Design, Fabrication and Testing of Banana Fibre Extraction Machine

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1. Introduction

- *Fibre:* filament obtained from a plant / animal tissues.
- Banana is cultivated in 68 out of 77 districts in Nepal.
- The plant is cut down to rot after its fruits, the remaining of plants is a waste.
- Banana trunk can be subjected to extract the fibre using portable machine, reducing the human manpower.
- Fibre has multiple applications in textile and carpet industries.
- There is no production of banana fibre extraction machines in Nepal.
- Imported machine has high cost due to taxation and transportation, thus, not affordable for middle class farmer.
- Also the existing machines are either single stage requiring lots of human effort and same input (banana bark) has to be fed twice or are made for the industrial purpose.

2. Objectives

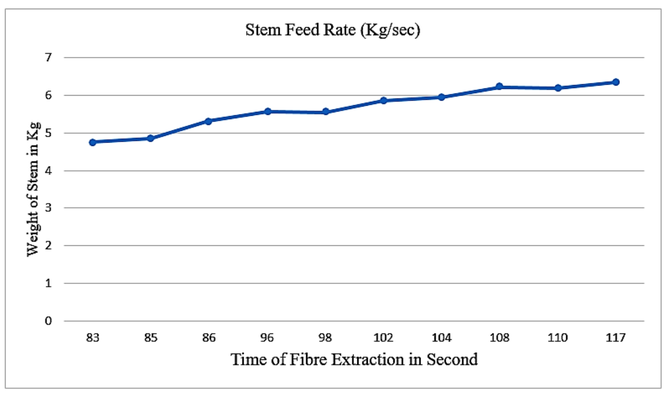
Main Objective : To perform a detailed design analysis, fabrication and testing of banana fibre extraction machine.

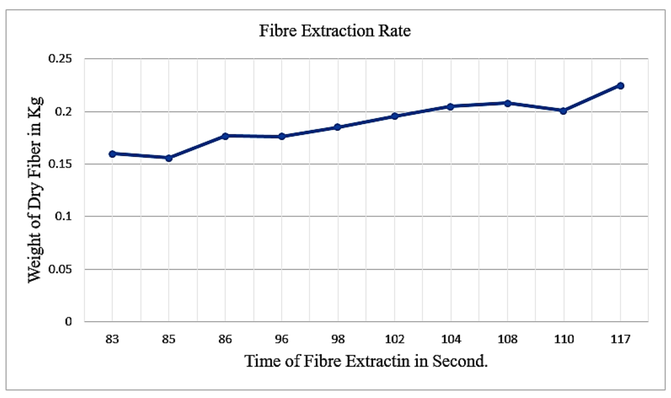
Specific Objectives :
- To analyse different possible designs and to build an easy operational banana fibre extracting machine.
- To perform economical analysis of the machine.

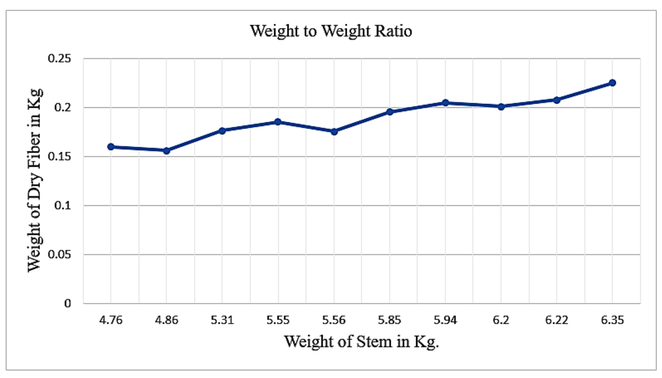
3. Methodology

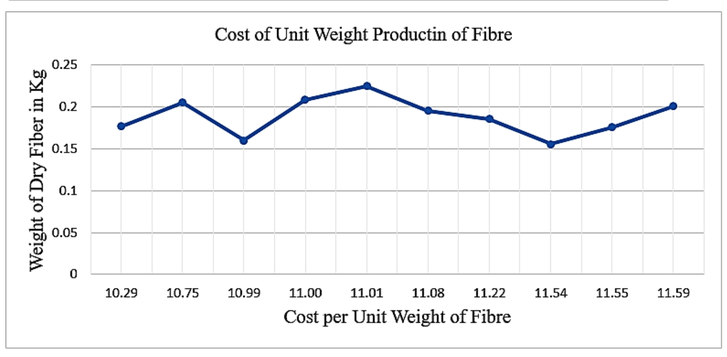
a. Desk Study
b. Expert Consultation
c. Field Visit
d. Market Research
e. Model Study
f. Result Analysis
g. Design Modifications
h. CAD Design
i. Prototype Fabrication
j. Prototype Testing
k. Result Verification

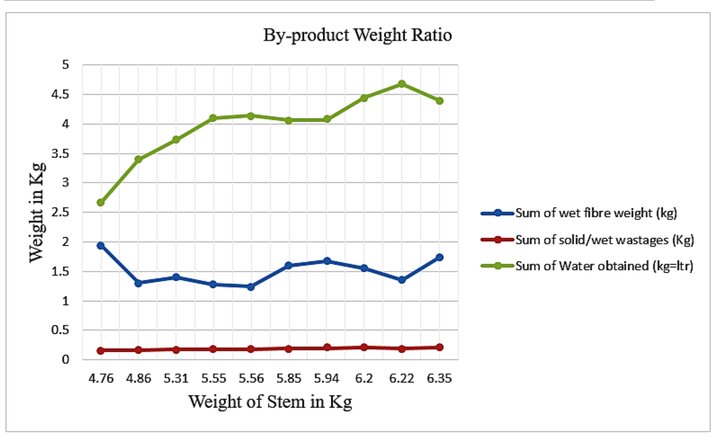
4. Results and Discussions











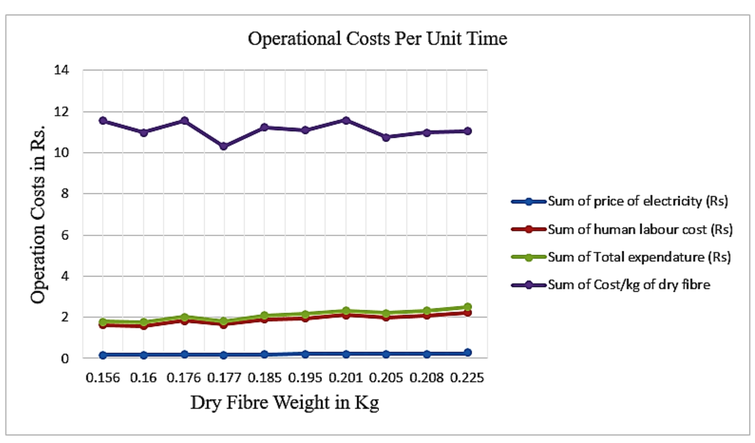


Fig 1: Results of various testing parameters

SN	Parameters	Average performance results		Remarks
		Our machine	Other machines	
1.	Sheath or Bark extraction (feed rate)	1648 Kg/day		
2.	Fibre production rate	54 Kg/day	30 Kg/day	180 % more efficient in
3.	Fibre production per unit stem weight	0.033 Kg/Kg		production rate.
4.	Operating cost per unit weight of fibre	11.07 Rs./Kg		

Fig 2: Extraction of fibre and extracted fibre

4.1 Features of Prototype Machine

- The machine has total dimension of 500 x 500 x 965 mm
- Total weight of 100kg.
- Feed guide is used at the entrance of the machine.
- The banana bark is passed through single stage of rollers followed by decorticator.
- A curled surface guide is used along the periphery of decorticator for high efficiency.
- There is a passage for the removal of water content after compression.
- The machine operator can comfortably feed the bark sitting on a normally available chair.
- The efficiency of the machine is high when bark with approximately 1m length is fed.

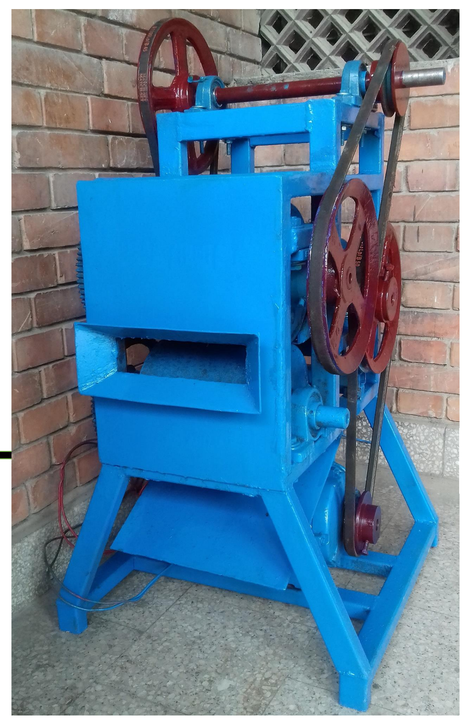


Fig 3: Fabricated Machine

5. Conclusion

- The project involved design, fabrication and testing of banana fibre extraction machine. The machine has a single stage roller set and the use of decorticator for the decortication of banana bark.
- The machine includes the major parts as frame, motor drive, decorticator and roller sets. Power transmission occurs through pulley belt mechanism up to upper roller and through gear drive between rollers. Water is removed in roller stage and residue is removed by continuous peeling and ultimately the fibre comes out of machine.
- The machine is more suitable for feeding at lower height so that the labour work is reduced.
- The suitable feed rate is approximately one bark in every 10 second. Here the one bark means the dimension not exceeding unit length, thickness less than 15 mm and width of 150 mm. The roller gap is not suitable for the bark exceeding this dimension.
- The noise generated in extraction process is very less, that is not disturbing.
- The machine has negligible vibration and requires frequent cleaning in every 1-2 hour.
- Once the bark is rolled or decorticated, it can't be subjected for second chance because doing so flexibility increases and there is a high chance of getting stuck in the middle.
- **Economic part of the project**

  1. Rate of Return = 184%
  2. Cost-Benifit Ratio = 1.18
  3. Comparison of Manual and Machine Extraction Annually:
     With Machine = Rs.16,50,000 Manually = Rs.15,000
  4. Total machine required for utilization of all banana pseudo-stem in Nepal = 120
  5. 480 People will get job opportunities on regular basis

Recommendations:

- Use of adjustable roller gap mechanism (spring/nut-bolt tightening) for variable thickness of bark.
- Reduction of roller speed for effective feed rate at decorticator

6. Acknowledgement

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