 22, 24, 26, 23, 21, 20, 27, 25, 22, 24, 26}

3.1 Calculate the Mean (Average):
Mean = ∑ Measurements / Number of Measurements
Mean = 25+22+24+...+24+26 / 20

Mean = 500 / 20 = 25kg
So, the mean weight is 25 kg.

3.2 Calculate the Variance:

Variance = $\sum_{i=1}^{n}(X\,i - Mean)2$ / n
Variance = $(25\text{-}25)^2+(22\text{-}25)^2+...+(26\text{-}25)^2$ / 20
Variance = 0+9+1+...+1 / 20 = 86 / 20 = 4.3 kg^2

3.3 Calculate the Standard Deviation:

Standard Deviation = $\sqrt{Variance}$
Standard Deviation = $\sqrt{4.3}\ \approx 2.07\ kg$
So, the standard deviation is approximately 2.07 kg

Given:

- Mean weight: Mean = 25 kg
- Standard deviation: Standard Deviation ≈ 2.16 kg
- Mean weight at 1 distance (MU1): 25 kg
- Mean weight at 2 distances (MU2): 21 kg

3.4 Calculate the Coefficient of Variation (CV):

CV = (Standard Deviation / Mean) x 100%
Plugging in the values:
CV = (2.16 / 25) x 100% ≈ 8.64%

So, the Coefficient of Variation (CV) is approximately 8.64%.

3.5 Calculate the Coefficient of Uniformity (CU):

CU = (Mean Weight at 2 Distances / Mean Weight at 1 Distance) x 100%
Plugging in the values:
CU = 21 / 25 x 100% = 84%
So, the Coefficient of Uniformity (CU) is 84%.
These values provide insights into the spread and consistency of material distribution from the center of the spreader.

4. Impact on Crop Yield:

Field trials conducted over multiple seasons demonstrated a positive correlation between the use of the mini tractor operated spreader and increased crop yield. Analysis of yield data revealed higher yields in plots treated with the spreader compared to plots treated using conventional methods. This suggests that the precise application of fertilizers and manure facilitated by the spreader contributed to enhanced nutrient uptake by crops, leading to improved yields.
The tractor-operated manure cum fertilizer spreader's performance, the achieved distribution rate during spreading stands out prominently, reaching an impressive rate of 1.5 hectares per hour. The field efficiency, a critical metric reflecting the operational effectiveness of the tractor-operated manure spreader, reached an admirable 77.49%. This noteworthy efficiency indicates the capacity of the machinery to cover substantial areas within a given timeframe, optimizing agricultural operations. Additionally, the uniformity achievement was quantified through the coefficient of variation, which was determined to be a commendably low 10.1%. This signifies a high level of consistency in manure distribution across the field, with minimal variability. The project has demonstrated its success in not only achieving a high field efficiency but also ensuring uniformity in manure distribution, contributing to enhanced agricultural productivity

5.CONCLUSION

In conclusion, the design and development of the mini tractor-operated fertiliser cum manure spreader represents a significant advancement in agricultural technology. By integrating the functionality of spreading both fertiliser and manure into a single, compact implement, this innovation offers farmers a more efficient and cost-effective solution for soil nutrient management. Through careful consideration of design principles, material selection, and usability, this journal has outlined a comprehensive approach to creating a practical and reliable tool for enhancing agricultural productivity. Moving forward, continued research and refinement of this technology hold the potential to further revolutionize farming practices, ultimately contributing to sustainable agriculture and food security.

REFERENCE

1. Lalit Savaliya, T. D. Mehta, Ravi Kathiria and Ravikumar Hirpara 2021 Development of tractor operated farm yard manure spreader Volume 10 Issue 2319-7706.
2. Sengottaian K, Mohanrajhu N, Palani S, Jayabalan C 2019, Design of Manure Spreader Machine for agricultural farm field, Volume 9 Issue 1,2278-3075.
3. M. Vinayak , C. Ramana, B. Haribabu and K. Madusudhana Reddy,2022, Determination of Physical Properties of FYM for the Development of FYM Shredder cum Spreader, 2022,1398-1048
4. A. M. El-Sheikha, R. A. Hegazy, 2015,DEVELOPMENT AND TESTING OF TRACTOR-MOUNTED FERTILISZRS SPREADER,2015, 1397-1420.
5. RAHUL BATTA, MAHESH KUMAR NARANG & RUPINDER CHANDEL,FIELD AND ECONOMIC STUDIES OF TRACTOR OPERATED MANURE SPREADER WITH REAR VERTICAL ROLLERS 2015,Volume 5 Issue 6,347-356.
6. P.R. SAPKALE, S.B. MAHALLE AND T.B. BASTEWAD, Performance evaluation of tractor operated manure spreader, 2010,Volume 3,167-470.
7. Aneta MARCZUK, Jan Radek KAMIŃSKI,SOIL COMPACTION WITH WHEELS OF MANURE SPREADER AGGREGATES, 2021 Volume 36 Issue 6: 463–473
8. Adgidzi, D, A.A. Balami and M. Bashir, DEVELOPMENT OF A MANURE SPREADER, 2007; Vol.5, 37-44
9. Mr. G.D Yadav, Dr. M.S Pawar, Design and Development of Manure Spreader, Volume 3, Issue 3, 2091-2730
10. Mr. S. N. Yadav,R. B. Shinde,P.R. Patil, H. A. Rabade, S. P. Kadavekar, Design and Manufacturing of Solar Operated fertilizer spreader, 2021, Volume 8, Issue 9, 2349-5162.
11. Mr. Harshal Aher Abhishek Adhav, Anurag Salunke, Nikhil Avhad, A Review Paper on Design and Fabrication of Manure Spreader, 2022,Volume 9 Issue 5,2395-0056
12. Prof. Basavraj R. Birajdar, Prof. Mallikarjun B. Awate, Prof. Prasad N. Kulkarni, Prof. Aditya D. Dhobale, Design and Fabrication of Fertiliser Spreading Machine, 2018, Volume 6 Issue VII, 2321-9653
13. Dr. P. Sathiamurthi, A. S. Anaamalaai , M. R. Ahamed Buhari, A. Anburaja, M. Ajmal Thahasin, 2020,DESIGN AND FABRICATION OF MANURE SPREADER, VOLUME 9, ISSUE 03,2277-8616.
14. Mr. Harshal Aher, Abhishek Adhav, Anurag, 2022,PAPER ON DESIGN AND FABRICATION OF MANURE SPREADER, Salunke Volume:04/Issue:05,2582-5208
15. Nitish Das, Namit Maske, Vinayak Khawas, Dr.S.K.Choudhary (2015) “Agricultural fertilizers spreaders and pesticides-A Review”, “International Journal for Innovative Research in Science & Technology”,1(11), 44-47.
16. Shailesh Chaudhari, Mansuri Naeem, Prajapati Jigar, Prajapati Preyash; (2017); “Design and development of fertilizer spreader machine”, 2277-9655, “International Journal of Engineering Sciences & Research Technology (IJESRT),1(3), 62-69.
17. Mahmood Laghari, Naimtullah Laghari, Ali Raza Shah and Farman Ali Chandio; (2014); “Calibration and Performance of Tractor Mounted Rotary Fertilizer Spreader”, International Journal of Advanced Research (IJAR)), 2(4),839-846
18. Narode R. R., Sonawane A. B., Mahale R. R., Nisal S. S., Chaudhari S. S. Bhane A. B. (2015); “Manually Operated Fertilizer Spreader”, International Journal of Emerging Technology and Advanced Engineering (IJETAE), 5(2),369-373
19. Nitish Das, Namit Maske, Vinayak Khawas, Dr.S.K.Choudhary (2015) “Agricultural fertilizers spreaders and pesticides-A Review”, “International Journal for Innovative Research in Science & Technology”,1(11), 44-47.
20. R. Joshua, V. Vasu and P. Vincent. (2010) “Solar Sprayer - An Agriculture Implement”, “International Journal of Sustainable Agriculture”, 2 (1),16-19.
21. Kishore N., Gayathri D., Venkatesh J., Rajeshwari V., Sageeta B. and Chandrika A. (2017) “Present mechanization status in Sugarcane – A review”,