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Comparison of cost of planting in developed planter with respect to traditional methods

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Abstract
In order to fulfill the timeliness of farm operations and increase work output per unit time, there is need of machines. Agricultural machines increase the productivity of land and labor. Turmeric is an important spice crop cultivated in Maharashtra. India accounts for about 80% of world turmeric production and 60% of world exports. In general, planting mother rhizome gives better yield. Jayashree *et al.* 2014 reported that mother rhizome alone may not sufficient to cover a large area, hence, in addition to mothers; primary fingers are also used as seed due to high seed rate of 2000-2500 kg/ ha. The optimum spacing in furrows and ridges is 45- 60 cm between the rows and 25 to 30 cm between the plants. Turmeric planting is manually done by placing the seed rhizomes of 6-7 cm length with at least one or two sound buds in the ridges.

The cost analysis for use of bullock drawn turmeric planter were calculated. The cost of sowing with the bullock drawn planter was found to be Rs. 27.50/hr whereas with traditional methods by manually planting of turmeric by placing seed was found to be only Rs. 23.75/hr. The actual field capacity of the bullock drawn planter was 0.230 ha/hr and 0.055 ha/hr, respectively. Thus, the cost of sowing per hectare with bullock drawn planter was Rs. 119.5/ ha and Rs. 431.82 /ha, respectively. Therefore, it may be said that sowing with bullock drawn planter is 3.5 times economical than traditional method. In addition to economy, the timely completion of sowing operation as well as enhanced production is an unparallel advantage for the use of planter. Total cost required for the planting of turmeric by manual dibbling is 13000 Rs/day.

Total cost of operation of planter were observed with traditional methods 167.99 Rs/hr. Cost of operation of pair of bullocks were observed with traditional methods was 52.8 Rs/hr. and Total cost of operation of pair of bullocks 156.9 Rs/hr. Total operating cost required for cover 1 ha land by bullock drawn turmeric planter 2014.19 Rs/ha. Hence, we got the time required to cover time for 1 ha planting of turmeric planter of width 1.2 m & length of 1 ha land 83333.3 m. were 6.94 hr./ ha observed.

At present, it is observed that the farmers in the state had faced problems in turmeric planting due to lack of labour shortage. Turmeric rhizomes are planted by manually in the furrows by dibbling at a spacing of 30 x 30cm, and 15 x 15 cm. After dibbling the rhizomes are covered with the loose soil by the hand. Manual planting of turmeric is both labours intensive and costly, resulting in various problems for farmers. During manual planting, the labours have to dig the soil to sow turmeric. Therefore, the present study was undertaken to comparison of cost of planting with developed planter with respect to traditional methods. The rhizome planter was designed to suit various soil types and conditions to perform several functions simultaneously by opening the furrows, planting of rhizomes and covering of rhizomes by soil and forming ridges in single pass.

The developed implement is expected to improve the timeliness and efficiency of operation as well as reduce drudgery and cost of turmeric production. The availability of easy to use bullock drawn turmeric planter for farmers can alleviate these problems substantially, and can also help to maintain timely planting and reduce the farmers' drudgery. At present, it is observed that the farmers in the state had faced problems in turmeric planting due to lack of labour shortage. Therefore, it is essential to develop a rhizome planter for mechanizing planting of turmeric, with bullock for small and marginal farmers. The turmeric is planted in beds or ridges. Mechanizing planting operation results in uniform plant spacing, depth and aids further mechanization of intercultural operations that will reduce the total production cost and increase yield and productivity. The present study was hence, planned to evaluate bullock drawn turmeric planter.

Keywords: Turmeric planter, bullocks, hiring cost and wage of operator

Introduction
Turmeric (*Curcuma longa* L.) plant is a perennial herb belonging to the ginger family Zingiberaceae, has primary and secondary rhizomes of different forms, from spherical to slightly conical, hemispherical and cylindrical. The rhizome is deep bright yellow in colour.

Turmeric was derived from Latin word terra merita (merited earth). Turmeric is an important spice grown in India since ancient times. It is referred as Indian saffron and commonly called as Haldi. Turmeric is also called as yellow gold. India is the largest producer, consumer and exporter of turmeric in the world.

Turmeric rhizomes are planted in the furrows by dibbling at a spacing of 30 x 30cm, and 15 x 15 cm. After dibbling the rhizomes are covered with the loose soil from the ridge. The capacity of man is very low about 0.05 ha./man/day and payment for planting is 11.9 per cent of total cost of production. Because of the high costs of the traditional methods of turmeric planting, cultivation and harvesting which is very time consuming and labor intensive, its large scale production is not economical and is therefore very limited. The manual method of seed planting, results in low seed placement, serious back ache, need for huge labor source, high labor cost and drudgery in their work. This results in inadequate and non-uniform plant stand. This practice not only results in higher planting material cost but also lower the crop yield. The traditional system has the limitations of uneven depth of rhizomes placement, slow ground coverage and high labour requirement.

The developed implement is expected to improve the timeliness and efficiency of operation as well as reduce drudgery and cost of turmeric production. The availability of easy to use bullock drawn turmeric planter for farmers can alleviate these problems substantially, and can also help to maintain timely planting and reduce the farmers' drudgery. At present, it is observed that the farmers in the state had faced problems in turmeric planting due to lack of labour shortage. Therefore, it is essential to develop a rhizome planter for mechanizing planting of turmeric, with bullock for small and marginal farmers. Mechanizing planting operation results in uniform plant spacing, depth and aids further mechanization of intercultural operations that will reduce the total production cost and increase yield and productivity.

Traditional Planting methods of turmeric

Manually dibbling Methods

During manual planting, the labors have to dig the soil to sow turmeric. The farmers are left to the traditional methods by manually planting. This method is time consuming, labor intensive, associated with human drudgery and a high demand for human energy. The manual method of seed planting, results in low seed placement, serious back ache, need for huge labor source, high labor cost and drudgery in their work. This results in inadequate and non-uniform plant stand. This practice not only results in higher planting material cost but also lower the crop yield. Apart from this, conventional system requires skilled labor. Bombale 2020 stated that the traditional system has the limitations of uneven depth of rhizomes placement, slow ground coverage and high labor requirement. It was noted that "time is the essence of farming" and whatever help shorten the time required for planting will help overcome the effect of adverse weather. The recent climatic change which results in delayed early rain and short duration of annual rainfall affects the maturity of the turmeric rhizomes due to the long-time taken in manual planting of turmeric. With the above stated reasons, the development of a bullock drawn turmeric planter became necessary.

Materials and Methods

Fig 1: Turmeric planting with developed bullock drawn turmeric planter

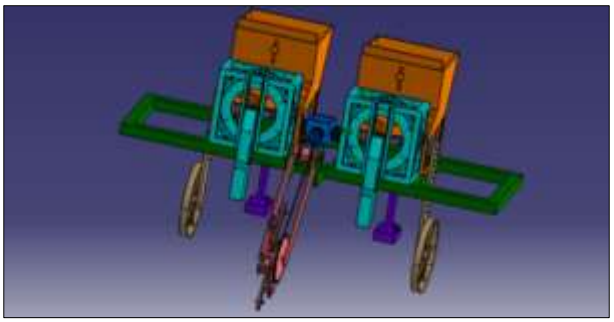

Fig 2: Design of Bullock drawn turmeric planter

Table 1: Specification of Bullock drawn turmeric planter

Sr. No	Particular	Specification
1	Overall dimension (l X wX h), cm	159 X49 X 90
2	Height of furrow opener, cm	36
3	Seed hopper, cm (l X wX h)	35 X 30 X 26
4	Row to row spacing, cm	60
5	Number of rows	2
6	Working width, cm	120
7	Ground wheel diameter, cm	46
8	Depth control wheel/ Transport wheel (side wheel) diameter, cm	100

An experiment on performance evaluation of UAE developed bullock drawn turmeric planter at the department of Farm Machinery and power Engineering and AICRP on UAE, College of Agricultural Engineering and Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the year 2021-22. The variables study of hiring charges of bullocks, wage of operator, working hours of planter, salvage value of machine, interest rate of farmer and life of planter. The required calculation of Cost of operation of developed bullock drawn turmeric planter, Fixed cost, Depreciation/hr., Interest rate/hr., Housing and Insurance© 4% of cost price, Total fixed cost, Variable Cost, Repair and maintenance @ 10% of cost price, Wages of operator @ 400/day for two labor of 8 hours, Total cost of operation of planter, Cost of operation of pair of bullocks, Cost of operation of pair of bullock, Fixed cost and Depreciation cost.

These variables were examined to study cost of hiring charges of bullocks, wage of operator, annual dung cost, labour charges and cost of traditional method of turmeric planting. The field experiment was carried out during the end of June 2022 seasons in order to evaluate the performance and evaluation of two row Turmeric planter in field

Comparison of cost of planting with developed turmeric planter with respect to tradition methods

Before conducting comparison of cost of planting in developed turmeric planter with respect to traditional methods. The hiring charges of bullocks, wage of operator, working hours of machine, variable cost, fixed cost and depreciation cost were carried out for obtaining the comparison of cost of planting in developed planter with respect to traditional methods.

Cost Economics of Bullock Drawn Turmeric Planter.

1. Cost of operation of developed bullock drawn turmeric planter

Price of planter, P = Rs.100,000
Life of planter, L = 10 year
Salvage value, S = 10%
Working hours per year,
H= 300
Interest rate for farmer,
I = 6%
Wages of operator = 400 Rs/day

A] Fixed cost

a) Depreciation/hr

$$= \frac{Price\ of\ planter - Salvage\ value}{\text{Life of Planterl x Working hr /year}}$$

b) Interest rate /hr.

$$= \frac{price\ of\ planter + Salvage\ value}{2} \times \frac{Life\ of\ planter}{\text{Working hours per year}}$$

c) Housing and Insurance© 4% of cost price

$$= \frac{P}{H} \times I$$

B] Variable Cost

a) Repair and maintenance @ 10% of cost price
b) Wages of operator @ 400/day for two labour of 8 hours

2) Cost of operation of pair of bullocks

Let, cost of pair of bullocks,
P = Rs. 90,000
Life of Bullock, L= 10 year
Working hours, H = 300

A] Fixed cost

a) Depreciation/hr
b) Interest rate@ 6%
c) medical expenditure @ 3%

B) Variable Cost

a) Feeding cost/day
Dry matter @ 2% body weight

i) 9 kg dry matter from 10 kg bhusa
Cost of bhusa/straw @ 1 Rs/kg = 10 Rs

ii) 1.5 kg feed grain for body maintenance
Dry matter from 1.5 kg feed grain (90%)

iii) Rest 7.65 kg dry matter from green fodder (25% dry matter)
b) Labor charges = 100 Rs/hr.
c] Annual dung cost
In one day, 20 kg dung/pair of bullock and cost of dung @ 0.15 Rs/kg
Total operating cost required for cover 1 ha land by bullock drawn turmeric planter

Cost of Traditional method of turmeric planting

By manually hand dibbling method.

Results and Discussions

Fig 3: Turmeric planting with Developed turmeric planter

Comparison of cost of planting in developed planter with respect to traditional Methods.

1. Cost of operation of developed bullock drawn turmeric planter.
2. Price of planter, P = Rs.100,000
3. Life of planter, L = 10-year Salvage value,
4. S = 10%
5. Working hours per year, H= 300
6. Interest rate for farmer, I = 6%
7. Wages of operator = 400 Rs/day

A] Fixed cost

a) Depreciation/hr.

$$= \frac{100000 - 10000}{10\ x\ 300}$$

= 3 Rs/hr.

b) Interest rate /hr.

$$= \frac{100000 + 10000}{2} X \frac{10}{300}$$

= 18.33 Rs/hr.

c) Housing and Insurance© 4% of cost price

$$= \frac{P}{H} X\ I$$

$= \frac{100000X\ 0.04}{300}$

= 13.33 Rs/hr.

Total fixed cost = a + b + c
= 3+18.33+13.33 Rs/hr.
=34.66 Rs/day

B] Variable Cost
a) Repair and maintenance @ 10% of cost price

$= \frac{100000X\ 0.10}{300}$

= 33.3

b) Wages of operator @ 400/day for two labour of 8 hours
= 800/8
=100.00 Rs/hr.
Total Variable Cost = a + b
= 133.33 Rs/hr.
Total cost of operation of planter
= Total Fixed cost + Total Variable cost
= 34.66 + 133.33
= 167.99 Rs/hr.

2) Cost of operation of pair of bullocks
Let, cost of pair of bullocks,
P = Rs.90,000
Life of Bullock, L= 10 year
Working hours, H = 300

A] Fixed cost
a) Depreciation/hr.

$= \frac{90000-9000}{10\ X}$

=27 Rs/hr.

b) Interest rate@ 6%

$= \frac{(90000+9000)X0.6}{2X300}$

= 99 Rs/hr.

c) Housing and Insurance @ 60/ month:

$= \frac{60\ X\ 12}{300}$

= 2.4 Rs/hr.

d) Insurance® 1.5%

$= \frac{90000X0.015}{300}$

= 4.5Rs/hr.

e) medical expenditure @ 3%

$= \frac{90000X\ 0.03}{300}$

= 9 Rs/hr.

Total fixed cost = a + b + c + d + e
= 52.8 Rs/hr.

B) Variable Cost
a) Feeding cost/day
Dry matter @ 2% body weight

$= 900\ x\ \frac{2}{100}$

= 18 kg

i) 9 kg dry matter from 10 kg bhusa
Cost of bhusa/straw @ 1 Rs/kg = 10 Rs

ii) 1.5 kg feed grain for body maintenance
Dry matter from 1.5 kg feed grain (90%)
= 1.5 x 0.9 = 1.3 kg
1.5 kg feed grain @ 0.5 Rs/kg = 7.5 Rs

iii) Rest 7.65 kg dry matter from green fodder (25% dry matter)
Quantity of green fodder =7.65 x = 30.6 kg
30.6 kg green fodder @ 0.5 Rs/kg = 15.3 Rs
Total feeding cost = 10 + 7.5+15.3
= 32.8
=32.8/8
= 4.1 Rs/hr.

b) Labor charges = 100 Rs/hr.
Total Variable cost = a + b
= 104.1 Rs/hr.

c] Annual dung cost
In one day, 20 kg dung/pair of bullock and cost of dung @ 0.15 Rs/kg
= 20 x 0.15 x 300= 900 Rs /300 hr.= 3 Rs/hr.
Total cost of operation of pair of bullock = (A + B) - C
= (52.8+104.1) Rs/hr.
= 156.9 Rs/hr.
Therefore, the total cost of operation of developed Bullock drawn turmeric planter,
= (Cost of operation of planter) + (Cost of operation of pair of bullocks)
= 156.9 + 133.33
= 290.23 Rs/hr.

We know that speed of bullock operated turmeric planter is 1.2 km/hr. (1.2 km/hr. = 1200 m)
Hence, we got the time required to cover time for 1 ha planting of turmeric planter of width 1.2 m & length of 1 ha land 83333.3 m.

$= \frac{83333}{1200}$

= 6.94 hr. / ha

This is time required for 1 ha land by turmeric planter.
Total operating cost required for cover 1 ha land by bullock drawn turmeric planter

= 6.94 X 290.23
= 2014.19 Rs/ha.

Cost of Traditional method of turmeric planting

By manually dibbling method.
Assume, 65 labor required for the planting of turmeric in one hectare land.
Labor charges is per day = 200 Rs/day.
Ridge planting by bullock drawn Total cost required for the planting of turmeric by manual dibbling
= 65 X 200
=13000 Rs/day.
Turmeric planter and manual planting by hand dibbling were compared in terms of effective field capacity, labour requirement, seed rate, yield and cost of operation. The data obtained is presented in Table.

Comparison of cost of planting in developed planter with respect to traditional planter

Table 1: Comparison of cost of planting in developed planter with respect to traditional planter

Particular	Method of planting		Remarks
	Bullock drawn turmeric planter	Manual by hand dibbling	
EFC, (ha/h)	0.29	0.0019	
Labour Required (Man-h/ha	2	65	
Cost / hour, (Rs)	221.29	50	
Cost / ha, (Rs	1882	13000	85.53 (% saving)
Seed Rate, kg/ha	1882.210	2470	20 (% saving)

The test result shows that the planter has effective field capacity of 0.29 ha/h with field efficiency having 85.53%. Whereas the overall miss index was found to be 7.2% and multiple indexes is 9.2%. It was also recorded that the machine required 6.94 hours to complete 1 hectare of land. Table 4.13 shows the comparison of cost of operation between planter and hand dibbling of turmeric fingers. The results indicated that turmeric finger planter requires only Rs.1882 per ha for planting of turmeric whereas, manually by hand dibbling requires Rs. 13000. The machine cost was taken including the hiring cost of bullocks. The annual use of the machine was taken only 300 h per year.
Therefore, the cost of planting of turmeric with bullock drawn turmeric planter were observed cost effective, seed rate saving, time saving and labour saving than traditional methods of planting.

Conclusions

1. The farmers face a lot of labour and management problems in turmeric cultivation. It requires about 200-250-man hours per hectare for planting operation.
2. Therefore, the present study was undertaken to comparison of cost of planting in developed planter with respect to traditional planter.
3. The developed bullock drawn turmeric planter is cost effective and time effective than traditional planting methods.
4. The rhizome planter was developed based on the agronomic planting considerations, engineering and physical properties of rhizomes.
5. The developed rhizome planter was observed with different planting methods and traditional methods were used to evaluate functional performance rhizome planter.
6. Total cost required for the planting of turmeric by manual dibbling is 13000 Rs/day.
7. Total cost of operation of planter were observed with traditional methods 167.99 Rs/hr.
8. Cost of operation of pair of bullocks were observed with traditional methods was 52.8 Rs/hr. and Total cost of operation of pair of bullocks 156.9 Rs/hr.
9. Total operating cost required for cover 1 ha land by bullock drawn turmeric planter 2014.19 Rs/ha.
10. Hence, we got the time required to cover time for 1 ha planting of turmeric planter of width 1.2 m & length of 1 ha land 83333.3 m. were 6.94 hr./ ha observed.
11. Total cost required for the planting of turmeric by manual dibbling was observed 13000 Rs/day.

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