

07

UPCYCLING ECO-VILLAGE IN PERHENTIAN KECIL ISLAND

Aida Haslinda Othman & *Zeenat Begam Yusof
Department of Architecture,

Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia.

ABSTRACT

Upcycling and recycling are among the components under solid waste management which needs to be carried out in order to make solid waste management successful in Malaysian marine park islands. Current issues at marine park islands are accumulation of solid waste in the sea which is destroying the marine ecosystem. In Malaysia, about 80% people are aware about the importance of recycling. However, not many people understand the concept of upcycling especially in marine park islands. Some may have misunderstood the difference between upcycling and recycling. This research focuses on what are the best and new solutions to educate islanders on the application of both upcycling and recycling at Perhentian Kecil Island. The aims of the research are to reduce solid waste in Perhentian Kecil Island and to provide a platform for people to learn the entire process turning waste into valuable products. An upcycling eco-village is proposed to improve the knowledge of upcycling and recycling. Interviews, questionnaires, observation and case studies techniques were used to collect the data. The findings were used to formulate design brief and schedule of accommodation for upcycling and recycling centre. The centre will help to reduce the issues of solid waste accumulation on the marine park islands .

Keyword: *Upcycling, Marine Park Islands, Recycling, Solid Waste Management*

* Corresponding author: zeensoni@iium.edu.my

INTRODUCTION

Perhentian Kecil Island is part of Terengganu Marine Park, the northern most island group off the East Coast of Peninsular Malaysia and located in the south China sea, 25 kilometers away from proposed centre. Pulau Perhentian has two inhabited islands, Pulau Perhentian Besar (Big stopover Island) and Pulau Perhentian Kecil (Small stopover Island) with approximately land area of 867 and 524 hectares respectively (Islam, Noh, Yew, & Noh, 2013). This centre will upcycle and recycle plastics bottles, aluminium cans, glass bottles, into new products such as batik fabric, plastic carving as wall panel, souvenirs and many more

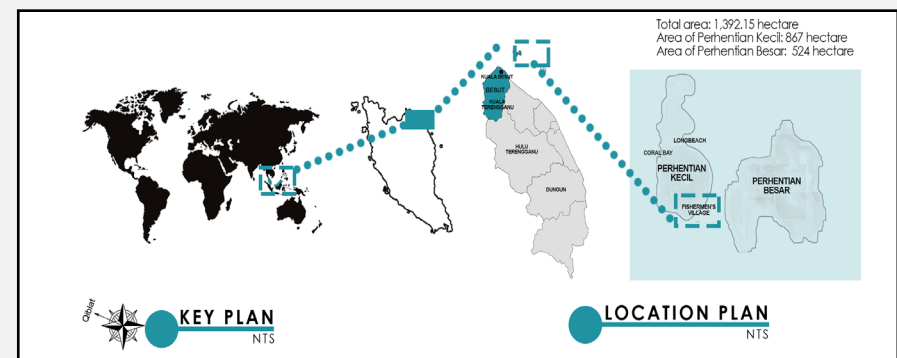


Figure 1: Perhentian Island

According to the Department of Marine Park (2016), the statistic on tourist arrivals in Perhentian Island is increasing year by year due to the development of infrastructures on the island (Nasir et al., 2017). The increase of tourism activities created an undesired problem such as pollution and poor waste management that affect its reputation as well as the life of the coral reefs. Solid waste disposal on small islands is a major problem and a challenging aspect for tourism industry (Saat, 2019, Yusof Z.B, 20).

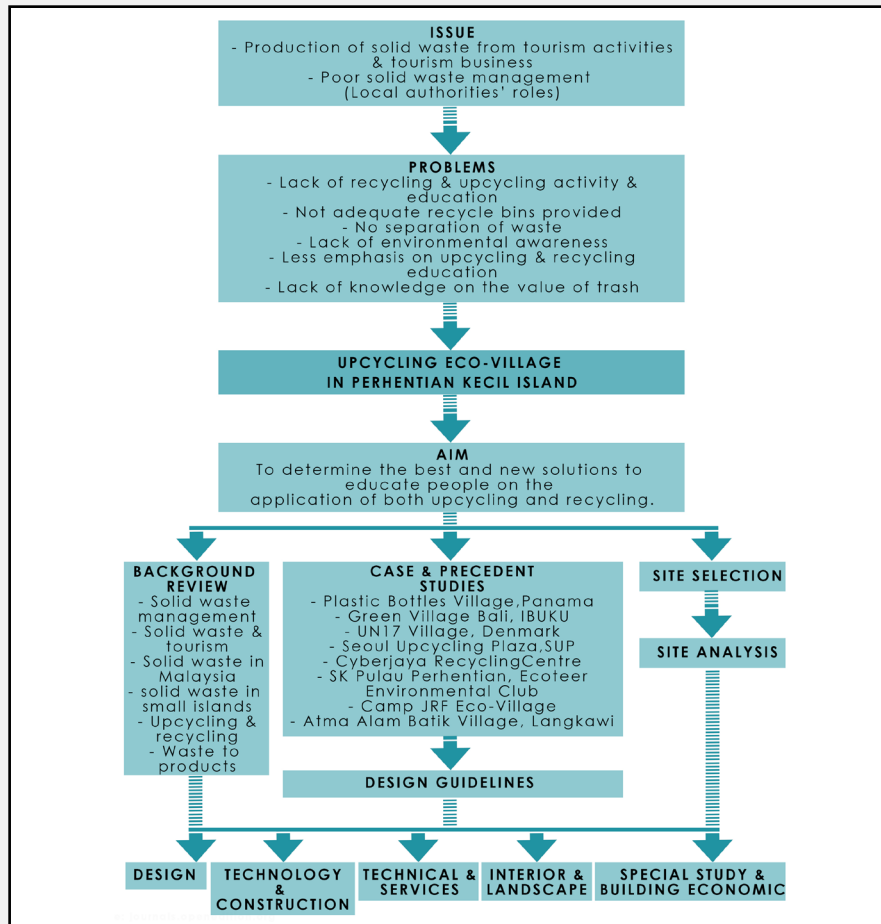
ISSUES

Figure 2: Issues, objectives, solutions and architectural solutions



CONCEPTUAL PROCESS, PROCEDURE AND SCHEMATIC DESIGN

Table 1: Research Structure



THEORETICAL FRAMEWORK

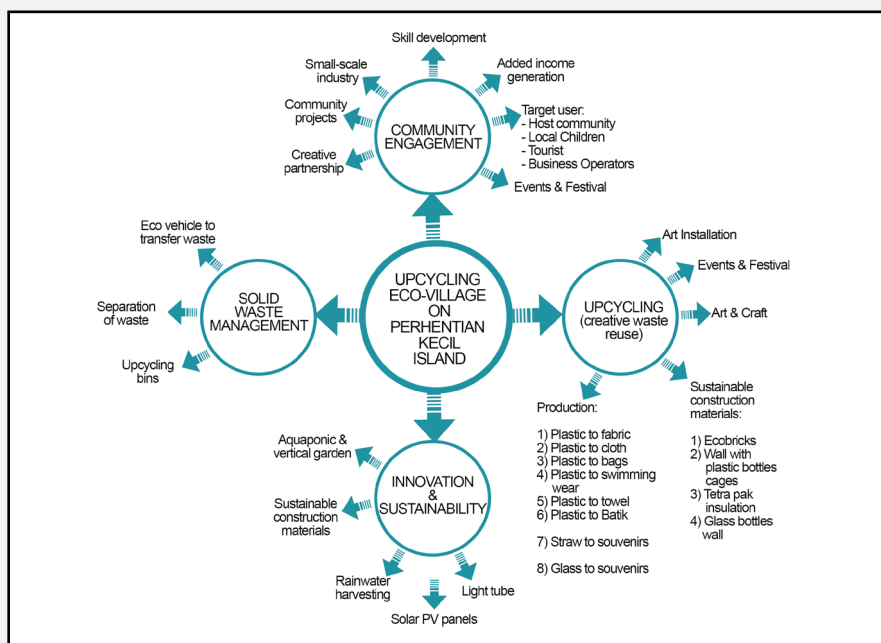


Figure 3: Theoretical framework

This project focuses on the best and new solutions to educate islanders on the application of both upcycling and recycling. The centre will provide various activities that will help tourists to identify recyclable materials, process of upcycling and recycling and creation of new products from recycle materials. Besides, this project identify the suitable approaches to be implemented hence tourists can learn the entire process and improve the knowledge of upcycling and recycling

DESIGN CONCEPT

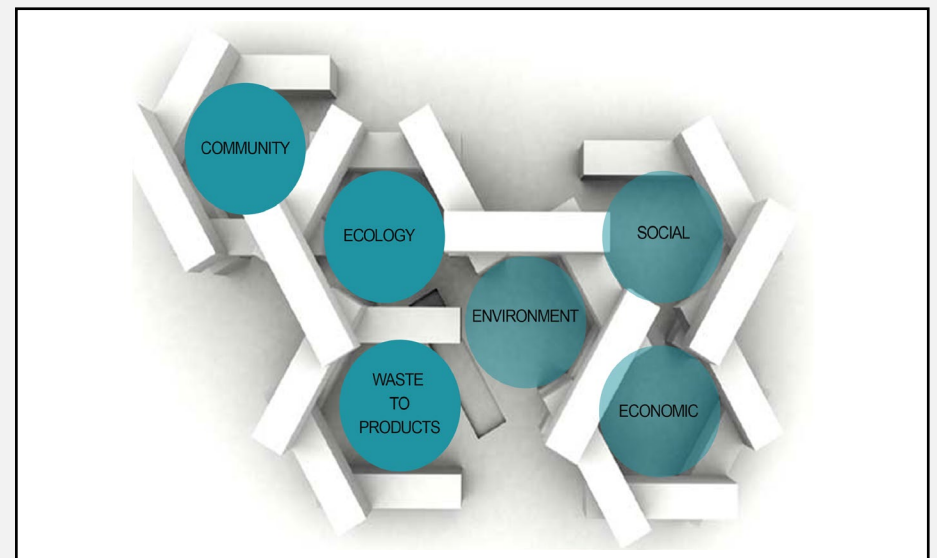


Figure 4: Design Concept - Weaving

The design concept is **Weaving** which means to integrate man-made environment with natural environment in order to create harmony and sustainable environment at the Perhentian Kecil Island. The idea is to interweave (integrate) the community (social), nature (environment) as well as converting waste into products (economic) to create a sustainable and resilient life.

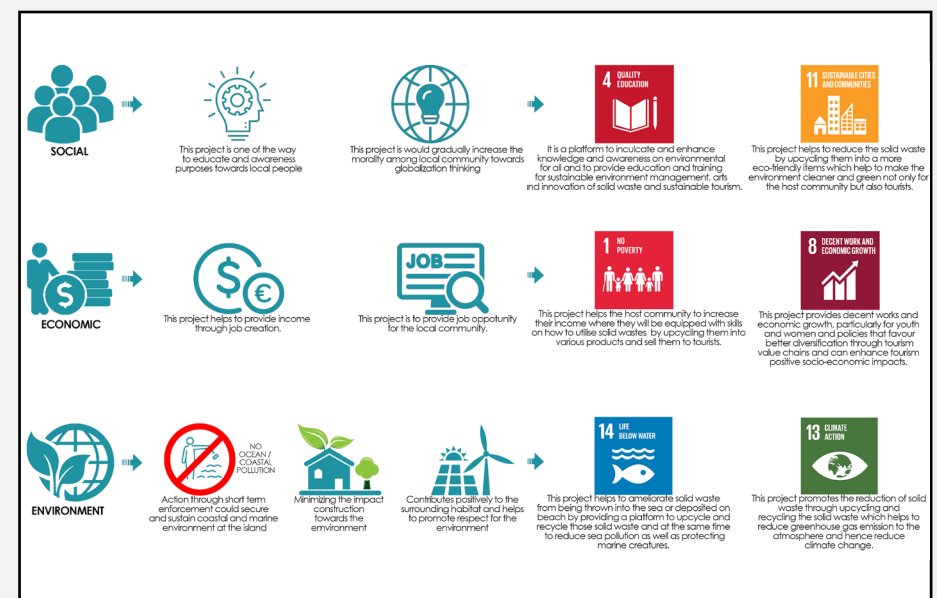


Figure 5: The actions towards Sustainable Development for Upcycling Eco-village in Perhentian Kecil Island

FINDINGS

The upcycling eco-village will be a platform that provide education to raise awareness and enlighten the public about the value of upcycling and recycling. It is a flexible space for commercial, education, exhibition, learning and creative which aim to reduce solid and organic waste by upcycling or recycling them into eco-friendly products. This initiative helps to make the marine environment cleaner and greener.

MASTERPLAN

The centre is proposed by considering the neighborhood context. A masterplan is prepared to integrate the existing village. Pedestrian walkway and community area are proposed to create integration. Several waste stations and upcycled kiosks are proposed along the existing pedestrian walkway in the village and at the beach area to promote recycling. The community area is a recreational area which integrate tourists and villagers.

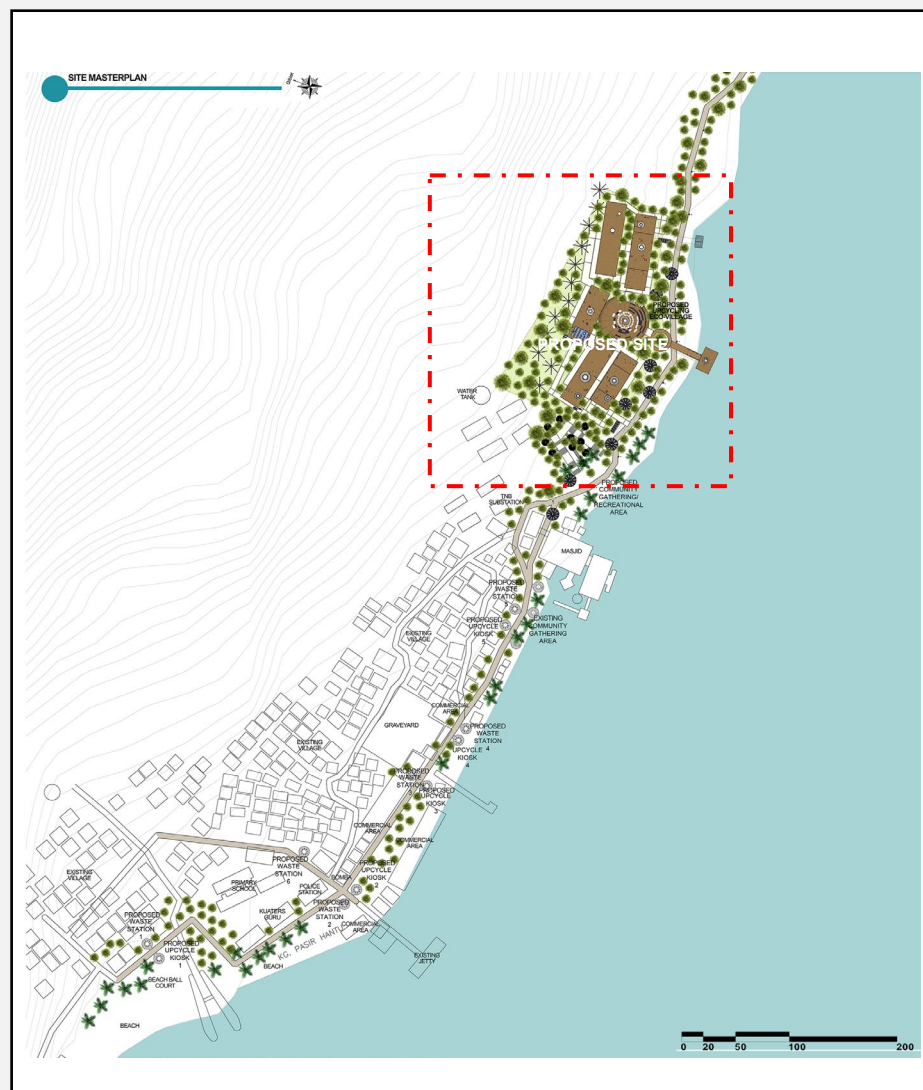


Figure 6: Masterplan Upcycling Eco-Village in Perhentian Kecil Island

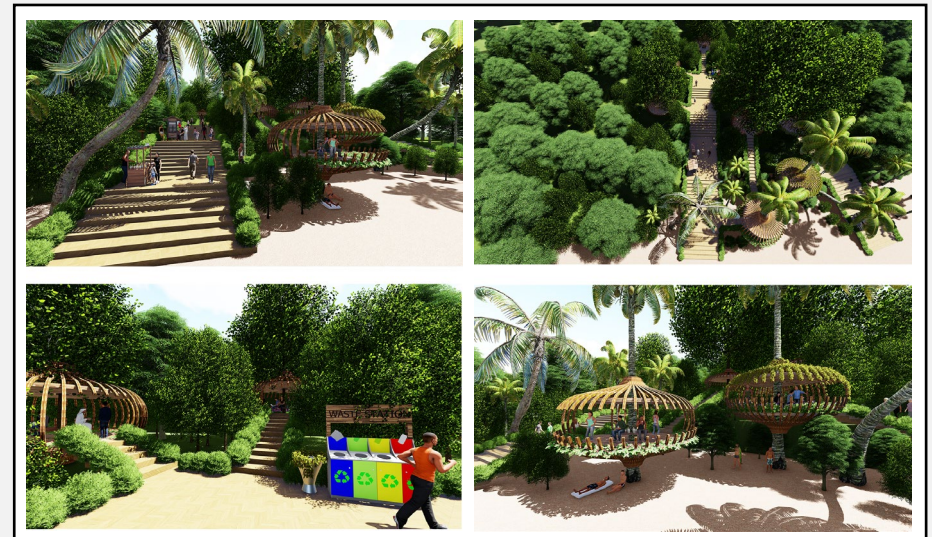


Figure 7: Recreational area / Community gathering area located in between existing Masjid and proposed site

PROPOSED SITE

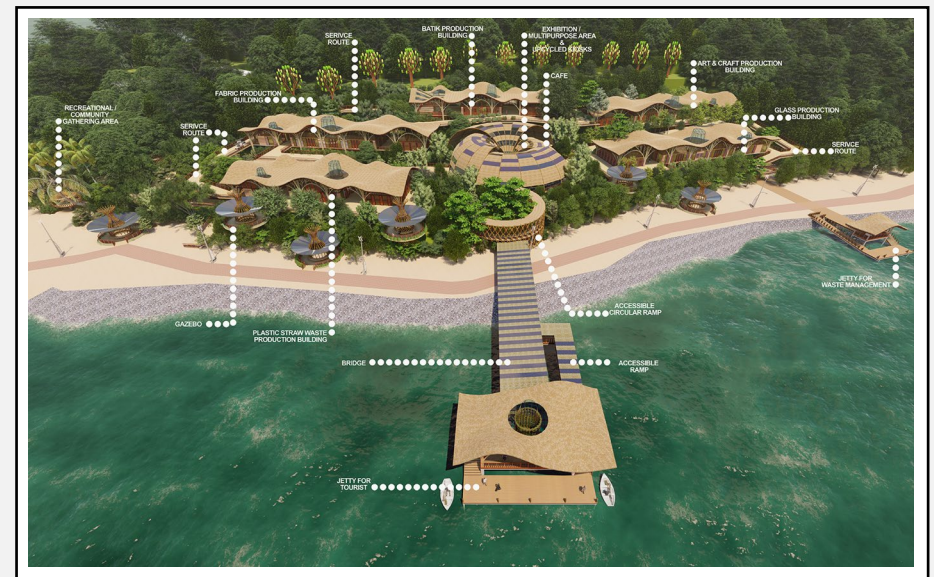


Figure 8: Proposed Upcycling Eco-Village in Perhentian Kecil Island

The proposed site consists of five (5) production buildings which convert waste into various products, exhibition area/multipurpose area, commercial area, café, gazebo and seating areas, jetty for tourists. Each of the building is connected via wide boardwalk and accessible ramp.

Waste collected from waste stations will be transferred to the waste storage area in each production building by solar E-vehicles. Solar E-vehicle will use the upgraded pedestrian walkway along the existing village into the site. The route for the Solar E-vehicle is located at the rear part of each production building, connecting to each other and the services jetty. While waste collected from other part of the Perhentian Island will be transferred by boat into the site by services jetty.

JETTY FOR TOURIST

The jetty for tourists has two level. Both staircase and ramp are provided, connecting the lowest level to the upper level. Solar panels are installed on the roof to provide electricity for the jetty.



Figure 9: Jetty for tourist



Figure 10: Accessible ramp connecting lower level and upper level jetty (left), Bridge connecting jetty for tourist with circular accessible ramp (right)



Figure 11: The view of existing pedestrian walkway connecting with the existing village with the proposed site

There are two routes to access the proposed centre. First, from the existing jetty in the existing village. Tourists can walk from the existing jetty to the proposed centre along the existing pedestrian walkway (as shown in Figure 10). Second, the centre can be accessed via the proposed new jetty connecting directly into the proposed site (as shown in Figure 8 and 11).



Figure 12: The jetty for tourist is covered with thatch roof and has solar still structure in the middle while the bridge is covered alternately with thatch roof and thin solar film.

CIRCULAR RAMP

The circular ramp connects the jetty and existing walkway at the lower level to the exhibition/ multipurpose area at the upper level. The material for this circular ramp is bamboo. As people walking along this ramp, they will see the views of ocean and forest alternately along their journey to the upper level. This circular ramp is accessible for all including people with disabilities.



Figure 13: The accessible circular ramp

EXHIBITION AREA/ MULTI PURPOSE AREA

The exhibition cum multipurpose area is where various kind of activities will take place such as outdoor upcycled exhibitions, talks and promotions. This area is equipped with a few seating areas, sunken seating with aquaponic bamboo structure in the middle, ticketing booth at the entrance, commercial area and café are located at the mezzanine floor.



Figure 14: Entrance to the Exhibition/ Multipurpose area (left), Ticketing booth (right)



Figure 17: The sunken seating area in the middle of the exhibition/ multipurpose area

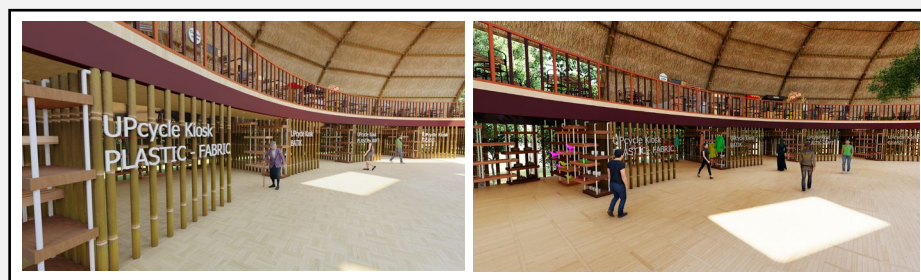


Figure 15: Commercial area (Upycled Kiosks) at the Exhibition/ Multipurpose area selling upcycled products

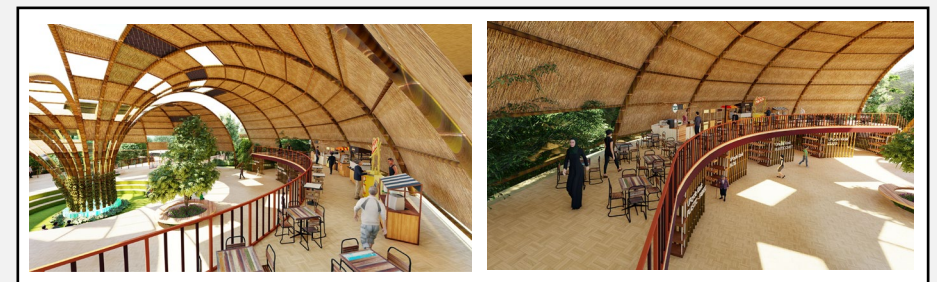


Figure 18: Café (above Upycled Kiosks), the mezzanine floor

There is a designated parking area for E-cycle provided for tourists (as shown in Figure 15). This E-cycles are the tricycle generated by solar panel as a medium for the tourists to travel along this area apart from walking and cycling. The boardwalk and the ramp are 7 meters wide which adequate to allow people to walk, cycle and use E-cycle.



Figure 16: The parking area for E-cycles at the multipurpose area.

The exhibition/multipurpose area is covered by polycarbonate sheets, flexible thin film solar cells, thatch roof and supported by bamboo structure. The bamboo structure in the middle function to capture rain water for irrigation (as shown in Figure 17).

The café is located above the Upycled kiosks (as shown in Figure 18). The stalls and furniture at the café made of recycled timber. The café and exhibition area are covered with thatch roof, polycarbonate sheets and solar thin film, supported by bamboo structure. It is an open plan which receive abundant of natural lighting, natural ventilation and blend with the existing landscape.

PLASTIC STRAW UPCYCLING AREA

From the exhibition area, people can walk to plastic straw upcycling area at the south. This building consists of three parts. The first one is the display area which display plastic straw upcycled products (as shown in Figure 19).

The second part of the building is the production area where people can learn and experienced themselves how to upcycled plastic straw into various products, This production area is divided into 2 stations. The first station is equipped with 3-in-1 Recycling Machines to process and convert plastic straw into small flakes later into various forms (as shown in Figure 20).



Figure 19: Display area for upcycled plastic straw waste

The second station is working area where people assemble the processed plastic straw waste into various kind of souvenirs and products (as shown in Figure 21).

The third part of the building is the cleaning and waste storage area where waste collected will be stored here and washed before being upcycled into another products.



Figure 20: Station 1 in Plastic Straw Waste production building



Figure 21: Station 2 in Plastic Straw Waste production building

GLASS BLOWING PRODUCTION AREA

From exhibition area, people can walk to Glass Blowing Production building at the North. This building consist of three parts. The first one is the display area which display glass waste upcycled products.

The second part of the building is the production area where people can learn and experienced themselves how to upcycled glass bottles waste into various products through glass blowing process, This production area is divided into 2 stations. The first station is the demonstration area where visitors can learn and watch step-by-step glass blowing process using glass bottles waste (as shown in Figure 22).



Figure 22: Station 1 in Glass Blowing production building

The second station is glass blowing workshop where visitors can experienced the glass blowing process on their own (as shown in Figure 23). The third part of the building is the cleaning and waste storage area where waste collected will be stored here and washed before being upcycled into another products.



Figure 23: Station 2 in Glass Blowing production building

FABRIC PRODUCTION AREA

As people walk along the ramp from the straw upcycling area at the third level, they will arrive at Fabric Production area at the fourth level. This area consists of three parts. The first one is the display area which display fabric upcycled products.

The second part of the building is the production area which is equipped with various machines turning plastic waste into fabric. People will learn step-by-step on how to upcycle plastic waste into fabric as they walk along the production area. This production area is divided into 4 stations.

The first station is equipped with Shredder Machines which shredded plastic waste into small flakes (as shown in Figure 24). The second section is equipped with Yarn Machines which squeezed and melted small flakes plastic waste into thread (as shown in Figure 24).



Figure 24: Station 1 & 2 in Fabric production building

The third station is equipped with Woven Machines which will roll the thread into fabric (as shown in Figure 24). The fourth station is cutting and sewing area for the upcycled fabric (as shown in Figure 24). The fabric can be sewn into various type of clothes. The third part of the building is the cleaning and waste storage area where waste collected will be stored here and washed before being upcycled into another products.



Figure 25: Station 3 & 4 in Fabric production building

ART & CRAFT PRODUCTION AREA

As people walk from Glass Blowing building at the third level up to the fourth level, they will arrive at Art and Craft Production building where they will learn step-by-step process on how to turn plastic waste into art and craft products as they walk along the production area. This building consists of three parts. The first one is the display area which display plastic upcycled products. The second part of the building is the production area which is equipped with various machines turning plastic waste into art and craft products.

This production area is divided into 3 stations. The first station is equipped with Shredder Machines which shredded plastic waste into small flakes (as shown in Figure 26). The second section is equipped with Extrusion, Injection and Compression Machines which will mold shredded small plastic flakes into various form flakes (as shown in Figure 27).

The third station is the workshop or installation area of the processed flakes (as shown in Figure 28). The fourth part of the building is the cleaning and waste storage area where waste collected will be stored here and washed before being upcycled into another products.



Figure 26: Station 1 in Art & Craft production building



Figure 27: Station 2 in Art & Craft production building



Figure 28: Station 3 in Art & Craft production building

BATIK PATTERN PRODUCTION AREA

Batik pattern production area located at the fifth level. It is connected by ramp from Fabric Production and Art and Craft Production area at the fourth level. People will learn how to make batik pattern on the fabric which is made from the plastic waste earlier. After plastic waste is upcycled into fabric from the Fabric Production building, some of the fabric will be sent to Batik pattern production building to be produced as either batik sarong or batik clothes.

This building consist of three parts. The first one is the display area which display fabric of various batik pattern.



Figure 29: Station 1 & 2 in Batik pattern production area



Figure 30: Station 3 & 4 in Batik production building

The second part of the building is the production area. This production area is divided into 4 stations. The first station is Tracing Area and the second station is Waxing area (as shown in Figure 29). The third station is Drying area and the final station is Sewing area (as shown in Figure 30).

The third part of the building is the cleaning and waste storage area where waste collected will be stored and washed before being upcycled into another products.

SPECIAL STUDIES: DECORATIVE WALL PANELS FROM PLASTIC WASTE

All buildings enclosed with the decorative wall panels made from plastic waste with different designs. These panels can be manufactured easily, even by people who have no special expertise on wood carpentry or chemistry. The process of making wall panels from plastic waste is safe and does not require a lot of energy as compared to plastic recycling process (Ahmed, Anwar & Ahmad, 2018).

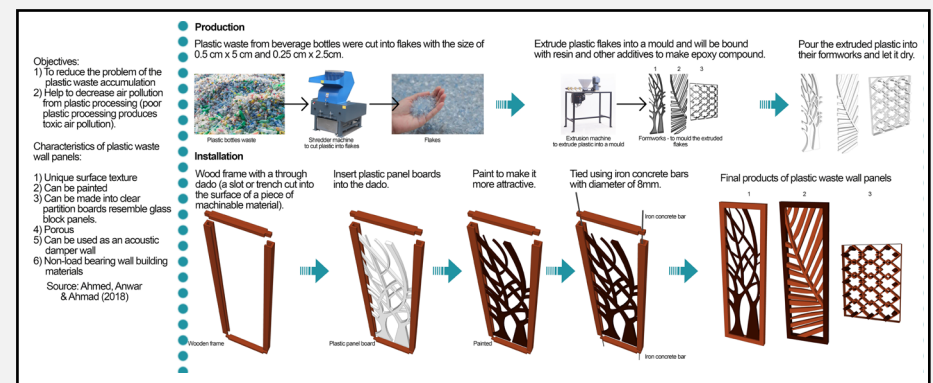


Figure 31: Construction of decorative wall panel from plastic waste



Figure 32: Art & Craft Production building enclosed with decorative wall panels made from plastic waste

SPECIAL STUDIES: ECOBRICK (FILLED FRAME)

Ecobrick is a plastic bottle which has been packed tight with plastic rubbish, such as food wrappers and plastic bags to create a building block. Some plastic wastes cannot be recycled easily, but they cause a lot of problems if they are dumped or burned. Ecobricks contain the plastic waste so they do not cause harm to the environment and provide free construction materials that is lightweight and robust.

These panels can be manufactured easily, even by people who have no special building construction expertise.

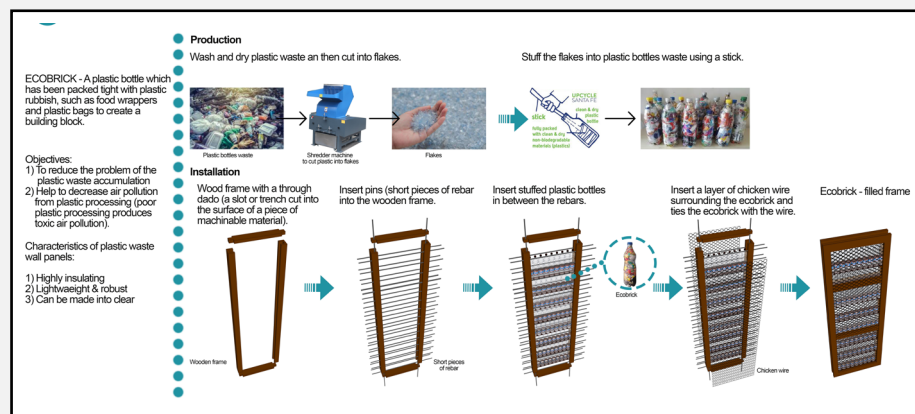


Figure 33: Construction of ecobrick filled frame



Figure 34: Ecobrick in between wall panels in Fabric Production building

SPECIAL STUDIES: WINDOW GARDEN PANELS FROM PLASTIC BOTTLES WASTE

Plastic bottles can reuse as green panels for building. Figure 35 below indicates how plastic bottles can reuse as plants panel for building.

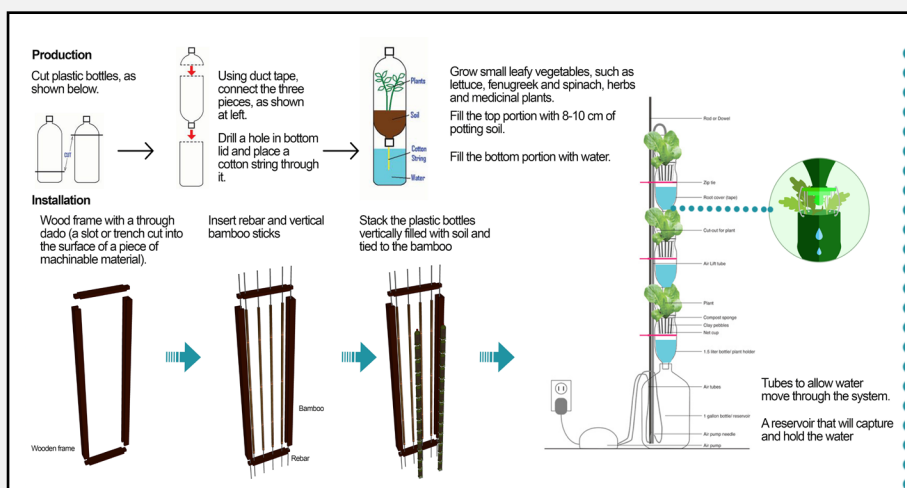


Figure 35: Construction of window garden wall panels



Figure 36: Art & Craft Production building enclosed with decorative wall panels made from plastic waste and window garden wall panel made from plastic bottles

SPECIAL STUDIES: TREE-SHAPED WIND TURBINES (WIND TREE)

The Wind Tree is a steel structure (trunk and branches) on which 36 Aeroleaf are installed. The Aeroleaf are all independent, which facilitates electricity production and maintenance as each turbine can be monitored without stopping the overall production (electrical assembly in parallel) and without risk (low voltage 48V) (Shekhanabi B Chalageri, Akash M Deshpande, Manjunath S. Banad & Eresimi, 2017)

Advantages of Aeroleaf:

- 1) It is optimized for the lowest wind speed (2.5 m/s)
- 2) Quiet operation due to small radius of their blades
- 3) Gearbox is not necessary
- 4) Can be installed everywhere
- 5) Can produce electricity irrespective of the wind direction.

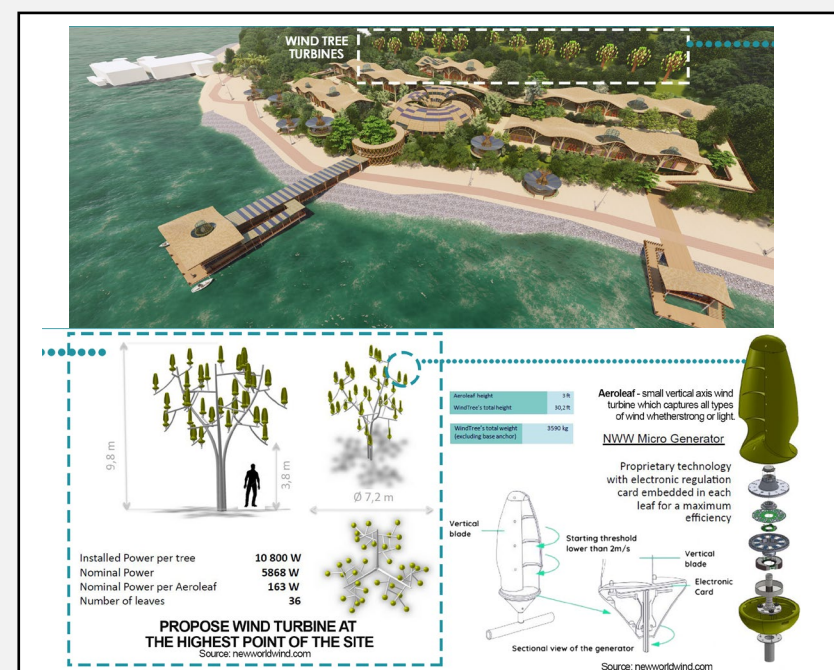


Figure 37: Proposed wind turbines

SPECIAL STUDIES: THIN SOLAR FILM CELLS

Thin-film solar cell, type of device that is designed to convert light energy into electrical energy (through the photovoltaic effect) and is composed of micron-thick photon-absorbing material layers deposited over a flexible substrate. It was originally introduced in the 1970s by researchers at the Institute of Energy Conversion at the University of Delaware in the United States (Chauhan, 2014).

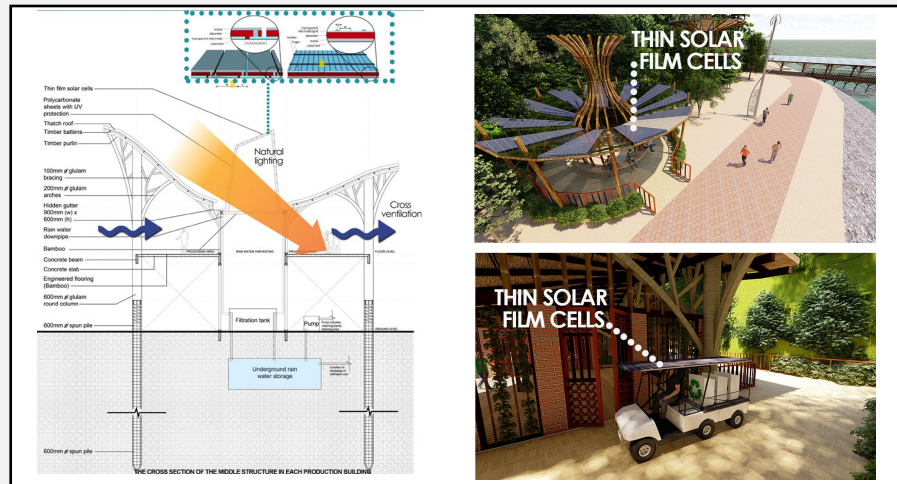


Figure 38: Thin solar film cells in all buildings and Solar E-vehicle

SPECIAL STUDIES: SOLAR STILL

Solar still is a device to desalinate seawater. It is a simple device to get potable/fresh distilled water from impure water, using solar energy as fuel, for its various applications in domestic, and industrial sectors. Solar still is a distillation system which can be small or large. It is designed either to serve the needs of a single family, producing from 1/2 to 3 gallons of drinking water a day on the average, or to produce much greater amounts for an entire neighborhood or village (Aybar, 2007).

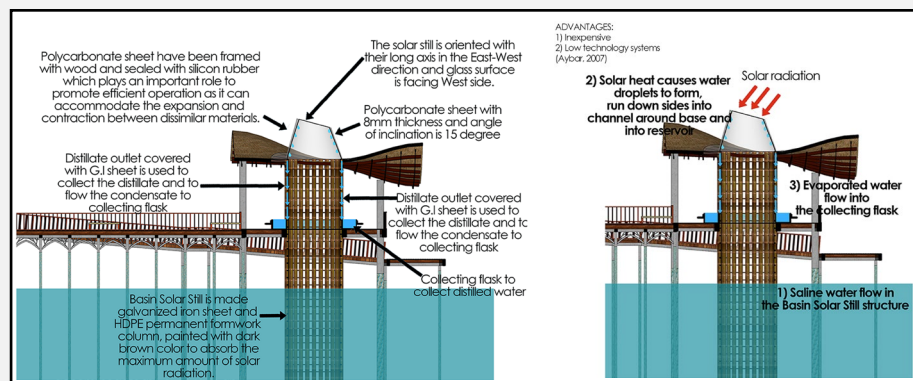


Figure 39: Solar still structure at jetty for tourist

REFERENCES

- Ahmed, M., Anwar, A., & Ahmad, S. A. (2018). a Literature Review on Study of Concrete Strength Using Partial Replacement of Cement With Rice Husk Ash and Fine Aggregate With Ceramic Powder. *International Journal of Recent Scientific Research*, 9(3), 23083–23086. <https://doi.org/10.24327/IJRSR>
- Aybar, H. S. (2007). Solar Desalination for the 21st Century. *Solar Desalination for the 21st Century*, (May 2007). <https://doi.org/10.1007/978-1-4020-5508-9>
- Chauhan, K. R., Burgess, I. J., Chang, G. S., & Mukhopadhyay, I. (2014). Preparation of CdTe thin film by electrodeposition in butyl methyl imidazolium bath at 80 C. *Journal of Electroanalytical Chemistry*, 713, 70-76.

SPECIAL STUDIES: RAINWATER HARVESTING

All production building is equipped with rainwater harvesting structure to be used for waste cleaning process. The bamboo structure in the middle of the Exhibition/ Multipurpose is a rainwater harvesting structure for irrigation system. The gazebos along the walkway also act as rain water collectors and to be reused for irrigation.

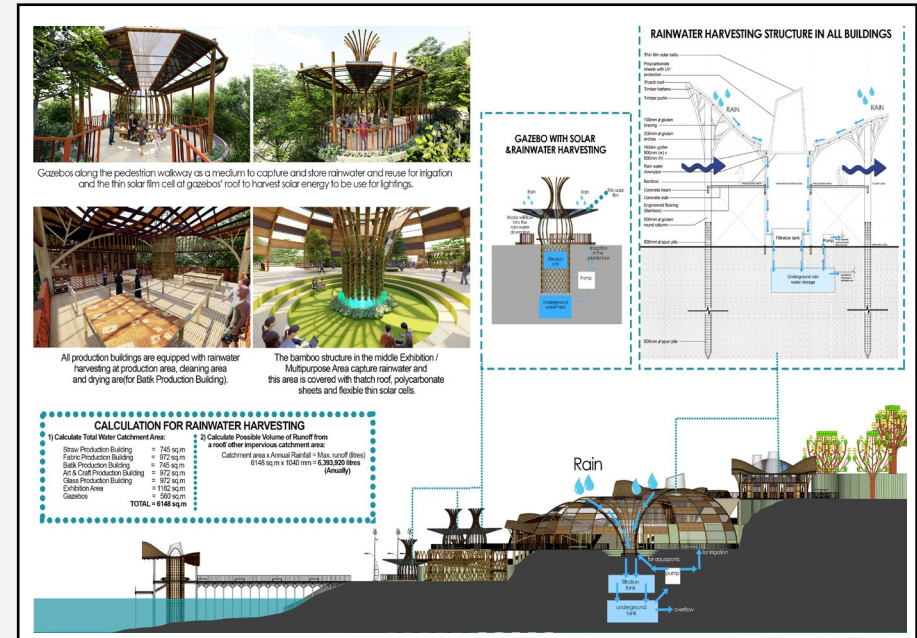


Figure 40: Rainwater harvesting system

CONCLUSION

The centre was designed in consideration of sensitive marine environment. All the materials and system proposed taken into consideration of natural surrounding, user satisfaction, climatic consideration, economic and social integration of the villagers. The centre is designed to address current issue related to accumulation of solid waste on marine park islands. The centre recycle and upcycle plastic bottles, straw, glass bottles and plastics into various products. By having this kind of centre on the islands can reduce the issue of solid waste on the Malaysia marine park islands and can increase economic of islanders on the islands.

- Islam, G. M. N., Noh, K. M., Yew, T. S., & Noh, A. F. M. (2013). Assessing Environmental Damage to Marine Protected Area: A Case of Perhentian Marine Park in Malaysia. *Journal of Agricultural Science*, 5(8), 132–141. <https://doi.org/10.5539/jas.v5n8p132>
- Muhamad, R., & Muhamad, R. (2019). A Study of Supply Chain Management for Sustainable Solid Waste Plan in Perhentian Island, Terengganu. *Int. J. Sup. Chain. Mgt Vol*, 8(5), 1022.
- Nasir, N. M., Ibrahim, M., Mahamod, L. H., & Othman, R. (2017). Challenges to implement carrying capacity framework: A case study of Pulau Perhentian Marine Park institutional framework. *Planning Malaysia*, 15(1), 163–168
- Poudel, S. (2013). The influence of the accommodation sector on tourism development and its sustainability: The case study of Strand Camping, Larsmo. 55.
- Saat, S. A., Saputra, J., Jamin, R. M., Shekhanabi B Chalageri, Akash M Deshpande, Manjunath S Banad, A. S. P., & Eresimi, P. S. (2017). Generation of electricity by wind power. *Polar Record*, 6(44), 535–537. <https://doi.org/10.1017/S0032247400047483>