https://doi.org/10.31705/BPRM.v4(1).2024.5 Picture Article

A VALUE ADDED SUSTAINABLE PRODUCTION OPPORTUNITY OUT OF RICE STRAW TO ECONOMICALLY UPLIFT RICE FARMING COMMUNITIES

(RICE STRAW BASED MATERIAL INNOVATION INTO PRODUCT DESIGN)

"SUSTAINABLE PRODUCTION OUT OF GENERATING RICE STRAW"

In the Sri Lankan Agriculture Sector, rural rice cultivation farmers have found the best way of eliminating the highly generating rice straw by direct open field burning due to the high cost of straw collection and management, transportation cost, storage difficulties, shortage of rural labor, cost factors of organic fertilizer making, and lack of adequate methods and technology. These practices have created a number of environmental and social impacts. Increase of heat generation, emission of greenhouse gasses, causes damage to micro organisms in the upper soil layer and reduces microbial activities, soil deterioration, damages the air quality and negatively impacts on human health. This experimental project comprised two phases, material development phase and product design phase. The concept was, management through value addition. The project approach was to come up with an effective and creative management solution for the highly- generating rice straw and minimize the current practices by introducing a method to reutilize while coming up with a value addition for the rural rice farming community. The main aim of this project was to improve rural farmers' livelihoods by fostering sustainable rice straw management into a sustainable paradigm. This experimental project focused on rice straw conversion into value-added material development which able to create a sustainable product solution for the market while creating a production opportunity for the rural community as a secondary income source. The final goal of the project was to economically uplift the rural farming lives by providing an additional income mainly for the non-cultivation period.

The project mainly considered rice straw generation and management difficulties and sustainability focused impacts within the rural farming communities. As a product designer while empathizing and analyzing rural farming lives the lack of secondary income was identified. The entire project was focused on providing a sustainable product solution for the market by introducing a method to sustainable rice straw management within the community while creating a value added opportunity for rural farming lives.

PHASE 1- Material Experimentation

Figure 1: Composite material processing

The first phase of the project was the material development stage. Initially started with identifying the raw material qualities with simple domestic testing and conducted parallel studies of the existing literature related to the project while developing the material pieces.

Second stage of the material development was started with developing composite material pieces by mixing up with rice straw with additive samples which are available within the community considering the easy accessibility and less cost factor.

As the first step of the composite material development process the rice straw and other additive samples were collected and measured considering the required material quantity ratios. Then conducted the pre-treatment processes which required for the raw materials to improve the durability and to remove microbial activities. After the pre-treatment process successfully done can make the required pulp mixture by blending the pre-treated materials. After the pulp mixture manual molding is done, can stay for the drying period.

Composite material sample pieces were developed changing the additive composition and by changing the physical properties of additives and rice straw by changing its particle sizes. This mainly used to make strong bonds between rice straw particles and additive particles to achieve strength composite material sample outcome. Each and every composite sample piece has its own qualities and unique strength levels.

Figure 2: Dried out composite sample pieces

PHASE 2- Material Testing

As the second stage of the material development process, developed composite material samples have tested with LAB testing and domestic testing to check the material gained qualities and to identify the material applicability's for a product manufacturing outcome.

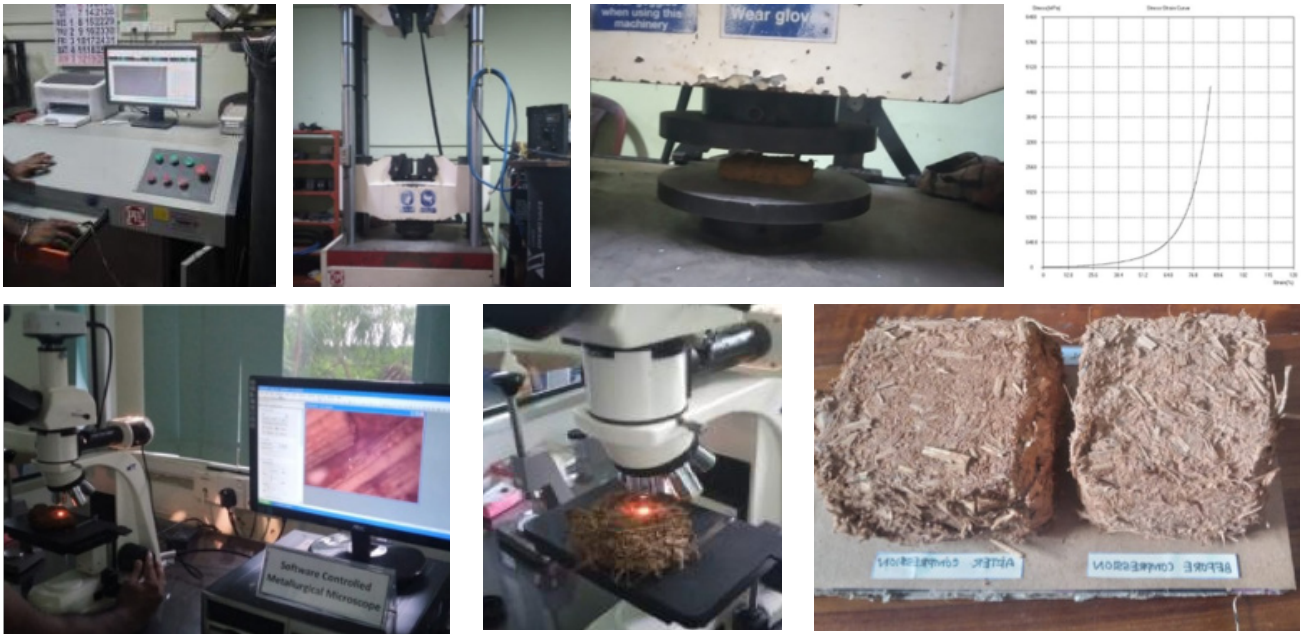

Figure 3: Conducted composite material LAB testing process

With the material development process was able to identify the composite sample strength levels and the compression amounts. This testing process mainly focused on identifying the material applicability's and to identify the durability factors for a production outcome.

Based on the LAB testing results rice straw with clay and brick powder additives based composite sample piece has chosen for the further developments.

PHASE 3- User Segmentation Analysis

As a designer perspective then started identifying the feasible product opportunities out of the developed composite material piece considering the market demand, context availability considering the cost factor, available techniques and technologies and the feasible manufacturing scale within the community and also mainly based on the gained composite material qualities for a production outcome.

Finally design outcome was a Biophilic modular unit for a, sustainable strategies following up cooperate sector compact space office companies in suburban area. The user segmentation was selected based on the site visits and considering the requirement of the workers.

The Biophilic design focused on improving the productivity within the work place while improving the air quality.

PHASE 4- Mold Making and Manufacturing

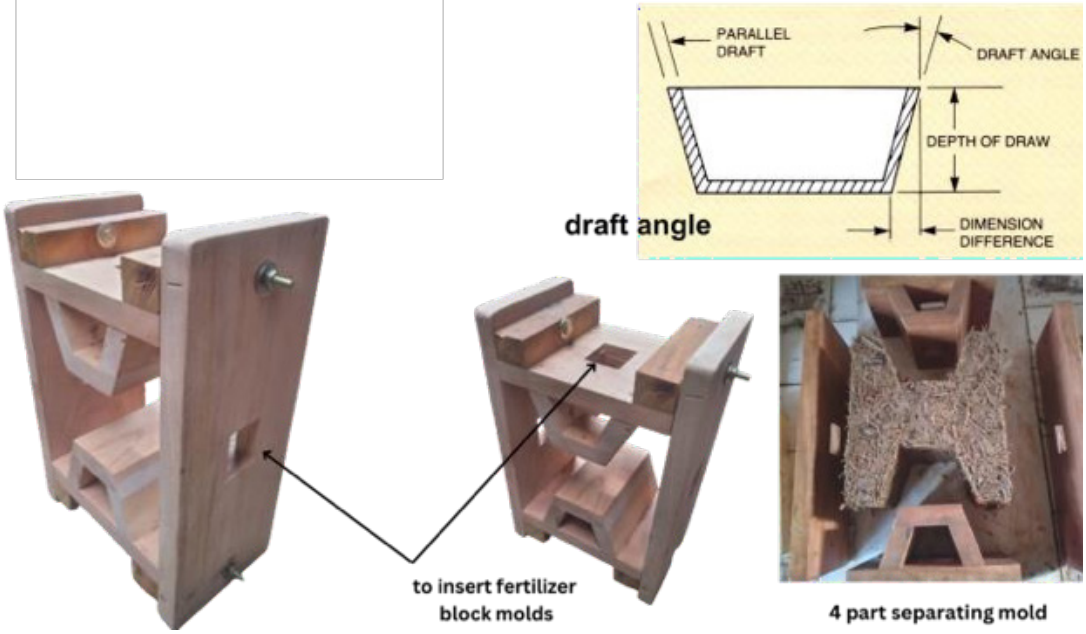

Figure 4: Mold making for the batch production of the modular unit

While designing the product mold mainly considered on the drat angle of the mold and the easy releasing methods. Mold comprised with four side separable units which helps to release the product without making damages to the undried edges. Also mainly have introduced manual molding technique for the manufacturing due to the available technologies and the considering the community awareness.

Figure 5: Manufacturing process with manual molding technique

The mold is released once the molding has completed properly and stay for the drying process. After that the modular unit is packed and sending to the customers through available distribution channels within the community.

Figure 6: Modular unit installation

Within the provided plantation grow interior plants which are mentioned in the instruction guides.

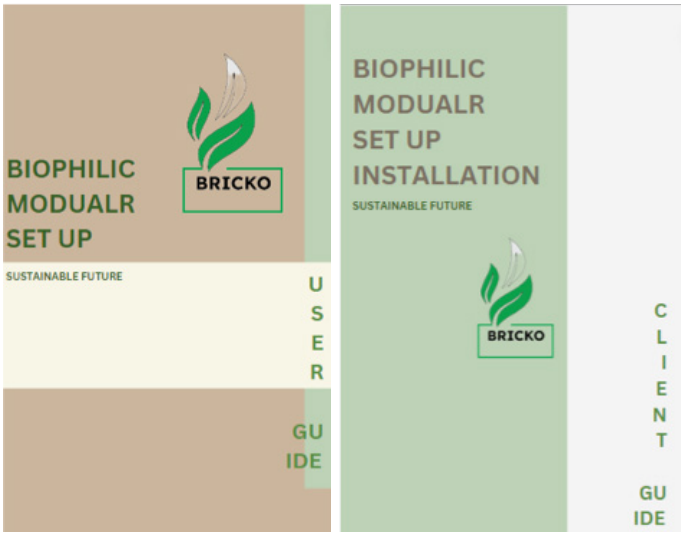

Figure 7: Customer instruction provided leaflet for the modular unit installation

Figure 8: Biophilic modular units with customizable planting spaces

The modular unit has designed considering the planting space while providing a different user experience.

By placing these modular unit the customer can make the unit according to the required form and the height based on the provided customer guideline instructions through following up leaflet instructions.

Figure 9: The Biophilic set up into interior space

While designing the modular unit has provided separate areas for plat growing. Based on the available space and the required height the modular unit can be installed following up the installation guidelines.

Figure 10: The Biophilic modular set up installation within interior space with 3D illustrations

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