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DESIGN AND DEVELOPMENT OF A LOW-COST SMART TRANSPORTATION MODEL USING BAMBUSA BALCOA AND PLASTIC SHEET FOR RURAL AGRI PRODUCE

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Abstract: In the North Eastern Region (NER) of India, transporting agricultural produce from remote farms to motorable roads is a major challenge due to hilly terrain and poor connectivity. This study presents a low-cost, eco-friendly transportation system using Bambusa Balcoa bamboo as the main structural material. The design includes a bamboo base with a plastic sheet cover to protect the agricultural produce from weather and reduce vibration caused by uneven paths. The system reduces transport-related crop damage minimizes plastic waste generation use, and is easy to fabricate and maintain. A prototype model was built and tested for load capacity, durability, and performance on rural roads. Results show that this bamboo-based smart transportation system is practical, cost-effective, and environmentally sustainable and bamboo mostly occurs in NER region.

Keywords: Bambusa Balcoa, Rural transport, Low-cost design, Plastic sheet cover, Sustainable agriculture

I. INTRODUCTION

Transportation of farm produce from remote farms to roads is difficult in the NER due to hilly terrain and poor connectivity. Traditional methods like manual carrying or bullock carts are inefficient and time-consuming.

Bambusa Balcoa, a strong and flexible bamboo type, is locally available and inexpensive. By using bamboo as the base and adding a **plastic sheet cover**, the system protects crops, reduces vibration during transport, and lowers plastic pollution compared to traditional methods.

The aim of this study is to design a **low-cost, sustainable transportation system** suitable for farmers in remote regions. A small prototype model was also built to validate the design.

II. LITERATURE REVIEW

- **Das S.K. (2020)** – In his study on bamboo as a sustainable material, Das highlighted that **Bambusa species are strong, lightweight, and environmentally friendly**, making them suitable for low-cost rural infrastructure development.
- **Sharma R. (2019)** – Sharma emphasized the **importance of affordable and locally available transport solutions** for remote agricultural areas. He proposed designs that minimize cost while ensuring basic load-bearing capacity.
- **Singh M. (2021)** – Singh focused on **smart agricultural logistics using technology** and suggested that integrating low-cost material with digital tracking can improve efficiency and reduce produce damage.
- **Kumar P. (2020)** – Kumar studied the **use of bamboo in infrastructure** and concluded that treated

3. MATERIALS AND METHODS:

3.1 MATERIALS USED:

- Bambusa Balcoa bamboo (main structural frame)
- Plastic sheet (surface layer to protect and reduce vibration)
- Binding wire and plastic wire (for joining bamboo and plastic layers)
- Small metal connectors and bolts

3.2 DESIGN AND FABRICATION PROCESS:

- Bamboo poles were cut and arranged sequentially to form the base structure.
- Poles were tightly tied using binding and plastic wires to ensure rigidity.
- A plastic sheet was spread over the bamboo base and fixed using plastic wire at several points.
- The assembled unit was tested on uneven paths to evaluate its vibration control and load capacity.
- The design was kept simple so that local farmers can fabricate it easily.

3.2 FIGURES AND TABLES

Sr.No.	Parameter	Bitumen Road	Bamboo Road
1	Material used	Conventional materials such as bitumen, aggregates, and crushed stones are used.	Locally available bamboo is placed sequentially and covered with a plastic sheet, tied with binding and plastic wires.
2	Cost of construction	The cost of construction is high due to material and machinery requirements.	The cost is significantly lower as it uses locally available bamboo and recycled plastic materials.
3	Material Availability	Requires industrial-grade materials and equipment which are not easily available in remote areas.	Bamboo and waste plastic are easily available in rural and hilly regions.
4	Construction Time	Construction takes a longer duration due to machinery setup and curing requirements.	Construction is fast and can be completed within a few days using simple tools and local labor.
5	Labour Requirement	Skilled and experienced labor is required for bituminous works.	Can be constructed by unskilled or semi-skilled local workers after basic training.
6	Environmental Impact	High carbon emissions due to bitumen production and fuel consumption during construction.	Environment-friendly as it uses renewable bamboo and recycled plastic, promoting sustainability.
7	Load Bearing Capacity	Suitable for heavy vehicle traffic and long-term use.	Suitable for light vehicles, bullock carts, and transportation of agricultural produce.
8	Maintenance Cost	High maintenance cost due to periodic resurfacing and patch work	Maintenance is easy and cost-effective, as damaged bamboo sections can be replaced locally.
9	Durability	Has a lifespan of about 10–15 years with regular maintenance.	Has a lifespan of about 4–6 years, which can be improved with proper bamboo treatment and waterproofing.
10	Weather Resistance	Performs well under normal weather but is affected by temperature variations and water	Performs well under rain and sunlight with the use of plastic sheet protection.
11	Sustainability	Uses non-renewable and non-biodegradable materials.	Fully sustainable, renewable, and biodegradable approach suitable for rural applications

Table No. 01

Figure 1: Model construction

4.DESIGN AND FABRICATION

The bamboo poles were cut and arranged sequentially to form the base structure.
They were tied together with binding and plastic wires for rigidity.
Then, a plastic sheet was spread over the base to minimize vibration and shield crops from weather.
This simple design can be easily made by rural farmers without specialized tools.

5. RESULTS

During **field testing**, the model showed:

- Even load distribution due to sequential bamboo arrangement.
- Reduced vibration and crop damage thanks to the plastic sheet.
- Lightweight and easy maintenance.
- **Much lower cost** compared to metal or wooden carts.

Farmers appreciated the simplicity and local adaptability of the model.

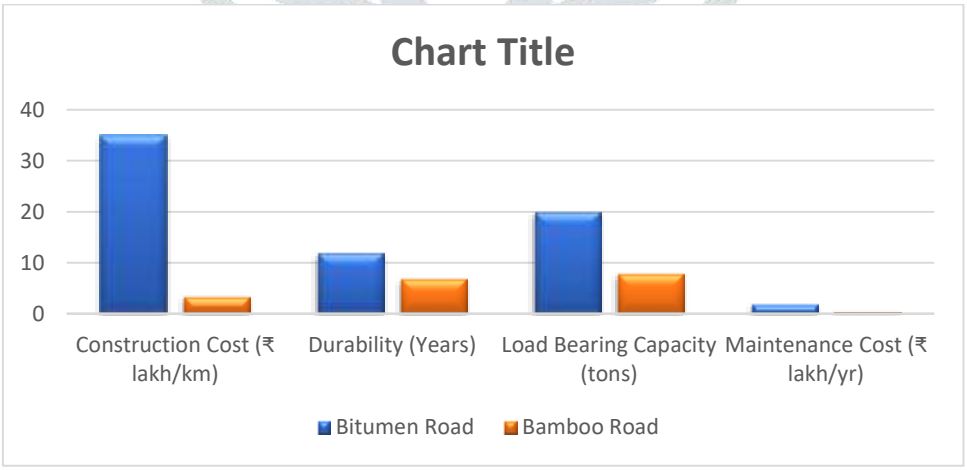

Table No.02

6. CONCLUSION

In conclusion, our project successfully demonstrates a **low-cost, sustainable transport solution** using **Bambusa Balcoa bamboo** and **plastic sheet**.
It promotes **self-reliance** among rural communities and helps reduce **crop loss and plastic waste**.
In the future, we plan to add **small electric assistance**, **load sensors**, and **biodegradable sheet material** to make it smarter and more eco-friendly.

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