Research Article

Chili Haven: EcoGreen Miniature Greenhouse

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Abstract: *Chilli peppers are an essential crop for producers and a dependable source of income. They can be cultivated in a variety of climates and require little care, making them an attractive crop for small-scale producers. This study is conducted in Kg Bambangan, Tuaran, Sabah, a village located within the buffer zone of Crocker Range Biosphere Reserve (CRBR) with precipitous terrain and infertile soils. As the cultivation took place on hilly terrain and was susceptible to insect infestation, a miniature greenhouse dubbed 'Chili Haven' was created as a test for chilli cultivations. This innovation intended to provide rural and urban households with a sustainable source of fresh produce. This objective is in line with Sustainable Development Goal 2 (SDG 2), which seeks to eliminate hunger, achieve food security, and promote sustainable agriculture. The miniature conservatory was designed ingeniously to provide the optimal growing environment for chilli peppers. It is ideal for small spaces, apartments, and balconies due to its diminutive size and lightweight design. Overall, planting chilli seeds in the field can be difficult, but innovative solutions such as miniature greenhouses can help surmount these obstacles and provide a more controlled and productive growing environment.*

Keywords: Miniature greenhouse; Chilli peppers; SDG 2

1. INTRODUCTION

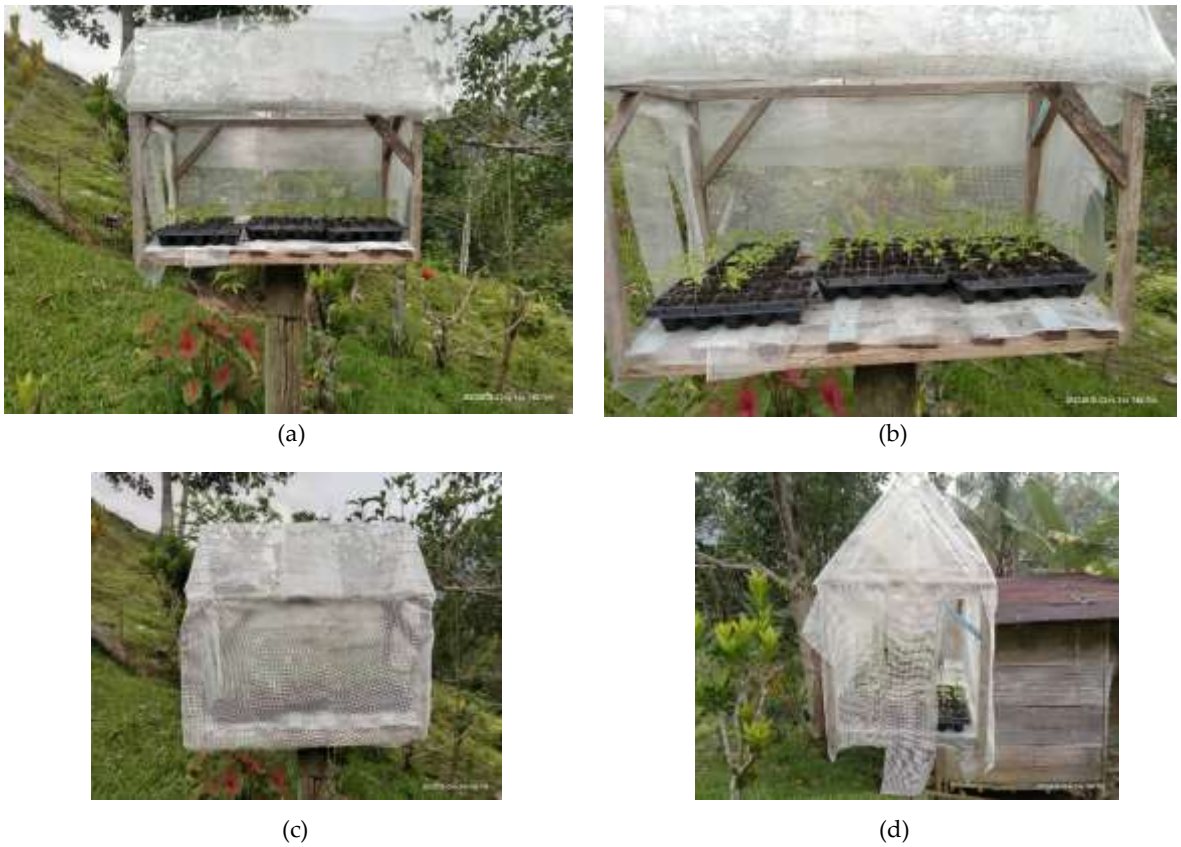
Chilli (*Capsicum annum* L.) is a common ingredient in numerous cuisines around the globe. It is a highly valuable crop that is vulnerable to a variety of environmental factors, including temperature, humidity, and insect infestation (Alimuddin et al. 2018). In many regions, it is challenging to maintain these conditions naturally, which can hinder the growth and yield of chilli plants. Furthermore, birds and insects frequently consume chilli seeds, preventing them from germinating and resulting in low yields. This issue can reduce crop yield, which can have a negative effect on the economic viability of chilli cultivation. In addition, it can lead to food constraints for those who rely on chilli as a staple ingredient. Therefore, a solution that can provide a controlled environment for chilli plants to grow, thrive, and promote healthy germination rates is required. To address this issue, various strategies, including physical barriers, chemical repellents, and cultural practises, can be investigated. The use of miniature greenhouses, which can create the optimal conditions for chilli plants to thrive regardless of the external environment, is one of the potential solutions (Ahuchaogu et al. 2022). Nonetheless, the efficacy and viability of miniature enclosures for chilli plants have yet to be determined; therefore, the purpose of this study is to assess their potential benefits and limitations.

Therefore, the purpose of this study is to develop an EcoGreen Miniature Greenhouse as an experimental planting for chilli seeds, and to evaluate its effectiveness by measuring its growth rate. This innovation revolves around a sustainable and eco-friendly solution that reduces carbon footprint.

2. METHOD & MATERIAL

The study is conducted in Kg. Bambangan, Tuaran, Sabah (GPS 5°51′45" N, 116°19′53" E). It is located on the western slopes of the Crocker Range in the northern section of the Crocker Range Park. It is positioned at an elevation of approximately 1,130 above sea level. The proposed EcoGreen Miniature Greenhouse for chilli cultivation resembles a bird's nest and is tiny. The miniature greenhouse was created using computer-aided design, Microsoft Paint, and materials that were inexpensive and readily available. Our EcoGreen Miniature Greenhouse is made entirely from recycled wood and other discarded wooden items. The wood is carefully selected, cleaned and treated to ensure it is safe for use in a farming environment. The design includes the following features:

i. Wooden frame: The EcoGreen Miniature Greenhouse is constructed from recycled wood. The wooden frame provides stability and support for the structure (Figure 1a).
ii. The roof and walls: Greenhouse protective net purchased from http://www.shopee.com.my is installed on the roof and walls of the miniature green house. The nets allow 40 to 50 percent of sunlight to travel through and provide a view of the chilli seedlings within. It is hinged so that it can be readily opened for watering or gaining access to the interior.
iii. Planting area: There are germination trays purchased from MR. DIY, which only costs RM2.00 per tray capable of holding 25 seedlings each inside the greenhouse. Four (4) germination trays were provided so that the miniature greenhouse's space could be utilised.



(a) (b)

(c) (d)

Figure 1 (a), (b), (c) and (d). The design of miniature greenhouse and the successful growth of chili.

The miniature greenhouse's performance was evaluated by monitoring the growth and development of chili seedlings over 28-days period.

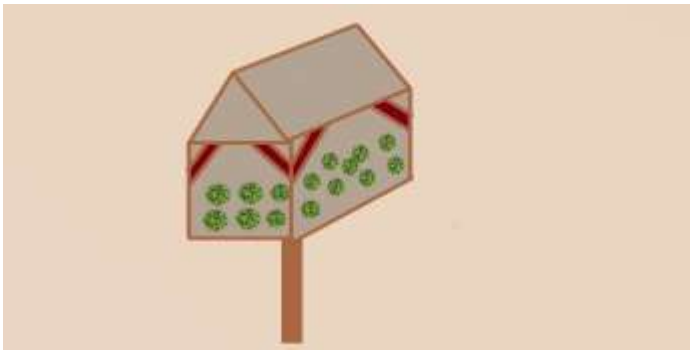
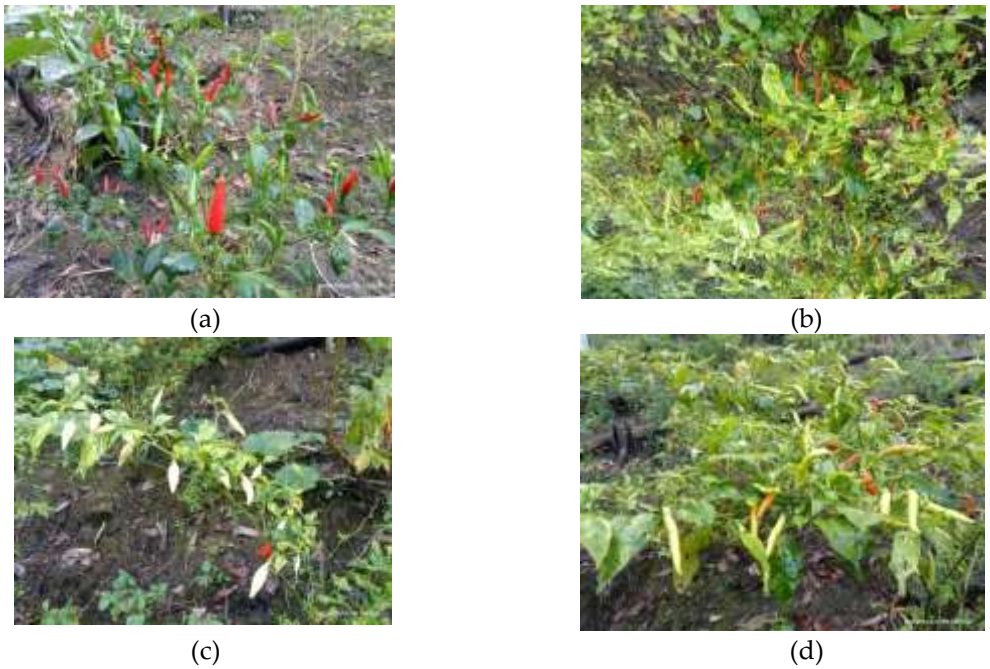


Figure 2. A rough sketch of the design for miniature greenhouse for chili farming using Microsoft Paint.

3. FINDINGS

The chilli seedlings grew well, gaining an average of 7 cm in height and ready to be transferred into the field. No pests were found in the miniature green house, and all of the chili seedlings showed no signs of pest or disease infestation after 30 days observation (Figure 1b). All of the chilli seedlings that successfully germinated were transplanted into the field (Figure 3). Approximately 3 kilogrammes of chilli are harvested and sold on the local market.



(a) (b)

(c) (d)

Figure 3. (a), (b), (c), and (d): Chilli plants that successfully germinated were transplanted into the field and began to produce abundant harvests.

3.1 Novelty

The miniature garden is constructed with nearly 80 percent recycled and repurposed materials. It does not incur excessive expenses. Its structure, which resembles a bird's nest and is sustained by a used wood beam, prevents any predators or pest animals from reaching the chilli seedlings. It is a straightforward innovation that can be adopted by anyone, subject to enhancements and modifications deemed necessary.

3.2 Usefulness

Compared to conventional agricultural techniques, the diminutive greenhouse's space-saving design requires very little space. In addition, the 'hanging' or 'floating' structure prevents pest animals from entering the miniature greenhouse, thereby reducing the number of chilli seedlings. It can be utilised as an ideal 'transit' and hardening-off process for all seed varieties prior to field sowing. In addition, one can attend to and monitor the progress of chilli cultivation by ergonomically standing and observing the growth progress inside the miniature greenhouse.

3.3 Contributions / Impacts

The EcoGreen Miniature Greenhouse has excellent commercialization potential due to several factors, including:

i. Growing demand for sustainable agriculture: As people become more aware of the environmental impact of conventional agriculture, there is a growing demand for sustainable agriculture practices. The EcoGreen Miniature Greenhouse can meet this demand by providing a sustainable and environmentally friendly solution for farming.

ii. Increasing demand for locally grown produce: There is an increasing demand for locally grown produce, as people are becoming more conscious of the benefits of consuming fresh and locally sourced food. The EcoGreen Miniature Greenhouse can provide a consistent supply of locally grown produce, which can be marketed as a premium product.

iii. Growing interest in urban farming: With more people living in urban areas, there is a growing interest in urban farming. The EcoGreen Miniature Greenhouse is ideal for urban farming, as it can be used in small spaces such as balconies and rooftops.

iv. Potential for partnerships with educational institutions: The EcoGreen Miniature Greenhouse can be an excellent tool for educational institutions to teach sustainable agriculture practices. This creates a potential market for partnerships with educational institutions, such as schools and universities.

v. Potential for government incentives: Governments around the world, including Malaysia are promoting sustainable agriculture practices by providing incentives and subsidies to farmers who adopt them. The EcoGreen Miniature Greenhouse can benefit from these incentives and subsidies, creating a potential market for government contracts.

4. DISCUSSION

Even though the invented miniature greenhouse lacks automated devices for monitoring the water and fertiliser levels, the results of this study demonstrate that automation is not necessary for the daily operation of the miniature greenhouse. However, we would like to suggest some automation

implementation in the EcoGreen Miniature Green in order to apply the water supply periodically and sufficient lighting, which is solely dependent on the solar system. Automation does not need to be technologically demanding or based on an algorithm. This study demonstrates that the greenhouse is effective at maintaining optimal conditions and promoting the healthy growth of chilli plants, making it a valuable resource for communities interested in chilli cultivation. This innovation is a solution for the locals of Kg. Tudan, who have had trouble keeping seeds intact in the soil and preventing animals and insects from disturbing them during direct seed sowing on beds. They need not frequently monitor the growth of the chilli plants in the field because they can simply observe the seedlings in the miniature greenhouse.

This innovation is also advantageous and applicable for students of the Faculty of Plantation and Agrotechnology at Universiti Teknologi MARA who take FPA100 and have practical classes every Friday. Due to the farm's vicinity to a secondary forest, students frequently encountered pest animals, most notably wild lizards that damaged the seeds on the sowing bed. As the Semester came to a close, some students were left with no germinated seedlings and limited harvestable yields.

This innovation's modular design indicates that the EcoGreen Miniature Greenhouse could be commercialised. Both its interior and exterior could be made more aesthetically pleasing and functional.

5. CONCLUSION

The design and development of a miniature greenhouse for chili farming provide an affordable and cost-effective solution that can enhance the learning experience of chili farming. This innovation has the potential to revolutionize the way plants are grown in either rural or urban areas, promoting sustainable agriculture and green spaces.

References

Ahuchaogu, I., Ehiomogue, P. & Udoumoh, U. (2022). Trends in greenhouse farming technology: A review. *Journal of Food Agriculture and Environment,* 19, 69-74. 10.1234/4.2022.5613.

Alimuddin, Al., Subrata, D., Nurmayulis, Khastini, R. & Arafiyah, R. (2018). Analysis of chilli plant physiology conventional system, green house hydroponic utilization system using fuzzy logic. *IOP Conference Series: Materials Science and Engineering.* 434. 012219. 10.1088/1757-899X/434/1/012219.