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Comparative cost analysis of conventional and various Garlic planting machinery

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Abstract
The agricultural tractor is at the centre point of agricultural mechanization. Tractor and farm machinery costs have great influence on farm business profit. Larger machines, new technology, higher prices for parts and new machinery and higher energy prices have all caused machinery and power costs to rise in recent years. In order to improve decision-making, the operational cost of raised bed type garlic planters was examined and compared with manually operated single row garlic planters along with conventional planting. The effectively field capacity were found as 0.183 ha/hr, 0.0367 ha/h and 0.00178 ha/h for raised bed type garlic planter, manual operated single row planter and conventional methods. The operational cost of the raised bed type garlic planter, manual operated single row planter and conventional methods were found as 4026, 3081 and 16100 ₹/ha, respectively. The pay-back period of the developed garlic planter was found to be 104 days.

Keywords: Variable cost, fic cost, depreciation, field efficiency

1. Introduction
The Indian agricultural sector has grown over the past several decades into one of the most varied and intricate in the world. The implementation of modern technology has contributed to a major boost in agricultural output in recent decades. Concurrently, the percentage of available power attributed to agricultural work decreased from 14.7% in 1960–1961 to 4.6% in 2013-2014. Farms were increasingly using tractors as a major source of power (Singh *et al*., 2014) [10]. Farm tractor and machinery has involved various big machines, implement and it associated the high cost investment. Farmers face the difficulty in decision making whether to buy or hire it. The assessment of the operational cost of the machine plays a crucial role in the adoption. When to hire or own equipment is of great concern to an operator who has a small acreage or uses equipment only a few hours each year. The yearly use, cash availability, and the availability and dependability of specialized services are all important elements to take into account. Generally, a farmer may afford to hire if the overall cost of ownership and running expenses for using his own equipment is less than the cost of bespoke hired work. Naturally, this does not account for factors like punctuality or the caliber of the job produced. (Fairbanks *et al*., 1971) [2].

For commercial use, assessing the operational costs of planting machinery is vital for efficient planning for agricultural output and management (Lary *et al*. 1997) [7]. Thus, in order to imply the farm management strategies in agricultural regions, it is necessary to understand operating expenses. Assessing the operating costs of different kinds of conventional machinery is also essential. To mitigate these challenges, the investigation was conducted for operational cost estimation of garlic planting machinery along with conventional methods.

2. Materials and Methods
The cost estimation involves the fixed cost and operational cost, and it performs the key role in feasibility and adoption of the machinery.

The raised bed type garlic planter was designed, developed and fabricated into a workshop at the department of Farm Machinery and Power Engineering, Vaugh Institute Agricultural Engineering and Technology, SHUATS, U.P. This developed garlic planter consists of ridger, three tynes along with the spoon chain types of metering mechanism. The developed planter was operated with an 18 to 22 hp. tractor. The manual operated single row planter and manual sowing methods were selected for the assessment for operational cost in garlic sowing. The manually operated single row planter involves two persons in sowing operation, first operating the planter and another to pull the planter.

Fig 1: Raised bed type garlic planter

Fig 2: Manually operated garlic planter

Fig 3: Manual sowing of garlic

Table 1: Technical specification of raised bed type garlic planter

Sr. No.	Particulars	Units / quantity
1.	Overall size of machine (L ×B × H), mm	(1400 ×1250 × 1100)
2.	Power requirement, hp	18
3.	Numbers of furrow opener, no's	three
4.	Numbers of Ridger, no's	two
5.	Spoon chain types of metering mechanism, no's.	1
6.	Size of spoon, no's	Three sizes
7.	Diameter of Helicoidally seed tube, mm	100, 125 and 150

2.2 Field Test

The developed prototype of a raised bed type garlic planter and manually operated planter was tested in a field condition at the research farm of Department of Farm Machinery and Power Engineering, Sam Higginbottom University of Agriculture Technology and Sciences in Prayagraj, Uttar Pradesh. A 24 hp. mini tractor was selected to operate the prototype planter. The manually operated garlic planter testing needed the two persons for planting operation one to pull the machine and another to operate the machine.

2.3 Cost economics of the garlic planter

The cost estimation of farm machinery involves two categories as fixed cost and operating costs. The fixed cost is how long a machine is owned regardless how much it is used. It includes depreciation, interest, taxes, shelter and insurance. The variable cost directly depends on the amount of machine use. The true value of some of these costs is not known until the machine is sold or worn out. But the costs can be estimated by making a few assumptions about machine life, annual use, and fuel and labour prices.

2.3.1 Fixed costs

The straight line method was used to calculate the annual depreciation charge rate of the machine. Depreciated value of the machine per year was written below.

2.3.1.1 Depreciation

It means diminishing the actual value of a machine with passing of time. It includes below par value occurs due to wear, obsolescence, and life expectancy of machines (Ross and M. H. 1960). The degree of mechanical wear may cause the value of a particular machine, and sudden introduction of new technology or efficient model, and the machine will suddenly become obsolete. The life expectancy of machines plays a critical role in the annual use value of a machine.

A machine's economic life is the number of years that expenses need to be projected. It is frequently less than the machine's service life because most farmers replace their machines before they run out of life

Therefore, the depreciation value was calculated as

$$\text{Depreciation} = \frac{C - S}{L \times H}$$

Where,
D = Depreciation cost, Rs/hr
C = Purchasing price, Rs
S = Salvage cost 10% of purchasing cost, Rs.
L = Useful life of tractor, years
H = Working hours in a year, hr

2.3.1.2 Interest

It is a charge offered over the initial investment of machine. This value is considered into a fix cost. The interest value was calculated as written bellow.

$$Interest = \frac{C + S}{2} \times \left[\frac{i}{H}\right]$$

Where,
I= Interest per hour
C = Purchasing price, Rs
S = Salvage cost 10% of purchasing cost, Rs.
i= Rate of interest, %
H = No of working hour per year

2.3.1.3 Taxes and Insurance

The tax rate was 1% of the initial investment of machine which would be depend on the life expectancy of machine

Fixed cost
The estimated fix costs is an sum of depreciation, interest, taxes, insurance and housing of machine

Fixed Cost = (Depreciation + interest rate + taxes + insurance)

2.3.2 Operating costs
The operation or variable cost includes the repairs and maintenance, Fuel, lubrication, and operator labour charge.

2.3.2.1 Repairs and maintenance cost
It is an the cost involve the 6 percent of the initial investment, it dedicated to maintenance and repair expenses of machine

2.3.2.2 Fuel consumption
It the fuel consumption was measured for developed garlic planter during the field operation. It measured in term of liter/hr.

2.3.2.3 Lubrication cost
The consumption of lubrication was considered as 30% of the total fuel consumption cost.

2.3.2.4 Labour cost
The labour wage per day was consider on the basis there skills and non-skill person. An hourly charge for labor needs to cover total operator costs. Skill person had paid 400Rs/day for man and unskilled women 230 Rs/day. (Kastens, 1997) [5].

3. Results and Discussion
It deals with the cost economics obtained through study of raised bed type garlic planters. The study related to field testing of developed prototype planters to find the cost economics in comparison with manually operated garlic planters along with conventional methods. The results revealed from the study were reported and discussed under the following content.

3.1 Cost economics of developed garlic planter
Nowadays, Garlic is sown mostly by hand dibbling method in the region. In garlic cultivation, the cost involved in the sowing is a major share of cultivation. The cost of sewing involved in the developed garlic planter was compared with manual sowing methods in terms of effective field capacity, labour requirement, seed rate and cost of operation.

Table 2: Annual uses of the developed planter

Sr. No.	Particulars	Initial cost of garlic planter, ₹	Actual working hours per day, h	Annual usage of garlic planter, h	Total life of garlic planter, year
1.	Tractor 24 hp.	3, 92,000	8	1000	10 years
2.	Raised bed types garlic planter	30,500	8	300	7
3.	Manual Operated garlic planter	12,000	8	250	7
4.	Conventional methods/ manual sowing of machine	-	8	-	-

Fixed cost of involve in garlic planting with uses of different machine

Table 3: Fixed cost of garlic planter

Sl. No.	Particulars	Cost			
		Raised bed type garlic planter,		Manual garlic planter, Per hour	Manual planting method
		Annual	Per hour		
	Fixed cost				
1.	Depreciation Rs/hr	3921	13.07	6.17	-
2.	Interest, Rs/hr	11677	38.93	2.64	-
3.	Housing, 1% of purchase, Rs/hr	305	1.01	0.48	-
4.	Taxes, 1% of purchase price, Rs/hr	250	1.01	0.48	
5.	Insurance, 1% of average price	167.75	0.56	0.48	
Total fixed cost, ₹		16320	54.4	10.25	-

Variable cost

Table 4: Variable cost for garlic planter

Sl. No.	Particulars	Cost Per hour			
		Annual	Raised bed type garlic planter	Manual garlic planter	Manual planting method
1.	Repair and maintenance, 6% of initial cost	30500 x 0.06 = 1830	6.1	2.88	
2.	Labour @ ₹ 400 per day (2 person) Women		100	100	70 × 230= 16100
3.	Fuel @ ₹ 85 per liter (1.89 l/h)		160.75	-	
4.	Lubrication, 30% of fuel cost		48.18	-	
Total variable cost			282.91	102.88	

Tractor Hiring charges ₹/h = 400
Total cost, ₹/h
= Fixed cost + Variable cost + tractor hiring charges
= 54.40 + 2982.91 + 400
= 737.31

Effective field capacity of garlic planter, = 0.183 ha/hr
Therefore, cost of planting with machine, ₹/ha = (5.46 hr/ha) = 4025.71 /-=4026

3.2 Comparison of operational cost of different methods of garlic planting
The operational cost of the garlic planting through the different methods as using the raised bed types garlic planter, manual operated garlic planter and conventional as manual planting of garlic.

Table 5: Variable/operational cost for garlic planter

Sr. No.	Methods of planting	Effective field capacity	Operational cost per hector, ₹/ha
1.	Raised bed type garlic planter	0.183 ha/hr	4026
2.	Manually operated planter	0.0367 ha/h	3081
3.	Manual planting	0.00178 ha/h	= 16100

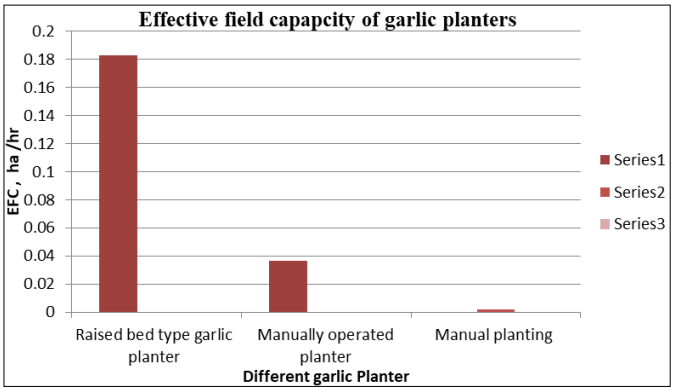

Fig 4: Actual field capacity of different garlic planting methods

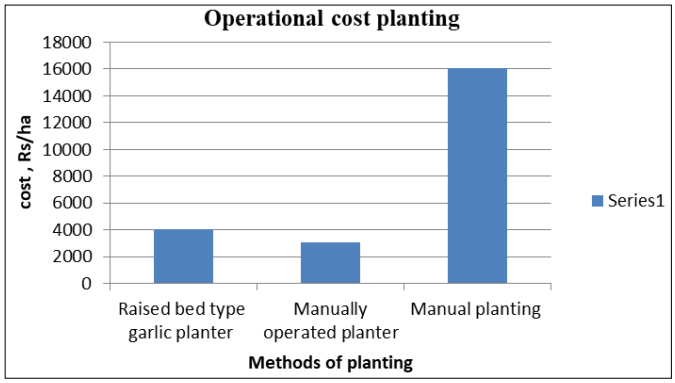

Fig 5: Operational cost associated per hector for different garlic planting methods

Cost of sowing by conventional method or manual planting

Manual garlic sowing cost, ₹/ha = (230 × 70) = 16100/-

Break Even point

BEP, hr/annum = Annual fixed cost/ (Custom fee ₹/h – Operating cost, ₹/h) x Effective output capacity, ha/h

= 16320 / (1152.04 – 737.31) x 0.183 = 423.50

Annual fixed cost, ₹ = 16320

Custom fee ₹/hr = (Cost of operation per hr + 25 percent over head

Charges) x 25 percent profit over new cost

Operating cost ₹/h = 737.31

Effective output capacity ha/h = 0.183

BEP, hr/annum = 7.201

Annual utility, ha = Effective field capacity, ha/h x Annual utility period, h

Annual utility, ha = 54.9

Therefore, BEP is achieved at about 13.11 (7.201x 100/54.9) percent of the annual utility rate of 300 hour of the developed garlic planter.

Payback period

Payback period, year = Initial cost of machine / Average net annual benefit

Initial cost of equipment, ₹ = 35500

Average net annual benefit, ₹ = (Custom fee. ₹/h - Total cost of operation, ₹/h) x Annual utility rate, h = 124419

Payback period, year = 35500/124419

= 0.28

= 104 days

The pay-back period of the developed garlic planter was found to be 104 days. The sowing season of the cotton is 37 days/year so the pay-back period was found to be 0.28 years. It can be

4. Conclusions

The goal of the research was to estimate of the operational cost associated with garlic planter and compare with manually operated planter conventional method. Operational cost of the machine is play crucial role in adoption of machine. It provides decision making to farmers, whether to buy or hire the machine.

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6. References

1. Akram MO, Singh VK, Shivam PK, Singh A, Mathur A, Ali K, *et al*. Review on cost estimation of farm power and machinery. International Journal of Statistics and Applied Mathematics. 2024;9(1):109-112.
2. Fairbanks GE, Larson GH, Chung DS. Cost of using farm machinery. Transactions of the ASAE. 1971;14(1):98-101.
3. Goering CE, Hansen AC. Engine and Tractor Power. ASABE, USA; c2013.
4. Hunt D. Farm power and machinery management. Waveland Press. Lowa State University Press; c2001. ISBN: 0813805805.
5. Kastens TL. Farm machinery operation cost calculations. Manhattan, KS, USA: Kansas State University, Agricultural Experiment Station and Cooperative Extension Service; c1997.
6. Kushwaha D, Singh U, Singh C. Performance evaluation of a push-type manually operated garlic planter, International Journal of Current Microbiology and Applied Sciences. 2020;9(8):2348-2356.
7. Bond LK, Beard R. The Cost of Owning and Operating Farm Machinery, Utah State University Extension Bulletin; c1997. p. 1-60.
8. Liljedahl JB, Turnquist PK, Smith DW, Hoki M. Tractors and their Power Units. Wiley, New York; c1979.
9. Ross MH. Depreciation and user cost. The Accounting Review. 1960;35(3):422.
10. Singh S, Singh RS, Singh SP. Farm power availability on Indian farms. Agricultural Engineering Today. 2014;38(4):44-52.
11. Mathur ML, Sharma RP. Internal Combustion Engines. Dhanpat Rai and Sons, New Delhi; c1994.