

Review Article

Sago and the indigenous peoples of Papua, Indonesia: A review

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Abstract

A significant concern with the food security issue worldwide is indigenous peoples and their food resources. The indigenous peoples of Papua are still very dependent on rice, a heavily imported commodity. During the global pandemic, the indigenous peoples of Papua faced the issue of food supply and food resilience. Simultaneously, Indonesia has the largest sago (*Metroxylon sagu* Rottb.) palm-growing areas, accounting for over half (51%) of the 2.3 million hectares of sago worldwide, and about 90% of sago is estimated to be in Papua and Maluku. Indigenous food crops such as sago are exceptionally resilient to adverse local environments, highlighting their crucial role in ensuring food and nutrition security, particularly during a natural disaster. However, despite sago's multiple uses and benefits, it is still poorly evaluated as a food resource by the government, with consumption at relatively low levels. This paper reviews the state-of-the-art regarding indigenous peoples and their food resources, focusing on why sago is essential, not only for the indigenous peoples of Papua but also for the possibility of introducing sago to the world.

Introduction

The Food and Agriculture Organization (FAO) of the United Nations estimates that the number of people affected by undernourishment has increased from around 804 million in 2016 to nearly 821 million in 2017 (Food and Agriculture Organization, 2018). Moreover, recent findings from the Intergovernmental Panel on Climate Change (IPCC) of the United Nations regarding the average global temperature have identified that for each 1 degree of temperature increase, grain yields decline by about 5 percent. Maize, wheat, and other major crops have experienced significant yield reductions at the global level of 40 megatons per year

between 1981 and 2002 due to a warmer climate (Intergovernmental Panel on Climate Change, 2018). Hence, global food production needs to increase by at least 50 percent to feed 9.5 billion people in 2050 (Gardner, 2013). Therefore, innovative research regarding food security will be essential to offer innovative solutions to address this challenge.

Indigenous peoples and food security

A significant concern with the food security issue is that of indigenous peoples and their food resources. According to Kuhnlein et al. (2009), indigenous peoples are defined as those who retain the knowledge of the land and

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food resources rooted in historical continuity within their region of residence. In the context of this study, *Orang Asli Papua* is a term that has the same meaning as indigenous peoples according to the law of the Republic of Indonesia on Special Autonomy for the Papua Province (No. 21 of 2001). Many indigenous peoples are changing from traditional locally sourced foods to imported foods. The traditional knowledge of indigenous peoples' food systems has been recognised for thousands of years, not only for its physical and spiritual aspects but also for its balanced relationship with the natural environment, including healing and protection from disease (Johns et al., 2013). However, despite the richness of traditional knowledge of healthy eating and living in rural communities, the 370 million indigenous peoples globally are still very vulnerable to food insecurity, unhealthy diets, and prolonged illnesses (Egeland & Harrison, 2013). Recent data suggest that although indigenous peoples make up approximately 5 percent of the world's population, they account for 15 percent of the poorest (United Nations Development Programme, 2019).

Research suggests that there have been massive dietary shifts across the globe. This *nutrition transition* phenomenon (Popkin, 2006) from the use of traditional diets toward the consumption of westernised diets, which are more energy-dense, with high contents of sugar, salt, and saturated fats, contributes to the observed increase in the rates of obesity and overweight in many parts of the world (Popkin et al., 2012). More recent evidence shows that despite the awareness of the community about the health benefits of indigenous food resources, the consumption of these foods is low due to local people's preferences for the convenience of modern foods (Ghosh-Jerath et al., 2018; O'Meara et al., 2019). Furthermore, a threat to traditional food's existence is identified in research in South Africa, where the people have labelled their traditional food crop as "poor people's food" with negative connotations (Cloete & Idsardi, 2013). Thus, a challenge in the field of promoting traditional foods for indigenous peoples is not only to ensure the availability of foods for their daily consumption but also to raise the awareness and knowledge

of the people about the health benefits, environmental benefits, and sense of identity and belonging of their own traditional indigenous food sources.

Traditional foods are the cultural products of indigenous peoples passed down from previous generations. A growing body of literature has examined culture as an essential aspect in food security analysis, specifically through indigenous peoples' perspective (Kuhnlein et al., 2009; Demi, 2016; Huambachano, 2018). Food security is not just about the agricultural practices to produce sufficient food for the world (Huambachano, 2018) and the indigenous ways of thinking about the relations and connections between people and their natural environment (Ratima et al., 2019). Furthermore, concerning passing on traditional knowledge and values about traditional foods, culture, and identity, several studies found that elders and community members played a crucial role for young generations (Demi, 2016; Islam et al., 2016). Hence, the core problem of food security for indigenous peoples is preserving their cultural values and identity to ensure availability and sustainability for the next generations.

The cultural values of indigenous peoples are closely connected with the cultural values from outside the community, and industrial products are one of the challenges that need to be addressed carefully. The research on indigenous peoples has raised some concerns about the emergence of industrial food products that replaced traditional food consumption and production (Egeland & Harrison, 2013; Kuhnlein et al., 2013). Research on underutilised crops shows that only about 30 crops provide 95% of human food energy needs, four of which (rice, wheat, maize, and potato) are responsible for more than 60% of our energy consumption globally (Konuma, 2018). However, despite the emergence of public health issues among indigenous children because of the decline in the consumption of their traditional foods and their unhealthy diets (Seto & Associates, 2006; Popkin et al., 2012), Lemke & DeLormier (2017) suggest that there is a need to bridge indigenous and western approaches to mitigating this phenomenon to develop a comprehensive understanding of indigenous peoples' food systems, while at the same time

equally valuing both knowledge systems. Therefore, despite the influx of industrial food products to the indigenous community from the global market, a better understanding of the western food system is essential to ensure food security, adequate food resources, nutrients, and nutritional implications are to be ensured worldwide.

In the literature, many studies suggest that women use indigenous knowledge to a greater extent than men in achieving household food security (Kuhnlein, 2017; Lemke & Delormier, 2017; Aluko, 2018). However, despite their significant contributions to household food security, indigenous women in many countries face discrimination regarding their gender and ethnicity (Food and Agriculture Organization, 2015). This continuing gender-based discrimination negatively impacts indigenous women's health, nutritional status, and the overall well-being of households and communities (Lemke & Delormier, 2017). In nearly two-thirds of countries, women are more likely than men to report food insecurity, and 330 million women and girls live in poverty (United Nations Women, 2018). Recent data suggest that, globally, the prevalence of food insecurity is higher among women than men, 25.4 percent and 24.0 percent, respectively (Food Agriculture Organization, 2019). Therefore, promoting indigenous women's empowerment is fundamental to preserve the indigenous knowledge of food security in society and contribute to achieving goal number five in SDGs, which is gender equality and empowerment of all women and girls (United Nations Women, 2018).

Overall, this section has provided a substantive discussion regarding food security for indigenous peoples: from traditional foods and rich indigenous food culture to the emergence of external factors such as industrial products that bring different values to local food resources' traditional knowledge. The international community now recognizes that special measures are required to protect indigenous peoples' rights and maintain their distinct cultures and way of life (United Nations, 2019). Therefore, research on indigenous peoples should address elements of the local food system and demonstrate how these local foods

contribute to food security, nutrition, health, and local culture (Kuhnlein et al., 2009).

Indonesia context

Tanah Papua (Land of Papua) has enormous potential. It consists of two Indonesian provinces: Papua and West Papua. The two provinces contain half of Indonesia's total biodiversity, particularly its endemic flora and fauna (Marshall & Beehler, 2007), and the cultural diversity of Tanah Papua comprises at least 250 indigenous ethnic groups, each with their language or distinctive dialect, and their traditional ecological knowledge (Indrawan et al., 2019). However, according to the Food Security and Vulnerability Atlas (FSVA) published by the Food Security Agency of the Ministry of Agriculture of the Republic of Indonesia (2018), some areas of Indonesia, despite its rich area of biodiversity and cultural diversity, in particular, Papua and West Papua provinces, need more attention in terms of food security. Unfortunately, sago (*Metroxylon sagu* Rottb.), as one of the traditional crops, is still poorly evaluated as a food resource by the government. As pointed out in the FSVA 2018, there was no statistical data on sago production and consumption. The report only shows data regarding the production of rice, maize, cassava, and sweet potato. These crops were selected because they provide almost 50 percent of the daily calorie intake in the average Indonesian diet (World Food Programme, 2015). Hence, sago is still not considered as a potential crop to promote local food security.

Another factor that contributes to food security in Indonesia relates to the rice policy. Rice is a staple food and Indonesia's single most valuable commodity (McCulloch & Peter Timmer, 2008). Since the early 1970s, Indonesia's government has focused on rice-centred policy (McCulloch & Peter Timmer, 2008). A recent study shows that wheat imports have been increasing over the past two decades (Booth et al., 2019). Furthermore, Pingali (2007) suggests that Indonesia experienced the westernisation of Asian diets: the slowing of per capita consumption of rice and the increased per capita consumption of wheat-based products. Rice

availability is crucial for Indonesian people because the poor still spend about 26% of their expenditure on rice and 65% on all foods, tobacco, and beverages (Booth et al., 2019). According to Statistics Indonesia (2019a), about 26 million people live below Indonesia's poverty line. A person is considered poor when the expenditure per capita per month is below the poverty line. The poverty line of West Papua is equal to 516,362 IDR (Indonesian rupiah) or approximately 36 USD. Although Indonesia is considered the leading producer of paddy rice, as number three producers in the world after China and India, Indonesia must import rice each year to fulfil national consumption. In 2018, the value of rice imports to Indonesia was approximately 1.037 billion USD (Statistics

Indonesia, 2019b) or ranked third with 38 million metric tons of rice consumption worldwide (United States Department of Agriculture, 2019a). Also, wheat flour consumption keeps increasing each year (Table 1), with an average growth of 25.3% within the period of 2014–2018 (Organisation for Economic Co-operation and Development, 2019). Indonesia cannot produce wheat and is entirely dependent on wheat imports to fulfil the demand for wheat flour-based food and wheat products, with total wheat imports of 10.5 million tons in 2018 (United States Department of Agriculture, 2019b) or rank second in the world with approximately 2.57 billion USD in 2018 (Statistics Indonesia, 2019c; United States Department of Agriculture, 2019b).

Table 1. Consumption per capita of wheat and rice in Indonesia

Food Item	Year				
	2014	2015	2016	2017	2018
Wheat (kg/capita/year)	24.72	24.94	25.66	25.98	25.37
Rice (kg/capita/year)	134.36	134.83	133.82	133.10	134.58

Source: Organisation for Economic Co-operation and Development (2019)

These data suggest that Indonesian people's food consumption is very much dominated by rice, a staple food, and the increasing consumption of wheat, which is highly dependent on imports. Booth et al. (2019) argued that Indonesia's food security problems centre around rice policy and a broader food availability issue, which leads to greater reliance on food imports. At present, the potential of local food resources such as sago is neglected regarding food security. It may be particularly relevant for the people in the eastern part of Indonesia, especially in Papua.

Sago, the underutilised indigenous food resource

"Underutilised" is commonly applied to refer to resources whose potential has not been

fully realised. Indigenous food synonymous with used signifies food naturally existing, originating, or prepared in a place or country rather than arriving from another area (Food and Agriculture Organization, 2014). Many underutilised crops were once more widely grown but today face many social, economic, environmental, agronomic, and policy challenges (Padulosi et al., 2013). Despite all of the challenges and the current state of food insecurity worldwide, sago palm was identified as one of the most promising underutilised food resources with a high potential for contributing to global food security (Konuma, 2018).

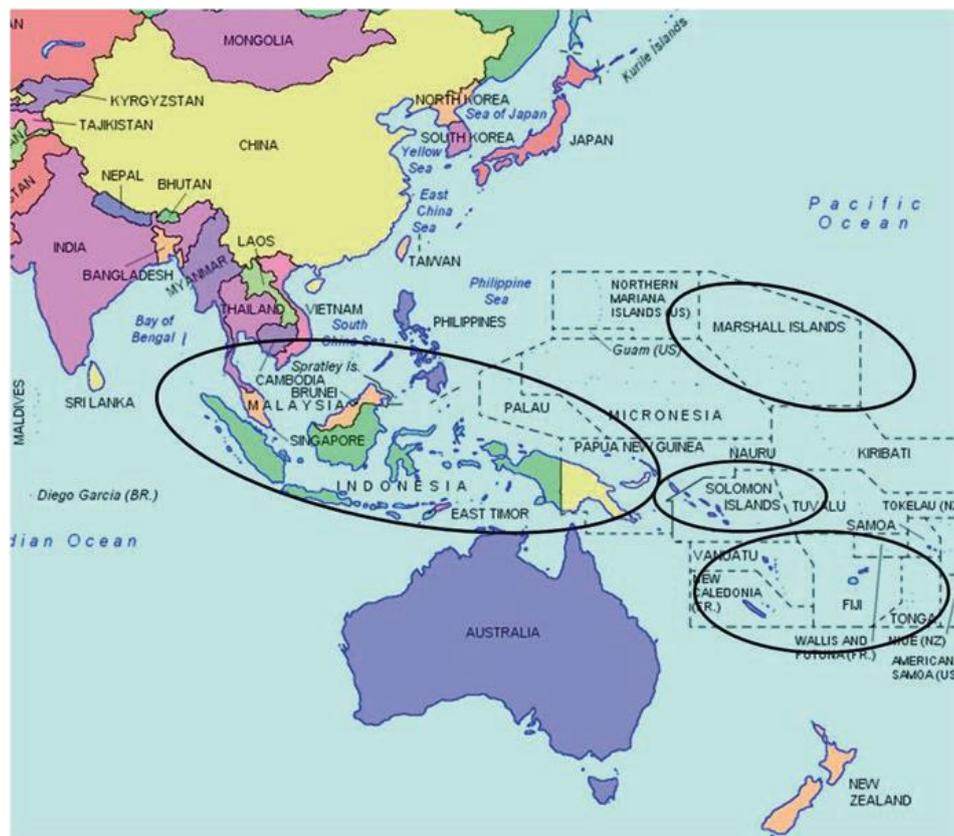


Figure 1. Map of sago palm-growing countries (Black circle countries)
Source: Konuma (2018)

Flach et al. (1997) suggested that the word *sago* is originally Javanese and means starch-containing palm pith. The scientific name is *metra* meaning pith or parenchyma and *xylon* meaning xylem (Singhal et al., 2008). Sago palm (Figure 2) is a species of the genus *Metroxylon* belonging to the Arecaceae family and is a socio-economically important crop in Southeast Asia (Flach et al., 1997). Figure 1 shows that sago palm is grown between latitude 10° north and 10° south in Southeast Asia and Pacific Island countries (Konuma, 2018), and it includes most of Indonesia Malaysia, southern Philippines, southern Thailand, Papua New Guinea, Solomon Islands, Vanuatu, Fiji, and Samoa (Ehara et al., 2018).

According to Konuma (2018), Indonesia has the largest sago palm-growing areas, with approximately 1.128 million ha of sago palm or 51.3% of 2.291 million ha of sago worldwide. About 90% of sago is estimated to be in Papua and Maluku (Flach et al., 1997). However, a previous study suggested that in the Papua area

alone, sago occupies 2.8 million ha, and 369,382 ha in West Papua. It is estimated that the potential of sago production in the provinces of Papua and West Papua is around 12.7 million tons of starch dry every year. Still, only about 0.34% is used, and an estimated 6 million tons of dried starch is wasted because it was not harvested every year (Djoefrie et al., 2013). In the context of Papua, sago is a multi-purpose crop used by indigenous peoples in Papua's coastal and lowland areas as the primary carbohydrate source consumed and processed for generations. (Hasibuan et al., 2018; Ondikeleuw et al., 2020). However, the analysis of community acceptance of rice and sago commodities reveals that rice has become the community's staple food, with sago serving as a food interlude. The findings indicate that rice is more accessible due to the subsidy program. In contrast, sago is more challenging to obtain due to a declining sago tree population and can only be harvested at certain times (Hasibuan et al., 2018).



Figure 2. (a) Sago palm trees on the bank of a river (b) Sago palm trees that flourish; (c) Wet sago flour wrapped in pandan leaves
Source: [IndiTheater \(no date\)](#), [Ambarsari \(2013\)](#)

The [Ministry of Agriculture/Government of Indonesia \(2018\)](#) reported that sago starch consumption was 0.36 kg/capita/year or -0.12% of average growth from 2014 to 2018 ([Table 2](#)). It is hypothesized that sago production in the eastern part of Indonesia could empower the acceleration policy on diversifying food consumption based on local sources as mandated in Presidential Decree No. 22 Year of 2009. The regulation is one of the policies to promote food diversification consumption of local food such as cassava, corn, sorghum, and sago. In addition, the current food policy in Indonesia is Laws of the Republic Indonesia No. 18 of 2012 concerning food. Specific policy on Papua is Government Regulation No. 65 of 2011 concerning the Acceleration of the Development of the Provinces of Papua and

West Papua. By having local raw material as a basis, Indonesia's food security could become more resilient against supply disruptions caused by natural disasters in the form of crop failure due to climate change, war impact, etc. ([Hariyanto et al., 2013](#)). Several studies have found that indigenous food crops are exceptionally resilient to adverse local environments, highlighting their role in ensuring food and nutrition security, particularly during and after the occurrence of a natural disaster ([Mavhura et al., 2013](#); [Sambo, 2014](#)). In the context of climate change, recent research suggests that the impact of greenhouse gas (GHG) emissions generated to produce 1 ton of sago (17.9 kgCO₂eq) is much lower compared with corn starch (2700 kgCO₂eq), potato starch (2402 kgCO₂eq), and cassava starch (4310

kgCO₂eq) (Yusuf et al., 2019). Moreover, Bintoro et al. (2018) argued that there are two roles for sago production to environmental improvements: water conservation and the absorptions of CO₂. Sago palms can conserve soil water because the plants require high soil humidity, and compared with other major crops such as corn and rice, sago palms have

the highest CO₂ absorption (Bintoro et al., 2018). However, despite sago's multiple uses and benefits, the sago palm national program is not supported by adequate funding, resulting in sago resources being neglected as one of Indonesia's potential crops (Winarno & Hariadi, 2017).

Table 2. Average per capita consumption of sago flour

Food Item	Year					Average Growth
	2014	2015	2016	2017	2018	
Sago Flour (kg/capita/year)	0.388	0.469	0.417	0.334	0.366	-0.12

Source: Ministry of Agriculture (2018)

It is also important to note that the use of sago palms is very diverse. It represents an important food source and can be used for various purposes such as thatching and to make industrial products, including bioethanol (Figure 2) (Bintoro, 2011; Flach et al., 1997; Konuma, 2018; Ehara et al., 2018). Palms are primarily used as building materials. The leaves are used for thatching, brushes, and baskets; the petioles and rachises are used to construct fences, toys, and walls; and the bark is occasionally used as the flooring material. (Ehara et al., 2018). Sago can produce dry starch at 20 tons per ha, more than the starch provided by rice or corn, 6 tons and 5 tons per ha, respectively. In addition, waste streams can support the circular bioeconomy. The residue of sago palms has been made to produce several products such as fermentable sugar, enzyme, compost for mushroom, animal feed, and adsorbent. The utilisation of sago residue

reduces the polluting effects of by-products from the sago processing industries and provides economic value (Awg-Adeni et al., 2010).

However, there are some drawbacks to the use of sago as a staple food. First, it lacks nutritional value, other than carbohydrates, particularly protein (Table 3). Second, the sago crop needs an initial eight years of unproductive time to get starch after the first planting if planted from seed (Flach et al., 1997; Ehara et al., 2018). Fortunately, Maluku, Papua, and South Sulawesi people eat fish as part of their diets, so they are not protein deficient (Bintoro et al., 2010). Furthermore, although the high yield level of sago can only be obtained after eight years, sago is considered a perennial crop, which means it can produce for many years once planted, compared with other crops that need to be replanted regularly (Flach et al., 1997).

Table 3. Nutritional value per 100 g of an edible portion

Nutrient	Maize	Rice	Wheat	Potato	Cassava	Sago
Water (mL)	10.83	11.89	12.42	6.52	59.68	12.8
Calories	364	366	332	357	160	349
Protein (g)	8.75	5.95	9.61	6.90	1.36	0.6
Carbohydrate (g)	73.89	80.13	74.48	83.10	38.06	86.3
Fat (g)	5.09	1.42	1.95	0.34	0.28	0.2

Source: Institute of Nutrition, Mahidol University (2014) and United Stated Department of Agriculture (2018)

There is considerable literature that suggests sago is one of the traditional indigenous staple food sources (Flach et al., 1997; Girsang, 2017; Bintoro et al., 2018). As one of the oldest crops, the sago palm is not only a food source but is also related to many aspects of livelihood in sago-growing areas, such as rituals, feasting, and many other cultural activities (Ehara et al., 2018). Unfortunately, although Indonesia has the largest sago palm-growing areas worldwide (Konuma, 2018), Papua & Remco (2018) have indicated that the conversion of forest into palm oil plantations has led to the destruction of sago forests and hunting grounds. Furthermore, indigenous communities are forced to change their food habits and depend on commercial food products such as rice and instant noodles (Papua & Remco, 2018). This phenomenon clearly shows how human and natural

capital disruptions significantly influence the traditional food systems of indigenous peoples (Torres-Vitolas et al., 2019). Moreover, a challenging area in food security in Indonesia is the lack of awareness from the stakeholders regarding the local traditions that exist within the communities. Thus, it is time for locally-driven initiatives that will involve all stakeholders to bring benefits to the local health, social, cultural, and economic development of the indigenous peoples of Papua to utilise the abundance of the cultural diversity of Tanah Papua (Indrawan et al., 2019). Overall, this section has provided a sufficient understanding of sago and its potential, not only for the livelihood of indigenous peoples but also for ensuring the sustainability of the underutilised food resources worldwide.

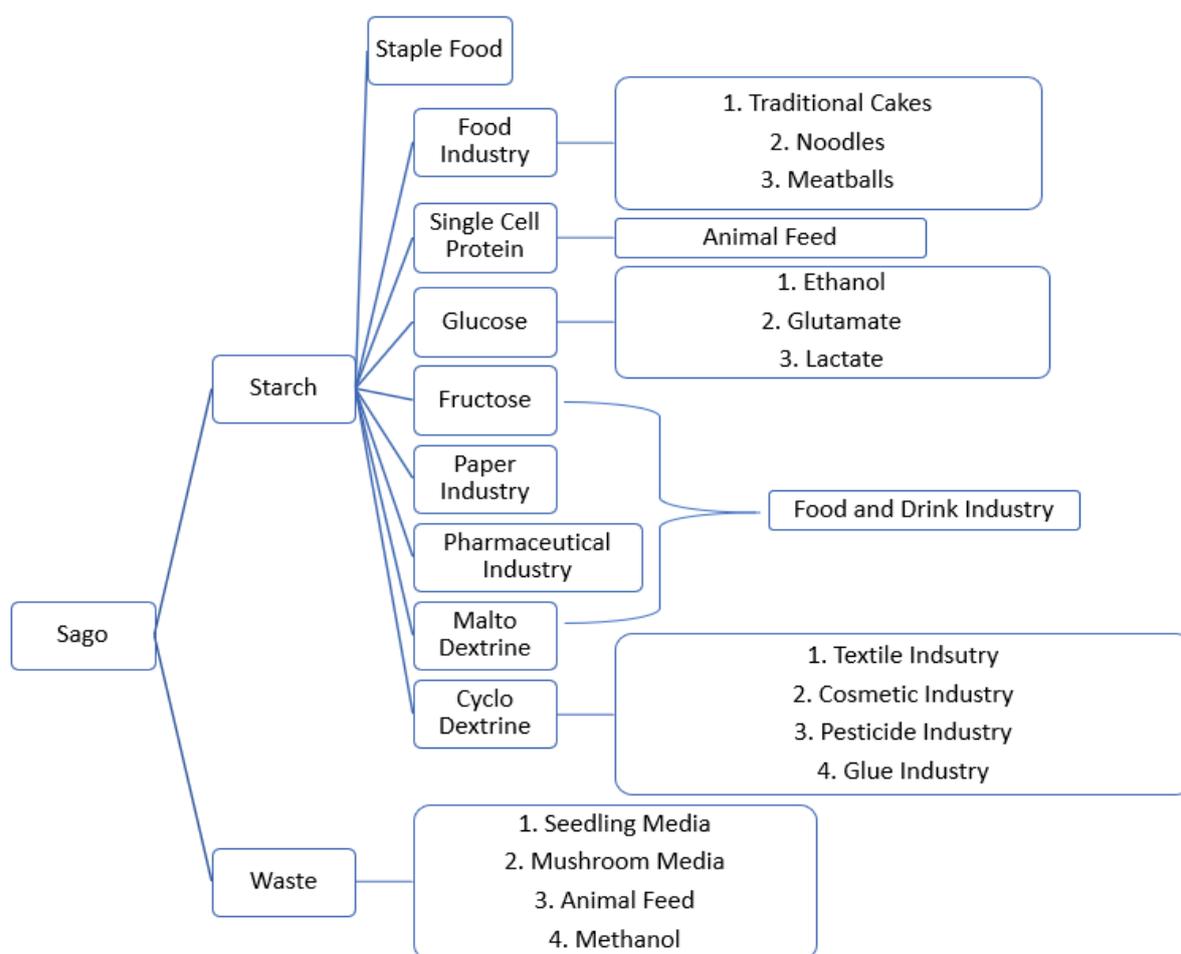


Figure 3. Sago utilisation
Source: Bintoro (2011)

Future of sago

Despite sago palm's enormous potential, little has been accomplished in cultivation, processing, and marketing (Jong, 2018). In the context of sago consumption in Papua, the local and national government, academicians, and private sectors need to work together to promote awareness about the importance of sago consumption as a staple food. The global pandemic teaches us that we can not only depend on relatively small numbers of crops for our food security. Data show that only about 30 crops currently provide 95 percent of human food energy needs, with four of them (rice, wheat, maize, and potato) accounting for more than 60 percent of our energy intake (Food and Agriculture Organization, 1995). Hence, sago as one of the underutilised crops can be an alternative solution. Recent research shows that sago can be processed into analog rice (a mixture of sago starch and brown rice flour) with good nutritional value and used as a staple food to complement rice (Hariyanto et al., 2020). The development and application of agri-food technologies to achieve 'sustainable intensification' of agri-food production has the potential to improve local and national food security. (Frewer, 2017). Another research in China shows that introducing agricultural modernisation policies will enhance food security while simultaneously promoting environmental protection (Clark, et al., 2018). Thus, the research and development of sago are considered essential for the indigenous peoples of Papua and the possibility of introducing sago to the world.

Conclusion

This paper has reviewed the concept of local food security and indigenous peoples and the importance of sago as one of the traditional foods for Papua, Indonesia. However, to realize sago's full potential, the research agenda must devote significantly more time and resources to better understanding the crop. Furthermore, there is an urgent need to shift perceptions of sago away from traditional, poor people's food connotations toward accepting how its benefits and the associated knowledge can be critical to the local food system's resilience.

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Author's declaration and contribution

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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