Turmeric Harvester for traditional and mechanized way of cultivation

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Abstract: In the agricultural environment, Turmeric cultivation is one of the major activities. A turmeric can grow up to 1 year to a maximum extent and then it must be cultivated. In our areas majority traditional way of farmers are cultivating the turmeric. They are facing the major drawback of unavailability of machines to cultivate the crop for traditional cultivation. There are number of machines available for the large-scale cultivation. In order to eliminate the difficulties faced by those cultivators, we decided to design the small-scale turmeric harvester for the crop with low cost and this will help the cultivators to cultivate with less labor charge and reach the industries on time.

Index Terms: Turmeric, Traditional, Cultivation, Better Techniques, Harvester, Worm Gear, Chain Drive, Digger, Conveyor, TMT Rod, Shaft, Storage Unit.

1 INTRODUCTION
India is one of the major agricultural countries in the world. As India’s population is growing the demand for food will definitely increase for that better techniques of farming are required to increase production. In India agriculture is facing serious challenges like scarcity of agricultural labour, not only in peak working seasons but also in normal time. This is mainly for increased non-farm job opportunities having higher wage, migration of labour force to cities and low status of agricultural labourin the society. In order to eliminate the difficulties faced by those cultivators, we decided to design the mini turmeric harvester for the turmeric crop with low cost and this will help the cultivators to cultivate with less labourcharge and reach the industries on time.

2 EXPERIMENTAL PART

PREPARATION OF COMPONENT
FRAME-The frame consists of a number of mild steel rods. WORM GEAR-The 40:1 gear ratio was used in the project DIGGER-Ploughing the turmeric cultivation land CONVEYOR-Transfer the turmeric from digger to storage unit with separation of the sand and stones.

UNIVERSAL COUPLING-Transfer the power from the tractor to harvester.

EXPERIMENTAL SETUP
After the machine was fabricated according to the model, the process gets started. In first step the machine was placed on harvesting ground with digger ploughing the ground. The tractor began to move then rotating power transmits to the harvester through the universal coupling and gearbox was provided to attain the required speed. The attached belt drive to the gear box begins to rotate, thus rotating the conveyor system. When digger began to plough, turmeric along with the sand particles arise and flow through the conveyor system. The conveyor system was moved the harvest upwards and removes the major sand particles and the harvest was dropped in the collecting basket. Then the turmeric was collected in storage bin and stored then send to the market.

3 CURRENT DEMAND
1. To fabricate an efficient machine particularly for small scale and traditional turmeric harvesting to help the farmers and To reduce the manual strain on the workers.
2. To set up a machine that is profitable and have straight forward instrument for ploughing the turmeric at a quite rate.
3. To help the traditional farmers to bring their turmeric gatherers are accessible in huge sizes and that is crops to market on time during this season.
4. To deliver an affordable machine for
traditional way of cultivation of farmers.

4 METHOD OF CULTIVATION
In mechanized method usually harvesting is done by large harvester machine which averages takes about 6-7 hours per acre with yield of 8-10 tons per acre. The cost of harvest sums around 20,000-25,000 per acre.

5 EVALUATION
In this section, we describe the methodology for evaluating computational software and testing on the field. To totally give a plan of the machine, were joined to have an appropriate structure technique Plan Conceptualization: In view of necessities of the farmers and the market study led. Various emphases of the structure of machine were readied.

Estimation and framework approval: arranging stage is basic stage as quality, exhaustion, factor of security, each and every particular point was taken while doing the calculations and arrangement

\begin{align*}
\text{Torque} &= \left(\text{HP} \times 5252\right) / \text{RPM} \\
\text{M.Ft} &= \text{HP} \times 75 / v
\end{align*}

Model making and testing: In the wake of completing the computations, a three-dimensional get together was made for all intents and purposes on the product inside the real conditions which gave a point of view of this present reality and its quality that permits doing testing of any kind possible

\begin{align*}
F_s &= \text{ayb/pd} \\
F_d &= \left(6 + \text{vng/6}\right) \text{Ft}
\end{align*}

For check the condition stratification, \( F_s \geq F_d \).

Testing: In the wake of amassing the model, testing was done to check the attainability of the model.

6 RESULT AND DISCUSSION
Turmeric plant are the main sources of turmeric in the world. Out of total turmeric produced in the world 60 per cent is obtained only from turmeric. Asia is the largest producer of turmeric followed by Europe. Production India is the largest producer, consumer and exporter of turmeric in the world. The motivation behind building up this paper was to create machine to decrease cost and time and labour required for turmeric collecting. By utilizing this harvesting machine and advance procedures we can increase the production in least cost and time. We can likewise take care of the issue of work deficiency. It will be very useful for traditional way of turmeric farmers. It also has future scopes for harvest onion and ginger.

7 DESIGNCALCULATIONS

A. POWER REQUIRED TO RUN THE HARVESTER:

\begin{align*}
\text{Power required to run the harvester} &= 2\pi \times \text{NT/60000} \\
&= \left(2\pi \times 3000 \times 39/60000\right) = 12KW \\
\text{Torque} &= \left(\text{HP} \times 5252\right) / \text{RPM} \\
&= \left(22 \times 5252\right) / 3000 = 39Nm \\
\text{Torque required by harvester} &= \left(9550 \times \text{Power}\right) / \text{RPM} \\
&= \left(9550 \times 12\right) / 1666 = 38Nm < 39Nm
\end{align*}

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B. DESIGN OF SHAFT:

\begin{align*}
\text{Design of Shaft} &= N_2 = N_1 / \text{rpm} \\
&= \pi \times m \times \text{rpm} / \text{rpm} \\
&= \pi \times m \times 40 / 60000 = 0.157mx
\end{align*}

C. DESIGN OF SPURGEAR:

\begin{align*}
\text{Design of Spur Gear} &= F_t = \text{HP} / 75 \\
&= 22 \times 75 / 0.157mx \\
&= 19266.5 / mx
\end{align*}

STRENGTH OF GEAR:

\begin{align*}
F_s &= \text{ayb/pd} \\
\text{FROM DESIGN DATA BOOK,} \\
\text{y} &= 0.392, \text{a} = 400kgf/c \\
m_2, \text{d} &= 0.75d, \text{d} = \text{q}^* \text{mx} \\
\text{b} &= 0.75 \times \text{mx} \\
\text{F_s} &= \text{400}*0.392*0.7511*mx^2 = 12 \\
93.6mx^2
\end{align*}

\begin{align*}
\text{For checking, F_s} &= F_t, 1293.6mx^2 = 1 \\
9266.5 / mx & mx = 3
\end{align*}

FACE WIDTH:

\begin{align*}
b &= 0.7511*mx = 0.7 \\
5^*11 * 3 &= 24.75mx
\end{align*}

PITCH RATE VELOCITY:

\begin{align*}
\text{v} &= 0.157mx / 0.471m/s = 28.26 \\
\text{m/min.} \\
\text{RECALCULATION OF TANGENTAL LOAD} \\
\text{ENTHICALLEND:} \\
\text{F_d} &= \left(6 + \text{vng/6}\right) \text{Ft} \\
&= 19266.5 / mx \\
&= 6422.16kgf
\end{align*}
RECALCULATION OF DYNAMIC LOAD:
FS = 1293.6m\times 2
= 7761.6kgf
FS > Fd.
Hence the design is safe.

DESIGN OF CHAIN:

Design Power = Rated Power \times Service Factor
= 16 \times 1.25 \times 1 \times 1.5 \times 1.25
= 38.46kW

Power Transmission
V = PZ_{1}N_{1}/60000
= 31.75m/s
N = Qv/102hks
16 = Q \times 31.75/102 \times 18 \times 2.343
Q = 2167.81kgf

From database
P = 15.875, D = 7.75mm, pb = 2220kgf
pb > Q,
Hence the design is safe.

Length of continuous chain
z_{1}= 14 teeth, z_{2}= 28 teeth
L_p = \frac{2A_p + z_{1} + z_{2}}{2 + (z_{1} + z_{2})/2}\pi a_{0}/p = 400/15.875
= 25.196mm. \quad l_p = 2(25.196) + 42/2 + 0.1972
= 71.58mm

Length Of Chain
l = l_p \times p
= 71.58 \times 15.875
= 1136.33mm

DIAMETER OF PINION:
D = P/sin(180/z_2)
= 15.875/sin(180/28)
= 141.7mm

DIAMETER OF WHEEL:
D = P/sin(180/z_1)
= 15.875/sin(180/14)
= 71.34mm

8 VIRTUAL MODEL
The conceptual model of the mini turmeric harvester is provided in Figure 1. The main components of the machine are frame, shaft, spur gear, chain drive, digger, conveyor, shaft, storage unit.

Figure 1: Virtual Model

9. ANALYSIS

10 WORKING MODEL

Figure 2: Working Model
9 CONCLUSIONS

been fabricated. Various components like conveyor, digger, frame, chain drive has been designed. This harvester is compact and able to harvest through the small cultivation area and wetland. Its compact design with the total width of 2 feet and length can easily move through the harvest area with a 22 hp tractor. The work load is greatly reduced and 6 hours per acre and the cost of labour is also very low compared to the large harvester. Collector bin can collect up to 40 kg and further modifications can be done to increase the capacity.

10 REFERENCE

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