

## Traditional Wisdom Sustainable Future: *Gula Apong* Processing Hut

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### ABSTRACT

*Gula apong* is a type of traditional sugar made from *Nypa fruticans*, a type of palm that can be found abundantly at coastal areas of Sarawak. *Gula apong* is processed and produced under a small hut known as *langko*, which is built in the *N. fruticans* forest. The current condition of existing *langko* is in a state of disrepair and neglect, marked by the absence of proper access roads, no clean water supply, no electricity, poor building structures, inadequate hygiene, and an inconvenient layout. The paper aims to improve the design of the *gula apong langko* to help sustain the *gula apong* industry with two main objectives: (1) to identify sustainable features for *langko* design and (2) to develop a new *langko* design incorporating these features while maintaining the original's essence. Fieldwork was conducted on seven *langko* structures located in Pusa, Asajaya, and Kuching. Data was collected through observation and site analysis to assess the physical condition, spatial layout, materials, and sustainability elements of *langko* structures. Non-structured interviews with local producers were also conducted to obtain more information on the *langko* conditions. From the study on the condition of the existing *langko*, the areas needing improvement include three main elements, including space planning, construction methods, and sustainable features. The new *Langko* design is divided into a semi-private area and a public area. The semi-private area is an enclosed space for the production of *gula apong*, while the public space can be used as a product display area or café. The semi-private area is built with enclosed walls to prevent contamination and ensure hygiene during the production of the *gula apong*. Water harvesting system, solar panel for lighting, transparent roofing for natural lighting, and sustainable local materials are among the features incorporated into the new design.

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## 1. INTRODUCTION

The celebrated *gula apong* of Sarawak, also known as nipa palm sugar, is extracted from the *N. fruticans* palm. This specific palm species grows profusely in Sarawak's coastal regions. Notably, Malay communities inhabiting the coastal areas of Asajaya (Samarahan Division) and Pusa (Betong Division) have a long-standing tradition of actively producing *gula apong* (Nais, 2021; Sahari et al., 2018). In the past, *gula apong* was traditionally produced in the coastal villages where refined white sugar was not yet introduced to local people. It was mainly used as a sweetener in drinks and foods. Compared to refined white sugar, *gula apong* is considered more natural due to its minimal processing and the absence of chemical additives throughout its production process (Abdullah et al., 2022). *Gula apong* contains high amounts of vitamins and minerals; hence, its popularity has

increased as a replacement for white and brown sugar (Saengkrajang, 2021).

Production begins early in the morning with the harvesting of the *air sadap* (*nypa sap*) from *apong* palm (*N. fruticans*) (Hui Yan & Sarbini, 2024). Collected *air sadap* is brought to a small processing hut known as *langko* for the next stage of *gula apong* production. In the *langko*, the *air sadap* is slowly cooked in a large wok over firewood. The cooking process will take approximately four hours and requires continuous stirring until it thickens into *gula apong* by afternoon. The production of *gula apong* requires passion and craftsmanship as the process is time-consuming and labor-intensive. Despite the production challenges, *gula apong* is still in high demand, particularly by the food industry (Sahrani et al., 2024). For instance, food producers such as Mokti, Sam's and Tea Tree incorporate *gula apong* as one of the main ingredients in their products. Mokti and Sam's are

renowned for their signature *gula apong* ice cream, while Tea Tree features *gula apong* as the primary sweetener in its beverage series (Sarawak Food & Drink Magazine, 2024).

*Gula apong* industry can be considered a cottage industry business that is home-based rather than being manufactured in a factory (Balakrishnan & Arithar, 2018). Therefore, the production process seems to be less efficient, and even with a massive number of raw materials, difficult for small entrepreneurs to sell products in large quantities quickly.

These problems occur due to the lack of investment and serious assistance from the government for the development of the *gula apong* industry (Dayak Daily, 2022). The Sarawak State Government, in collaboration with *Lembaga Pemasaran Pertanian Persekutuan* (FAMA) however, intends to export Sarawak's *gula apong* to Europe. Currently, *gula apong* is distributed not only throughout Peninsular Malaysia but also to markets in the Middle East and several Asian countries. In 2021, Sarawak exported RM1.93 million worth of *gula apong* products, with domestic sales reaching RM3.38 million, reflecting its growing demand and economic significance (Rundi, 2025). To support and expand these export efforts, producers are required to obtain Halal and food safety certifications such as *Makanan Selamat Tanggungjawab Industri* (MeSTI) and Good Manufacturing Practice (GMP), which play essential roles in ensuring hygiene, manufacturing quality, and hazard control throughout the food production process. These certifications aim to ensure product quality and safety, enhancing consumer confidence and market access locally and internationally.

In line with these certifications, a compliant processing facility is necessary for the proper production of *gula apong* (Utusan Sarawak, 2020). However, *gula apong* producers who are categorised as micro-scale entrepreneurs often lack the financial means to build improved *langko* that comply with the certification requirements. The poor condition of existing *langko*, combined with limited economic support, has led to a decline in interest among the younger generation to continue the trade (Abdul Hamid et. al., 2024) As a result, there is a growing risk that *gula apong* production may gradually decline, especially with the increasing availability and affordability of alternative sweeteners such as refined sugar, honey, and treacle.

Thus, this paper aims to improve the *gula apong langko* design in order to sustain the *gula apong* industry. There are two main objectives, which are (1) to identify sustainable features for *langko* design and (2) to develop a new *langko* design incorporating these features while maintaining the original's essence. The proposed *langko* with sustainable characteristics is hoped to be used as a pioneering project for *gula apong* entrepreneurs to improve

their existing *langko*. It can also simultaneously enhance the productivity and sustainability of the *gula apong* industry.

Upgrading the *langko* plays a vital role in preserving the Sarawakian Malay food heritage associated with *gula apong* production. As integral components of the tangible Sarawakian Malay heritage, the *langko* and *gula apong* must be safeguarded to ensure their continued existence.

## 2. MATERIALS AND METHODS

Fieldwork was conducted in the Kuching, Asajaya, and Pusa areas. The locations were selected due to the high density of *N. fruticans* palm trees and the significant number of local *gula apong* producers. The fieldwork involved four different villages, namely Kampung Pinggan Jaya, Kampung Sri Tajo, Kampung Tambirat, and Kampung Kalok, consisting of seven *langko*. The fieldwork had been done over a period of time, with each visit lasting one to two days. The seven *langko* were selected purposely due to their active operation as a place to prepare, process and produce *gula apong*. The selection was based on several factors such as its current *gula apong* production, ease of access, securing owner permission, its geographical location, and its physical condition. Table 1 shows the details of the *langko* selected. Only seven *langko* could be included due to limitations related to accessibility, location and owner permission. Studies on rare events and occurrences have a high chance of producing small samples (McDermott, 2023). The *gula apong langko* is no exception due to its limited availability to be studied. This study adopts a qualitative research approach through direct observation and site analysis to assess the physical condition, spatial layout, materials, and sustainability elements of *langko* structures (Victoria et. al., 2017). Observations were conducted not only on the physical structure of the *langko* but also on how producers interact with and utilize the space and the surrounding environment in their daily operations. In addition, non-structured interviews with the seven owners of the *langko* were conducted to obtain more information on the condition of the *langko*.

**Table 1:** Details of the location of the *langko* studied.

District	Division	Village	No of <i>langko</i> studied
Kuching	Kuching	Kampung Pinggan Jaya	1
Asajaya	Samarahan	Kampung Sri Tajo	1
		Kampung Tambirat	3
Pusa	Betong	Kampung Kalok	2

## 3. THE CONDITION OF EXISTING LANGKO

The *gula apong langko* is mostly located within the *nipah* forest in rural areas. Access to the *langko* can be challenging due to the nature of the *Nipah* forest, which is

muddy and located near rivers. During high tide, the nipah forest is often swamped by water, and sometimes the *langko* area will be flooded by the tide. Production of *gula apong* is challenging during high tide and the rainy season due to the flooding of the *nipah* forest and the *langko*. Figure 1 shows a *langko*, which is located inside the *nipah* forest.



**Figure 1:** *Gula apong langko* located in the *Nipah Forest* of Kpg Tambirat, Asajaya

Observations reveal that many *langko* structures are in a state of disrepair and neglect, evident from the absence of proper access roads, clean water supply, and electricity, along with their poor building structures, hygiene, and layout. Some of the *langko* have leaky roofs and worn-out structures. The floor of the *langko* is usually bare soil, as shown in Figure 2. One of the reasons for the floor to be made of bare soil is due to the high tide occurrence or flooding from nearby rivers. The use of bare soil as flooring raises concerns about the cleanliness and overall quality of the *gula apong*.



**Figure 2:** A *gula apong langko* with bare soil as floor

The absence of walls in *langko* structures facilitates ventilation, accommodating the thick smoke generated from the boiling of *air sadap*. The large amount of smoke produced during the boiling process of the *air sadap* makes it impractical to have a fully enclosed hut. But according to representatives from the Ministry of Health Malaysia, the space shall be enclosed in order to prevent contamination from various external sources, such as pests and pollutants.

In the middle of *langko* is the elevated traditional stove made from bricks or dried soils as shown in Figure 3.

The elevated traditional stove is used to put the large wok for boiling and stirring the *air sadap*. Firewood is used to supply heat for the boiling process. The *air sadap* is boiled and stirred for up to four to five hours until it slowly becomes *gula apong*. Some *gula apong langko* have a small enclosed space on one side of the *langko* to store utensils for the *gula apong* production, as can be seen in Figure 4. The *langko* also has a small elevated platform known as *para* to put the firewood and bamboo container that is used to collect the *air sadap*. The elevated platform for storing bamboo containers was built near the stove so that the smoke could dry them. Figure 5 shows the elevated platform to store the firewood and the bamboo container.



**Figure 3:** Elevated traditional stove to cook the *air sadap* that will turn to *gula apong*



**Figure 4:** Small enclosed space at one side of the *langko* for storage



**Figure 5:** Elevated platform known as *para* to store and dry bamboo container for collecting *air sadap*

Observations on the *langko* condition indicated a need for improvements in key elements such as interior space planning, main structure, and facilities provided. The existing *langko* has an open-plan layout for all activities, which contributed to improper food handling during the *gula apong* production. In addition, the timber structures were found to be significantly damaged and deteriorating. The timber structure deterioration likely stems from moisture issues, errors during construction or repairs, and financial difficulties in its upkeep.

#### 4. IMPROVEMENT ON THE LANGKO DESIGN AND LAYOUT

United Nations Sustainable Development Goals, SDG 3 and SDG 11 promoted the development of sustainable cities with an aim at improving the living conditions of the communities by providing them with a better quality of life (Takano et. al., 2023; Bardhan, Kurisu & Hanaki, 2011). Thus, by designing appropriate *langko* for the *gula apong* production represents a significant step toward supporting *gula apong* entrepreneurs to contribute to the SDG 3 and SDG 11. Various types of economic activities related to high standards of products and services are the key factors to drive and boost the economy of many nations. The intention to design a new building layout is expected to meet basic food safety requirements. Moreover, efforts to improve the *langko* design help to conserve the traditional *gula apong* production facility for the purpose of a tourism attraction. According to Nuanmeesri (2022), there are more business opportunities for each nation to develop its tourism industry, distribute the national wealth, and increase the national employment rate simultaneously. This suggests that the *gula apong* industry can boost both food production and tourism economic activity to improve the economy of local people in the area that is actively involved in *gula apong* production.

Retail store layout—also referred to as store design layout or interior space planning is a term used by retailers to set up product displays, fixtures, and merchandise in their store. Among the important elements for a better store layout is to focus on the ergonomics of the workspace and the types of selling products. Designers need to come up with a retail store layout that works and is suitable for the business. The store design layout is considered as part of business operation strategies to ensure the easy flow of customers in the store and place the products strategically (Rosli et al., 2022). In order to make *gula apong langko* a tourism attraction needs new design layout is needed to fit the *langko* function as a *gula apong* production area, and at the same time serve as a place to display products related to *gula apong*. The *langko* can be adapted into a café, and at the same time, the tourist can experience the process of making the *gula apong*. These ideas aim to make the *gula apong langko* a lively tourism

product of Sarawak, and at the same time, as an active production area of *gula apong* need new suitable store design layout.

From the observation on existing *langko*, the identified three main elements requiring upgrades include space planning, construction method, and sustainable elements. The elements considered for redesigning the *langko* optimize work circulation, enhance hygiene, and ensure product quality and safety. It aligns with the foundational stipulations of JAKIM and the Ministry of Health, simultaneously elevating the commercial and economic viability of the *gula apong* industry. Therefore, information such as steps of making *gula apong* for the purpose of space planning, suitable economical techniques for the construction method, and availability of surrounding natural resources for providing sustainable facilities is essential.

Adaptability of sustainable criteria includes reducing, reusing, and recycling construction material waste, and also using locally available building materials (Saidu & Yeom, 2020). Meanwhile, a good space planning design and construction will enhance the cleanliness in food preparation and minimize health and security risks at work. Conversely, inefficient layouts can simultaneously lead to constriction, congestion, and poorly used space. Upgrading the *gula apong langko* to comply with food safety and health standards will not only improve its operations but also create opportunities for local tourism. Table 2 shows the comparison between the existing *langko* design and the proposed new *langko* design.

**Table 2:** Comparison between the existing *langko* design and the new *langko* design

Elements	Existing <i>Langko</i> Design	New <i>Langko</i> Design
Space Planning	Simple and congested, space usage focuses on processing <i>gula apong</i> only	Space usage can be optimised for processing, packaging, and display of <i>gula apong</i> products
	Open space	Divide into public and semi-private zones. A semi-private zone is an enclosed space to ensure the hygiene of the processing area
	No toilet and changing room	Includes a toilet and a changing room
Construction Method	Timber frame	Steel frame and bricks
	No window due to no walls	Sliding window and exhaust fan for ventilation
	No smoke hood	Smoke hood
Sustainable Elements	Rainwater tank	Rainwater harvesting system
	No solar lighting	Solar lighting
	No transparent roof	Transparent roof for natural lighting

#### 4.1 Space Planning

Layout design has become a fundamental basis that can impact work efficiency in food processing plants (Fitriani et al., 2015). The existing layout design of *langko* is simple and congested, resulting in poor ergonomic conditions for workers. The *langko* is only used for processing the *gula apong*, but packaging activities are carried out at another place. Therefore, a new layout is designed to establish the *langko* as a one-stop center, enabling all *gula apong* production to occur in a single location. The optimization of interior space layout can greatly reduce the workload of the manufacturer and even serve customers directly (Dong & Ran, 2022). The upgraded *langko* will not only serve as a *gula apong* production area but also as a place to market and display the *gula apong* products.



(a)



(b)

**Figure 6:** The *langko* is divided into public area (exterior) (a) and semi-private area (interior) (b)

Initially, grouping spaces or sub-zones into zones can lead to spatial layouts that are more logical from a discipline's point of view (Claessens et. al., 2020). The new *langko* is basically divided into two zones, which are public and semi-private areas, as shown in Figure 6. A public cozy section for the customers to taste food products made from *gula apong* can be proposed as part of upgrading the *langko*

for commercialization and tourism purposes. Meanwhile, the other part of the layout is designed for *gula apong* production activities. Although enclosed to maintain hygiene, it still allows customers to witness the process of producing the *gula apong*. Kitchen spaces are focal points when it comes to food production space planning by its necessary functions to the communications and the social aspect around it (Moslehian, Warner & Andrews, 2023).

The rapid economic development in recent years has led to the improvement of people's living standards, and consumers' requirements for food and beverages have transitioned from the initial focus on eating to a level of hygiene, health, comfort, and product preparation with the right procedure (Petrescu et. al., 2020). Therefore, toilets and changing rooms are being included to meet the standard requirement in the *langko* spatial layout. However, the toilets are located outside the main production area to facilitate the movement of materials in a hygienic way. Creating effective segregation between the toilet and the workstation, it helps minimize the risk of food contamination (Rosli et. al., 2022., Lelieveld, Holah, & Napper, 2014). Meanwhile, a changing room is compulsory for workers to change into suitable attire before the food processing activity starts.

The cooking area is the most crucial place where freshly harvested *nipah* sap is placed in a large wok known as *kawah*, heated over a wood-fired traditional brick stove. The cooking area is partially enclosed with glass windows to allow customer view the *gula apong* processing activity. Open shelves were lined along the walls to hold the cooking utensils, as it was described as a better and more economical solution to have visible and easily accessible storage (Mirka, 2023). Packing activities of the *gula apong* can be done at one side of the production area. This is to eliminate the need to transport the *gula apong* elsewhere for the final product packing activity.

#### 4.2 Construction Method

The new *langko* design layout can be incorporated into existing *langko*, used when rebuilding old *langko*, or applied to entirely new sites—depending on suitability. The proposed new location should be selected based on the availability of clean water sources, electric supply, access road, and proximity to *nipah* area. This is to ensure the *langko* design can be optimised for the safe production activity and assurance of food quality.

The construction methods remain relatively simple with the use of basic materials available in the market and incorporation of some traditional materials to maintain the original form of the *langko* for tourism attraction purposes. Among the traditional materials that can be incorporated in the *langko* construction include timber, bamboo, and palm thatch.

According to villagers that involve in the *gula apong* production, timber is preferred over steel structures because it does not rust. The problem when using timber is it poses a higher risk of fire. Thus, in the new design, steel framing is much preferable with the brick wall build. The steel frames can be protected by a protective coat, such as paint, in order to prevent rust.

The original *langko* does not have an enclosed wall to allow ventilation. Health Authority required the new *langko* design to build walls to protect the production area from contamination, especially when the *langko* not in operation. In order to obtain Halal status, the food production operation shall follow the requirements by JAKIM (Jabatan Kemajuan Islam Malaysia). According to JAKIM's Halal Certification Procedure Manual 2020, the premise shall be protected from any contamination, especially from any animals or pest and shall be in clean conditions (JAKIM, 2020). By providing enclosing the production space with a wall will protect the food products and any utensils used from any possible contamination.

A large sliding window will be installed to allow ventilation. The sliding window will be opened during the processing *gula apong* activity. This sliding window will be closed when the facility is not in use. A smoke hood can be provided on top of the stove to remove the smoke during the *air sadap* cooking activity. In addition, an exhaust fan can be installed to remove heat from the production area.

The exterior part of the *langko* is an open public area. Located at the front of the *langko*, the space can be used as a mini café for the visitors to relax and enjoy any *gula apong*-based food products. The construction materials for this open space are from traditional materials such as bamboo, timber and palm thatch. This can add aesthetic value to the *langko* as a unique tourism attraction. The improved *langko* design presents a seamless integration with its traditional elements.

### 4.3 Sustainable Elements

The original *langko* construction itself practiced sustainable construction in terms of materials and method of construction. The wood, bamboo and palm thatches used to build the *langko* are considered sustainable materials (Stia et. al., 2024; Liu et. al., 2022; Yadav & Agarwal, 2021; Tomovska & Radivojevic, 2017). Sustainable materials can be defined as materials that have low impact on the environment and low carbon footprint (Liu et. al., 2022; Yadav & Agarwal, 2021). Originally, the roof of the *langko* was made from *nipah* palm thatch. The frame of the structure is built from timber materials. Figure 7 shows one of the existing *langko* that still maintains palm thatch as the roof material.

In the new design of *langko*, the public space in front of the semi-private production area will incorporate the

traditional sustainable materials in its design. The roof is made from *nipah* palm thatches and the frame will be built from either bamboo or timber. The use of these materials not only supports sustainable construction but also helps to conserve the original form of the *langko*, especially for tourism attraction purposes. The *langko*'s value increases, thus transforming it from solely a *gula apong* production site into a viable tourist destination. This concept is comparable to coffee production sites in Bali and Banyuwangi, Indonesia. The premise serves as cafés and a tourism attraction (Rahardi et. al., 2024; Ribek & Saraswati, 2019).



Figure 7: Palm thatch roofing in the existing langko at Pusa, Betong

The new *langko* will be installed with a simple rainwater harvesting system. The collected rainwater will be used for general cleaning and as a water supply to flush the toilet. The installation of a rainwater harvesting system helps to save the clean water supply consumption (Lani, Yusop & Syafiuddin, 2018). A clean water supply will be used for food processing purposes and for cleaning the utensils. A filtration system can be installed in the water harvesting system to remove impurities from the rainwater.

The *langko* continues to rely on natural light for the lighting in the interior part. Existing *langko* does not have a proper wall to cover the *gula apong* processing area, thus allowing natural lighting in it. Due to requirements by the Ministry of Health Malaysia and JAKIM, the new *langko* design shall have an enclosed wall to protect the processing area from contamination. A lighting system powered by a solar panel can be installed in the *langko* to light the space. Apart from that, transparent roofing may be used in selected areas of the roof to allow natural lighting.

## 5. CONCLUSION

The existing *langko* was found to be in poor and improper conditions. The access road to the *langko* are in disrepair, and there is no clean water supply. The *langko* is located on a swampy terrain, which becomes flooded during high tide and the rainy season. Improvements to the existing *langko* are essential to ensure the continuity of the *gula apong* industry from a local cottage business to a mass production

industry. The existing *langko* design shall be improved to ensure food safety and maintain hygiene, and the quality of the *gula apong* produced can be guaranteed for the consumers. The new design proposed to improve the existing *langko* aligns with regulatory standards set by the JAKIM and the Ministry of Health Malaysia. Key sustainable elements features incorporated into the new *langko* design, such as the use of local materials, a water harvesting system, transparent roofing and lighting powered by solar-powered lighting. The effort to bring the *gula apong* industry to another level shall start from the improvement of the processing facility, which is the *langko* itself. A humble beginning with a small yet efficient facility can eventually scale to a mass production outlet in the future. Not only that, the *gula apong* production facility can serve as a tourism attraction in rural Sarawak.

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