Improving Livelihood of Sugar Palm Community in Malaysia

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Abstract

Engineering product development based on sugar palm tree in Kg. Kuala Jempol, Negeri Sembilan, Malaysia, is a joint venture project between Universiti Putra

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Malaysia (UPM) and Village Development and Security Committee (JKKK) of Kg. Kuala Jempol, Negeri Sembilan, with funding from the Ministry of Education Malaysia under the eighth National Blue Ocean Strategy (NBOS). This project is important in transferring university expertise to transform community. There were three main objectives, namely, to transfer the knowledge for the development of products based on sugar palm fibres, to transfer the knowledge for the development of products based on sugar palm tree and to help the local community in marketing the product. From this project, the village community is exposed to the potentials of sugar palm that is usually known for only sweetening beverages. At the end of this project, the community will continue the process of collecting and making products based on sugar palm trees and market them throughout Malaysia. The project has proudly developed 12 products based on sugar palm trees, namely, the sugar palm fibre, starch, roof, rope, brooms, brushes, bottlebrushes, vinegar, fruit, liquid sugar, fined sugar and block sugar. In a short time, all products can be realised along with packaging that can attract buyers. In addition, two products have received registered trademarks which are the sugar palm fibre and sugar palm starch.

Keywords

Sugar palm · Community · Sugar palm products · Fibre · Starch · Product development

10.1 Background

In 2015, the Ministry of Education Malaysia financed a community initiative at Universiti Putra Malaysia to produce products from sugar palm trees as part of the National Blue Ocean Strategy (NBOS) Initiative. According to Huzaifah et al. (2017a, 2017b), sugar palm tree has various names depending on place such as enau or kabung in Malaysia; gomuti, aren or kaong in Indonesia; palma azucarera in Spain; Lao in Sino-Tibetan; and many others. It belongs to the sub-family of Arecoideae and tribe of Caryoteae (Sanyang, 2015). Sugar palm tree has been chosen in this project because this tree is a multipurpose tree in which all parts of the tree can be used, including palm sap, trunk, fruits and leaves. The main purpose of NBOS initiative is to help the villagers so that the villagers can generate their own income.

In this project, the researcher was transferring information about the development of items made from sugar palm fibres, assisting the local community with product development and assisting the local community with product marketing. The project was carried out in a rural village in Bahau, Negeri Sembilan, Malaysia, called Kampung Kuala Jempol. The community was introduced to the potentials of the sugar palm, which was previously only known for producing palm sugar. Following the conclusion of the project, the community continued to collect and manufacture sugar palm tree-based items, which they sell across the country.

10.2 Products from Sugar Palm Trees

Coconut trees are widely recognised as multifunctional trees; however, few people are aware that sugar palm trees are also multipurpose. It's because almost every part of the tree (roots, leaves, stems, fibres, fruits, etc.) can be used for a variety of purposes and products (up to at least 60), either for traditional uses like sugar palm food products, *kolang kaling* (sugar palm fruits) (Fig. 10.1), vinegar or fibre products (such as fibre, roof, brush and broom) or for research purposes like starch and sugar palm fibre (Fig. 10.2), as well as base materials for a variety of structures. Researchers explored several uses of sugar palm products in the form of fibres (Fig. 10.3), foodstuff (Fig. 10.4) and other uses throughout the market investigation stage of the project (Fig. 10.5). Figure 10.5 shows tools constructed from sugar palm trunks and broomsticks made from sugar palm trees. Sugar palm seedlings in polybags are now available for purchase and planting (Fig. 10.5).

Fig. 10.1 Sugar palm fruits

Fig. 10.2 Sugar palm fibres and stem

10.3 Approaches

The NBOS project was completed in 1 year and 3 months, with a grant of USD 39,056.22 accepted (rate on 8 January 2018). The full sum was used to convey knowledge to the community and ensure its long-term viability. The funds were utilised to host community lectures and exhibitions and to design and create equipment such as a shed and a "small factory" to make products so that the local community can continue the initiative on its own in the future. The community had gotten a lot of orders, mostly from local markets, after running this initiative on their own for a year (project concluded in September 2016). Due to a lack of innovative techniques and procedures, particularly for mass manufacturing, the community has difficulty meeting demand. As a result, the same team of UPM researchers (who also worked on the first community project) launched a new community project called Knowledge Transfer Grant Scheme (KTGS) (with a grant approved of USD 6255.00; rate on 8 January 2018) to focus on project

Fig. 10.3 Different uses of sugar palm fibres

productivity enhancement to meet market demand and to assist villagers in marketing their products both locally and internationally.

10.3.1 Availability of Sugar Palm Trees

Sugar palm trees thrive in the undeveloped areas of the Jempol district's rural areas. In the village, some 1000 trees have been discovered in the wild. The sugar palm trees in Kampung Kuala Jempol were not widely and productively exploited by the inhabitants. Some of the locals did not use other portions of the sugar palm trees, who simply collected the sap and fruits for daily sustenance.

Fig. 10.4 Foodstuffs from sugar palm origin

10.3.2 Industry Visits

UPM researchers have put a lot of effort into the project, including making multiple trips to Indonesia, Sabah and Pahang, which have substantially aided the project's progress. The researchers went to Indonesia to learn more about the sugar palm industry from CV. Mulya Perkasa Company in Tasikmalaya, West Java Province, Indonesia, has extensive experience.

Expertise and information for the production of brushes, bottlebrushes, brooms, roofs and rope were brought back to Malaysia due to the tour (Fig. 10.6). Furthermore, information about sugar palm fibre as a roofing material was collected by visiting a community in Kampung Naga, Salawu District, Tasikmalaya Regency, West Java Province, Indonesia, that has utilised sugar palm fibre in roof making, which is very significant to emphasise in Malaysia. As a result of the development of holiday resorts that use traditional materials to build gazebos, cottages and chalets, demand for a traditional touch in building decorating is increasing in Malaysia. They became more motivated to manage the initiative after returning to Malaysia and sharing the information and products with the community. This is because the local

Fig. 10.5 Other uses of sugar palm tree

Fig. 10.6 Products from sugar palm fibres (rope, roof and broom)

community believed they could make it work based on the evidence presented and examples of firms that have been associated with the sugar palm. The problems in educating the community were obstacles that had to be overcome for the project to run smoothly.

Fig. 10.7 The manufacturing of sugar palm syrup (no. 1–4)

The second visit was to a company called Kebun Rimau Sdn. Bhd. in Tawau, Sabah, which produces sugar palm block and sugar palm syrup as its major products. Figure 10.7 depicts the stages of creating sugar palm syrup, from harvesting sugar palm sap to bottling sugar palm syrup. The equipment was created in partnership with Malaysia Agricultural Research and Development Institute and was designed by the firm (MARDI). After the sap is collected, it will be pre-heated to ensure that it is not readily damaged. The sap will then be filtered and sent into a second machine, which will treat it to make it denser and lengthen its shelf life. Following that, the syrup will be bottled and sold.

Benta, Kuala Lipis, Pahang, was the site of the third visit. The main product of this company is sugar palm block (Fig. 10.8). Almost most of the locals here make money by selling sugar palm blocks. Based on observation, the raw material for producing sugar palm blocks was gathered from wild sugar palm trees. They also make sugar palm blocks using a traditional manner.

Fig. 10.8 The sugar palm sap is cooked and poured into moulds

They climb the sugar palm tree early in the morning to get the sap. To remove any contaminants, the sap will be filtered before being placed in a large pan. The sap will next be boiled until it thickens and becomes viscous and then poured into the mould and left to harden before it cools. The final process is to pack the sugar palm blocks so they may be sold.

10.3.3 Technology Transfer (from Waste to Wealth)

Traditionally, agricultural waste has been used to dispose of the useless parts of sugar palm trees used for sap production. According to the use of sugar palm trees, the fibre and the tree trunk, leaves and fruit will be burned or left to decay, as illustrated in Fig. 10.9. UPM researchers devised a scheme to address this issue that converts these wastes into new goods, improving the locals' life in Kampung Kuala Jempol. The community was drawn to the project because of this concept. This project also included constructing a traditional building that houses the production process and distributes sugar palm goods. It is also hoped to increase the number of visitors to Kampung Kuala Jempol (Fig. 10.10).

UPM researchers briefed on the potential products from the sugar palm tree as part of this technology transfer. Aside from that, UPM taught the community how to make sugar palm-based products, including sugar palm block, sugar palm fruit, broom, bottlebrush, etc. In addition, UPM assisted in providing tools and machines for the manufacturing process.

The chief of Kampung Kuala Jempol praised the project and encouraged the community to take advantage of it. He also wants to promote this community as a

Fig. 10.9 The tree was burned to remove the fibre (*ijuk*); besides, the fruits and trunks were left to decay

tourist attraction in the Jempol district to fulfil the government's "One District, One Industry" initiative under rural industry.

Rural industry is also known as a traditional industry. This industry is a platform to produce any products or handicrafts produced by the village community who still use the traditional local methods inherited from their ancestors. Efforts to develop

Fig. 10.10 A series of demonstrations to the community on obtaining sugar palm starch and sugar palm fibres

local industries always get attention from the government because this industry is said to have a lot of importance. The government always gives support by giving incentives and capital to rural industrial entrepreneurs to develop in parallel with other sectors. Although the rural industry is considered small, it also contributes to its economy.

On the other hand, the existence of rural industry also provides employment opportunities to the children of the village itself. In turn, it can reduce the migration rate of rural people to the city centre. This situation can certainly reduce the city's population growth, and thus social problems can be avoided. In addition, the existence of rural industries can encourage residents to get involved in the business. Other than that, the rural industry run by the villagers can maintain the traditional artistic and cultural values inherited from time immemorial.

10.4 Products

Sugar palm fibre, starch, roof, rope, brooms, brushes, bottlebrushes, vinegar, fruit, liquid sugar, fined sugar and block sugar are the 12 goods based on sugar palm that has been successfully created (Fig. 10.11). All products with attractive packaging can attract buyers in a short period. In addition, two products, sugar palm fibre (Fig. 10.12) and sugar palm starch (Fig. 10.13), have registered trademarks (Fig. 10.13). Fibres (all fibre-based products), trunk (starches), flowers (sap for generating sugar) and fruits are the four primary sections of the sugar palm tree's products.

10.4.1 Sugar Palm Starch

Figure 10.13 depicts the steps involved in producing starch, also known as sago. Sugar palm sago starch manufacturing begins with the sugar palm tree being cut

Fig. 10.11 Twelve products from sugar palm tree

Fig. 10.12 Sugar palm fibre and sugar palm logo trademark™

Fig. 10.13 Sugar palm starch production and sugar palm logo trademark™

down. A chain saw is used to remove the inner part of the trunk. The sago material recovered during the extraction procedure is then soaked in water.

The sago detritus will be squeezed to extract the milk after a few hours and left overnight. The use of an extruder machine, as shown in Fig. 10.14, improves the extraction process of starch.

The milk will then separate into two layers: water and starch sediment. The starch will then be dried in direct sunshine after removing the water. The clump starch will be pulverised in the traditional way of making starch flour. Later, the original

Fig. 10.14 Sugar palm sago extruder machine for extracting starch

procedure is enhanced by using an extruder machine to extract the starch, similar to how coconut milk is made. The sugar palm starch can be purchased online using the Shopee application or directly at grocery stores. The price for 1-kg starch is between RM20 and RM30.

10.4.2 Products from Sugar Palm Sap

The sap is the major producer of the sugar palm tree. The production of sugar palm sap is not easy because it needs to be collected through the cut branches. The sellers or farmers who collect sugar palm sap must wait until the sap is full in the container; if the sap is left for too long it will turn into alcohol. A bottle of sugar palm sap was sold for RM4.

Other than that, sugar palm block, sugar palm syrup, fine sugar and vinegar (using the fermentation process), as well as bio-ethanol, can all be made from the sap. The price for sugar palm block varies between RM15 and 20/kg depending on the location. Sugar palm sap is obtained from male flower bunches because it produces a large amount of sugar palm sap of high grade. Sap can be yielded for up to 3 or 4 months. Sugar palm bunches that are shrink and dry indicate that sap production is coming to an end. Depending on the fertility of the trees, 4–5 L of sap can be gathered twice a day from each bunch. The number of male bunches present in

Fig. 10.15 Product derived from sugar palm sap

the tree can estimate the amount of sap present. If there are multiple male bunches on the tree, the sap from each one can be harvested simultaneously. Figure 10.15 depicts the products of sugar palm sap, whereas Fig. 10.16 presents the sugar palm block production flow.

10.4.3 Sugar Palm Fruits

Aside from the diversity of items made from sugar palm trees, they also produce fruits processed into food. According to some locations, the Malay community refers to this sugar palm fruit by its traditional name. However, some common names include "beluluk", "buah kabong" and "kolang-kaling", with "kolang-kaling" being the most popular in Indonesia. Because it is frequently employed in the culinary business, this fruit is one of the most popular side dishes in the Malay community (Fig. 10.17). The sugar palm fruit is oval, spiky and clear or white in colour. Sugar palm fruits can be purchased online or directly at a grocery with a price range of

Fig. 10.16 The production of sugar palm block starting from sap collection until packaging

Fig. 10.17 Sugar palm fruit

RM15–RM20/kg. The demand for sugar palm fruits will be increased when the Aidilfitri celebration comes.

10.4.4 Sugar Palm Fibres

Ijuk fibres are another local term for sugar palm fibre. It has a black tint and a diameter of 0.5 mm on average. This fibre can resist temperatures of up to 150 °C. These fibres' high strength and durability qualities make them multifunctional in harsh environments. Aside from that, it is also resistant to seawater. An ijuk fibre comprises hundreds of microfibrils held together by lignin, which gives the fibre its strength. On average, each sugar palm tree can generate about 15 kg of ijuk fibre. A machete is used to separate the ijuk from the tree. To make climbing a tall tree easier, a ladder is used, or notches are cut into the tree's height. The ijuk is then gathered before being packaged and ready for sale. Broom, brush, bottlebrush, roof and rope are examples of ijuk fibre products, as shown in Fig. 10.18. The product can be found at any grocery and the price is affordable (Table 10.1).

UPM is now undertaking research on sugar palm fibres (SPF) as a composite reinforcement material. Table 10.2 compares the tensile qualities of sugar palm fibres to those of other commercial natural fibres such as coir, cotton, kenaf and others.

Fig. 10.18 Products development from sugar palm fibres

Table 10.1 The product from ijuk fibre and their price according to Shopee application

No	Product	Price (RM)
1.	Broom	5.00–20.00
2.	Brush	1.20–3.60
3.	Bottlebrush	15.00–20.00
4.	Roof	12.00
5.	Rope (20 m)	5.00–10.00
6.	Ijuk fibre (1 kg)	20.00–30.00

Table 10.2 Tensile properties of sugar palm fibres and other commercial natural fibre

Fibre	Tensile strength (MPa)	Tensile modulus (GPa)	Elongation at break (%)	References
SPF/Kuala Jempol	233 ± 71.17	4.189 ± 1.61	20.6 ± 9.29	Huzaifah et al. (2017a, 2017b)
SPF/ Indonesia	219 ± 79.71	3.889 ± 1.78	20.4 ± 9.29	Huzaifah et al. (2017a, 2017b)
SPF/Tawau	211 ± 89.19	4.324 ± 1.15	15.8 ± 6.82	Huzaifah et al. (2017a, 2017b)
Cotton	287–597	5.5–12.6	3–10	Satyanarayana et al. (1990), Li et al. (2007)
Ramie	220–938	44–128	2–3	Li et al. (2007)
Hemp	550–900	70	1.6	Li et al. (2007)
Jute	393–800	10–30	1.5–1.8	Li et al. (2007), Rao et al. (2007)
Sisal	227–400	9–20	2–14	Rao et al. (2007), de Silva et al. (2008), Fávaro et al. (2010)
Kenaf	250	4.3	–	Lee et al. (2009)
Coir	108–215	4–6	15–40	Rao et al. (2007)

Misri et al. (2010) used a hand lay-up process to create a small watercraft utilising a hybrid of sugar palm fibre- and glass fibre-reinforced unsaturated polyester composites. Ijuk fibre is suited for water use due to its water resistance qualities, allowing it to survive in water for an extended period of time. However, because artificial fibre is stronger than a natural fibre, it is hybridised with glass fibre to improve mechanical durability. The experiments on sugar palm fibre undertaken by UPM researchers are listed in Table 10.3.

10.5 Equipment, Machines and Facilities Developed

A lot of equipment, machinery and facilities were produced as a result of this initiative, from harvesting to commercialising sugar palm goods. Figures 10.19, 10.20 and 10.21 depict some of the equipment and machines used in this project to convert sugar palm fibres into commercial products.

Table 10.3 List of selected studies conducted by UPM researchers on sugar palm fibre

Researchers	Fibres	Matrix	Process
Januar (2005)	Long sugar palm fibre	Epoxy	Hand lay-up
Suriani (2006)	Long sugar palm fibre	Epoxy	Hand lay-up
Dandi (2008)	Long sugar palm fibre	Epoxy	Hand lay-up
Leman (2009)	Long sugar palm fibre	Unsaturated polyester	Hand lay-up
Ishak (2009)	Long sugar palm fibre	Unsaturated polyester	Hand lay-up
Sahari (2011)	Sugar palm trunk fibre, sugar palm frond fibre, sugar palm bunch fibre, Ijuk fibre	Unsaturated polyester	Cold press
Sairizal (2011)	Long sugar palm fibre	Unsaturated polyester	Hand lay-up
Ishak et al. (2012)	Long sugar palm fibre	Unsaturated polyester	Cold press
Dandi (2012)	Short sugar palm fibre	High impact polystyrene	Hot press
Ibrahim (2013)	Long sugar palm fibre	Thermoset	Cold press
Sahari et al. (2013)	Sugar palm powder	Sugar palm starch	Hot press
Sanyang (2015)	Sugar palm cellulose	Sugar palm starch	Solution-casting technique
Ilyas et al. (2016, 2017a, 2017b, 2018)	Sugar palm nanocellulose	Sugar palm starch	Solution-casting technique

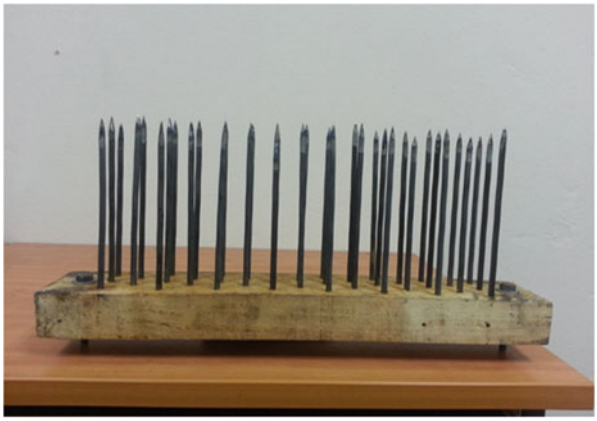

Fig. 10.19 Sugar palm fibre cleaned and isolated according to a certain grade

As illustrated in Figs. 10.22, 10.23, 10.24 and 10.25, a small factory was created to provide a better facility to accommodate all produced machines/equipment as well as working space for this project. This structure serves as a hub for the project and a collection, processing and commercialisation facility for sugar palm products. The

Fig. 10.20 Broom from sugar palm fibre

UPM team project developed the building, and the total cost was estimated to be around USD 20,000.00 using the grant funds. All project facilities, such as a loading bay, work area, office, room, bathroom and a separate small building for processing palm sugar and electric power and water supply, are available in the building.

Fig. 10.21 Bottlebrush and cleaning brush from sugar palm fibre processing

10.6 Conclusions

The goal of this community endeavour was to create sugar palm-based products. The National Blue Ocean Strategy (NBOS) initiative was supported by the Malaysian Ministry of Education (MOE). One of the goals of this project was to impart information about the production of products made from sugar palm fibres and get the community involved in the development and marketing of the product. This project aimed to introduce the community to the sugar palm tree's potential for goods other than sugar palm sap and fruit. This knowledge transfer programme included visits to three sugar palm-based businesses in Tasikmalaya, West Java Province, Indonesia; Tawau, Sabah; and Benta, Pahang, and training and equipment for the local population in Kampung Kuala Jempol, Negeri Sembilan. Sugar palm fibre, starch, roof, rope, brooms, brushes, bottlebrushes, vinegar, fruit, liquid sugar, finer sugar and block sugar are 12 goods developed due to this effort.

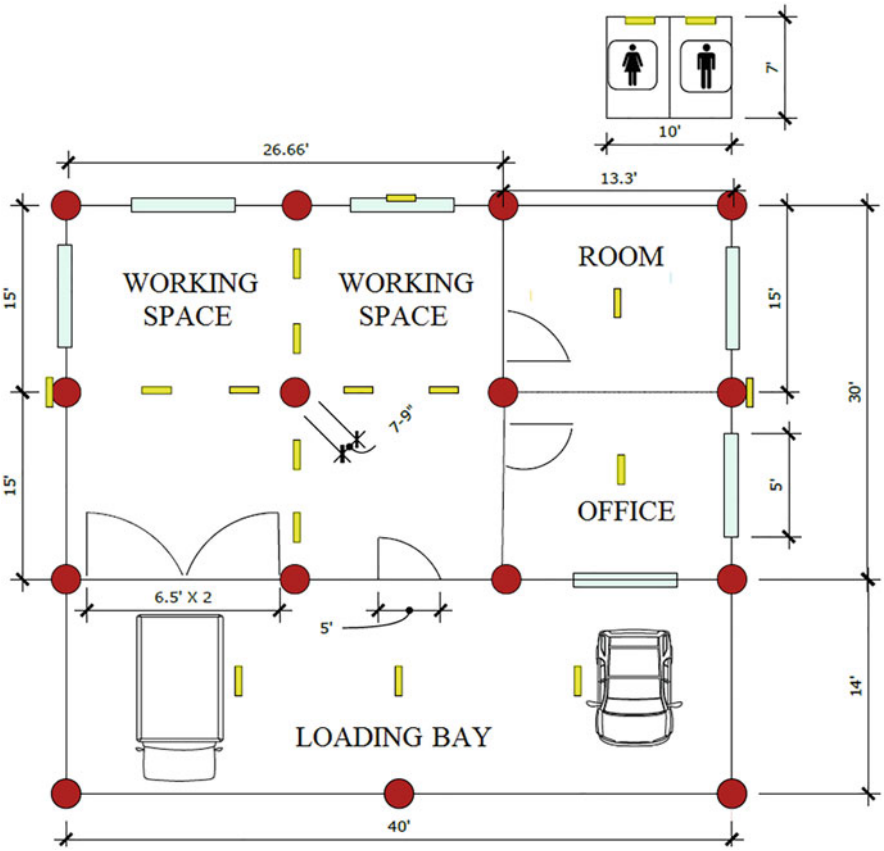

Fig. 10.22 Plan view of the building design

Fig. 10.23 Front view of the building design

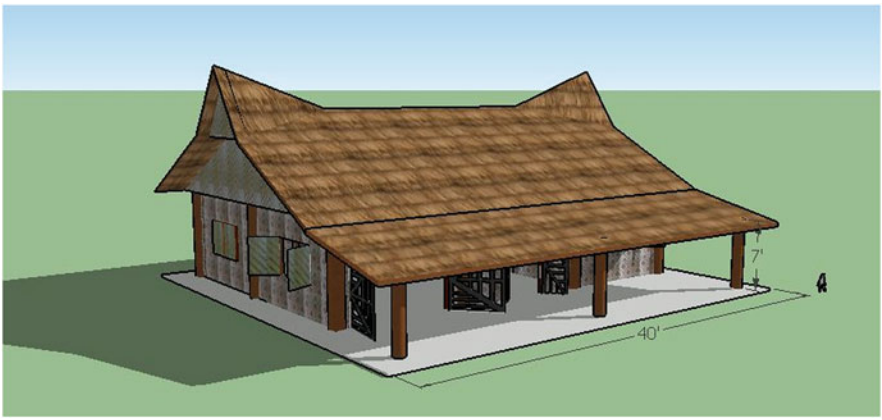

Fig. 10.24 Isometric view of the building design

Fig. 10.25 The completed building photo

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