14ISS04

Potential for Up-scaling Sago Production in Manus Province, Papua New Guinea

K. K. Galgal[1*], Mandal, Bir C.,[1] Jong, F. S.[2] and Mondia M.[1]

[1] *FAO Country Office, Level 2, Central Government Office, Kumul Avenue, Waigani, NCD. P O Box 545 Vision City 131 Waigani, Papua New Guinea.*

[2] *103, Jalan Minsen, 94200, Siburan, Sarawak, Malaysia.*

**e-mail: Keith.Galgal@fao.org*

Abstract

Manus Island in Papua New Guinea is a food insecure province with low-income level and low economic activities at provincial, district and household levels. Sago starch is a staple food that provide food security for the island province. Manus Island has a rich natural sago palm resource. A pre-feasibility study was conducted in three sample locations – Maraman, Laues and Wireh representing the main island of Manus between 17 – 24 September 2022. The Rapid Rural Appraisal (RRA) method was used to assess the utilization of sago palm for food security and for cash sale at the local markets in Lorengau town.

It is estimated that there is 2,000 ha of natural sago forest resource on Manus Island and are located along the coast. At a conservative dry starch yield of one ton/ha/yr, the existing sago resources has a potential to produce 2,000 ton of dry sago starch per year. Currently, utilization of the sago palm resource is confined to close proximity to villages and hamlets. It is estimated that only 10% of is utilized as staple with limited trading. Large areas are left untouched and underutilized. Traditional and inefficient processing techniques have greatly impaired sago starch productivity in Manus. There are 5-6 folk varieties identified by the locals, namely *pao, pamat, pomolou, nduri* and *amoi*. All are claimed to be high in starch yield. The average starch yield of 32% is lower than those of cultivated sago palms in Indonesia and Malaysia (av 40% wet starch). Nonetheless, higher yields are expected if these palms are grown under better light condition and growing environments. Most varieties are reasonably high starch yielding. To improve sago starch yield and income on Manus Island, a sago value chain is proposed through increased sago starch production and marketing.

Key words: Food, Manus, Sago, Value Chain, Yield

Introduction

Sago starch extracted from sago palm (*Metroxlyon sagu*) pith is one of the main staple foods for 30% of Papua New Guinea's estimated 9 million people. Sago provides food security, cash income and meets other cultural obligations for lowland, atolls, and wetland communities. It provides sufficient calorie for food security and sustains life in coastal rural communities during natural disasters such as droughts, floods, and cyclones.

Main sago producing provinces in Papua New Guinea (PNG) are East Sepik, West Sepik, Gulf, Western and Manus provinces. Manus especially, an island off the New Guinea mainland, is a food insecure province (National Statistical Office and ICF 2019) due mainly to poor soil fertility (Burke and Harwood 2009). Sago thrives in waterlogged wet areas and can tolerate low pH. It is abundantly available in natural forests as well as cultivated and consumed as the main staple food on Manus Island. Manus Islanders depend on sago for their livelihood, for food security and source of income.

However, sago making in PNG is using rudimentary tools and practices that are passed on down generations for centuries. Yield of sago starch using traditional methods are low despite the time and labour committed in making sago.

The objectives of this study were to assess the feasibility of developing a community-based commercial sago value chain for Manus Island.

Materials and Methods

A pre-feasibility study was conducted in three sample locations representing the main island of Manus between 17 – 24 September 2022. According to information from Manus Provincial Agriculture Office active locations for sago production are mostly along lower reaches of larger rivers near to the coasts. These areas are Maraman, Lowa, Wireh, Liap, Laues, Gunralis, Patu, Powai, Bundahi, Nyada, Buliso and Lessau. Three areas representing the main Manus Island were selected for this study. They were Maraman to the north, Laues to the South and Wireh to the West of Lorengau town, the administration capital of Manus province. Maraman and Laues were accessed by sea transport while Wireh was accessed by road transport on the Somare Highway. The Rapid Rural Appraisal (RRA) method was used to assess the utilization of sago palm for food security and for cash sale at the local markets in Lorengau town and the potential for community-based commercial utilization of sago palm. Google Imagery was used to estimate the area of natural and cultivated sago palms, potential yield and volume of sago starch.

Average height and diameter of the sago palm were measured using a tape measure from palms previously felled and the pith proceed. Pounded pith residues were collected from the three sample sites rewashed to measure residual starch recovery. Wet sago cake from the locals making sago at the time of the visit were sampled to observe sago starch sieving quality by traditional methods.

Pounded pith samples were collected from a few sites at Maraman and Laues. These were milled using a food grade blender and starch extracted by filtering through a 100 – 150 micro mesh nylon sieve.

Discarded pith residue samples were collected from processing sites, milled using a food grade blender and rewashed through a 100 – 150 micron mesh sieve to determine the amount of starch discarded.

To demonstrate the inconsistent and rather poor quality of the locally produced sago starch, samples were collected from the market and at processing sites for rewashing and filtering using 100 – 150 micro mesh nylon sieve for the examination of impurities.

A market survey was conducted at Lorengau town market to determine the volume and quality of sago starch sold for cash.

Results

Sago Palm Resources on Manus Island

Manus Island has a rich sago palm resource. Most of the sago palms are natural stands distributed along the coastal areas in scattered patches near to the lower reaches and banks of larger rivers. Sago cultivations were observed in small numbers close to villages and along creeks mainly in the centre of the island along the highway from east to west. Those that are cultivated at creeks are locally regarded as good varieties selected and brought in from other locations. Cultivation in other areas cannot be easily distinguished. Based on Google imagery there are approximately 1,000 ha of sago palm stands (natural and cultivated) on Manus Island.

Natural environment characteristics of soils, water and climate, and farming practices of sago cultivation, harvesting and processing at the sample locations studied are:

(i) Maraman

The soils at Maraman River are generally characterized as low-lying containing deposits of organic matter originating from mineralization upstream that are ideal for sago palm growth. The color of river water is brownish, caused mainly by the decomposition of organic matters like fallen leaves, trunks and other decaying vegetation. In the area where we visited, the water is brackish even at low tides.

Sago palm growth close to the riverbanks are generally poor, with yellowish or pale green leaves, most likely caused by the saline water during high tides that impedes growth. Further away from the riverbanks, the growth of palms is healthy.

There are 5 folk varieties identified by the locals, namely *pao, pamat, pomolou, nduri, amoi*. All are claimed to be high in starch production. One owner estimated that a felled palm (average diameter of about 45 cm, trunk length 8.6 m) will yield about 200-250 kg wet starch.

(ii) Laues

At Laues, sago palms are mostly found at the lower stretches of the Laues River and surrounding low lying lands. Higher densities of sago palm are located further away from riverbanks. The soils along the low-lying river resemble those of riverine alluvial. As the upstream, the elevation increases, and the soils on the riverbank are rather sandy/rocky with fewer stands of sago palms, but their growth is good.

The water is saline and brownish at the lower reaches but becomes increasing clear and fresh upriver.

(iii) Wireh

According to local knowledge, larger volume of sago starch is actively produced at Wireh and has the largest area of natural sago palms. This was evidently witnessed from a hilltop overlooking the vast areas covered by sago palm in this study.

The observation spot (2° 08' 25" S, 147° 03' 33" E) is about 40 km by road from Lorengau. A large area was observed to be covered with sago palm at the low-lying area (5 km from observation spot). Soils are similar to that observed at other two sites. However, further confirmation would require drone imagery.

At the top of the mountain ridges, with an elevation of 200-350 masl, the soil type is vastly red, yellow podzolic. Healthy sago palms are common in small patches especially located at creeks around hamlets and settlements. These are likely brought in from other areas and cultivated around the settlement areas for easy access.

Sago starch Production and Processing

Sago production on Manus Island is mainly subsistence using traditional methods and tools acquired and practiced from generations to generations. Sago processing for sale at Lorengau town market is limited to traditional methods of harvesting and processing.

Palm felling and trunk sectioning are carried out by axes. For a palm with trunk diameter of about 40 cm, around 5-10 minutes is required to fell the palm. As the numbers of palms to be processed is limited at individual household levels, the use of expensive chainsaws is beyond their reach and is not essential at this time.

Pith maceration is carried out manually using a traditional bow shaped tool called *kuai* or *kuel* in local Manus language. It performs two key functions namely chipping the pith from the trunk and pound the chipped pith tissues into smaller particle size to release the starch. The *kuai* has a blunt end that does both chipping and pounding in one motion. This task is carried out by hand. It is physically demanding and is normally carried out by man. One man can chip and pound 1.5-2m of palm pith of an average size sago palm trunk (average 40 cm diameter) per day, though it was claimed by a sago landowner at Laues, that it is possible to pound 5m of trunk if working full day.

Though effective in chipping and pounding in a single action, the blunt end of the *kuai* is not very efficient in chipping or ripping off the pith tissues from the trunk, especially at the lower trunk that contains long and tough fibrous tissues (vascular bundles). The pounded pith is coarse and much starch granules are left unreleased in the coarse pith particles. This inefficient rudimentary tool will continue to be used for sago making in Manus until a better more efficient pith milling techniques are introduced and adopted. As such, it is helpful if a more efficient *kuai* can be innovated in the near future.

Starch extraction from the pounded pith is done manually using sago frond sheath as a washing trough. This is normally done by a woman though it is also physical demanding task. The process of manual extraction of sago starch by traditional method involves few steps.

1. Fixing the sago frond sheath as a washing trough
2. A piece of nylon shade cloth is tied at the wide-open end to serve as a sieve to allow passage of starch while retaining the passage of fibers.
3. A starch collection tub commonly made from an open dugout canoe is used to collect and settle the extracted starch.
4. The pounded pith is then transferred to the washing trough. Water is added and the pounded pith is

churned by back-and-forth motion as well as pressing to wash out the starch particles. After a few rounds of water adding and washing, the washed pith residue is discarded.

5. Starch slurry that flows through the sieve is collected and settled in the canoe. Settled sago starch cake is dug out and packed into various weights.

The filter used for starch filtering is from locally available material such as mosquito nets, hessian bags, nylon shade cloth and coarse fabric. These materials have large pore sizes allowing pith particles and debris to pass through the sieve and contaminating the starch.

To demonstrate the inconsistent and rather poor quality of the locally produced sago starch, samples were collected from the market and at processing sites for washing and filtering. The impurities/residues retained by a 100 mesh (150 micron sieve) included pith tissues, bark fragments and other organic matters (Figure 1).

Fig. 1 Impurities washed out and collected on a 100-mesh sieve from starch sold at Lorengau market.

From the pith residues reprocessed, 31.9 % starch (wet starch, about 50% moisture) was recovered (Table 1). This is the amount of starch recovered using a food blender for milling to reflect its maximum yield by mechanical extraction (chemical digestion will give even higher yield). In traditional processing, the starch yield is substantially lower.

The average starch yield of 32% is lower than those of cultivated sago palms in Indonesia and Malaysia (av 40% wet starch). Nonetheless, higher yields are expected if these palms are grown under better light condition, such as removal of overhead shades, and modern processing methods are used.

Table 1. Starch recovered from discarded pounded pith residues are washing using traditional methods in Manus

Supplier of pounded pith	Pith weight (gram)	Raw starch weight (gram)	% Starch	Average
Ida	1500	500	33.3%	
John	4000	1500	37.5%	
Tommy Lucas	2800	750	26.8%	
Susan	2000	597	29.9%	31.9%

Sago Starch Consumption and Marketing

Sago palms are mainly used for subsistence as sago starch is the staple food (apart from imported rice) for most of the inhabitants on Manus Island. It was observed that most of the starch produced are consumed as staple especially in rural areas. Surplus sago starch is sold mostly at Lorengau town market as wet starch, in various packing from 1 kg to about 10 kg (Figures 2).

Fig. 2 Sago Starch packed with different packaging materials in various weights sold at Lorengau Town market, Manus Island.

The 1 kg packs are priced at K2 whilst larger packings wrapped in sago leaves or in nylon lags (4-10 kg/pack) are commonly sold for between K6 to K15/pack. On average wet sago starch is sold at Lorengau town market at K2.25 per kg.

About 200-300 kg/day of sago (in wet form) is sold at Lorengau town market. This is not reflective of the actual sago market as some might have been sold and some may not be sold on a particular day. All sago starch produced are consumed locally or transported to other provinces for self-consumption and not for sale.

The prices fluctuate according to daily supply. On the 24 September 2022 when we visited the market, there were more sago on sale and the price per pack (in sago leaves) was about K10 (usually K15 for similar packing).

Sun-dried sago starch is occasionally sold at the market too. Sago starch (dried and wet) is widely barter traded with inhabitants in the nearby islands for fish and other marine products.

Discussions

Manus Province is a food insecured island province due mainly to poor soil fertility. This was observed from the variety, quality and price of fresh food sold in local markets. Type, yield, quality and variety of food grown are direct result of soil type and fertility. While on the other hand sago thrives in waterlogged wet areas and can tolerate low pH. Most of the sago palms on Manus Island are natural stands distributed in patches scattered along the coastal areas, especially near to the lower reaches of larger rivers.

Sago cultivation was observed to be practiced further inland from the coast in small clusters close to settlement areas and along gullies and creeks. These cultivated varieties are locally regarded as good varieties selected and brought in from other locations. Cultivation in other areas cannot be easily distinguished. Along Pachu River, a tributary of Maraman River about 15 km North of Lorengau town, the capital of Manus province, some sago palms are well tended with good spacing (thinning out undesirable palms and bushes cleared).

These palms could have been cultivated earlier though no new cultivation was seen.

There is no inventory available on total area of natural sago palm forest on Manus Island. Nor there is any data available on cultivated sago palm. Using Google Landsat Imagery, it is estimated that there are 1,000 ha of sago palm on the main Manus Island. A detailed study employing high resolution satellite or drone images is needed to quantify the total area occupied by sago palms, both natural and cultivated.

Manus Islanders depend on sago for their livelihood, for food security and source of income. It was encouraging to see villagers cleaning and maintaining their existing sago palm clusters. Most of the palm varieties have reasonably high starch content and their off shoots can be used for propagation. Low starch yield in some sago palm varieties could be due to factors other than genotype, i.e. overshadowing by trees, salinity (for palms growing in areas inundated by high tide) and competition from neighbouring sago clusters.

The traditional tools and methods used for chipping and pounding (milling) sago palm pith and starch washing to separate starch from the pith fiber by repeated churning, washing and squeezing is tedious and inefficient. These repeated actions are aimed at releasing the starch granules from the pounded fibrous pith tissues to ensure the starch to pass freely through the sieves. Because starch granules are trapped in the fibrous pith tissues, plenty of water is required to wash off the starch and thus the washing, churning and squeezing has to be repeated a few times.

This process of starch and fiber separation can be done much faster and effortlessly in submerged condition. When the pounded pith is placed in water, the fiber is readily dispersed to release the trapped starch granules, allowing the starch granules to flow downwards through the sieves by gravity. Tedious churning, washing and squeezing actions can be simplified by light stirring of the milled pith particles in water above the sieves.

Starch settling and recovery using a dug-out canoe or large nylon bags are common and acceptable in the absence of better choices. The locals also placed a piece of plastic or woven nylon sheet at the base of the settling trough for ease of lifting out the settled starch.

On average 32 % of extractable wet sago starch was recovered from discarded pith residues indicating that pith chipping and pounding (traditional milling) for starch extraction using traditional tools and processing method is not efficient. For example, an average yield of sago palm pith is 600kg and 150kg of starch is recovered by traditional methods, the residual pith discarded is 450kg, the amount of starch discarded with the residue is 144kg (32%) or 49 % of the total starch. This indicate that traditional tools and methods used by locals on Manus Island is 50 % inefficient. Improved processing techniques are required for efficient sago starch extraction on Manus Island and maybe the same applies for rest of sago producing and consuming communities in PNG.

Market for sago starch on Manus Island is limited to consumers in Lorengau town. This study found that only small quantity (200 – 300kg) of sago starch (in wet form) is sold for cash per day. At average price of K2.25 per kg, the value of sago starch traded on Manus is Between K450.00 (USD128.00) to K673.00 (USD192.00) per day.

Market for sago starch on Manus Island and also for rest of PNG is still underdeveloped. Whilst demand by domestic and international consumers is increasing. Better understanding of the sago value chain is needed to develop the sago starch industry in PNG.

Sago is gluten-free, making it a suitable replacement for grain-based flour for people with celiac disease or those who are gluten intolerant requiring grain-free diets.

International consumers of sago starch are increasing. For instance, Japan has an increased demand for starch, which may open up markets for sago from PNG. However, the taste tendency of Japanese consumers is diversified to demand foods that are not only cheap, but safe, healthy, natural and low impact to environment in producing these foods.

Conclusion

Manus Island has abundant sago palm resource. The islanders have utilized these resources as staples for centuries employing traditional processing techniques. More efficient techniques are needed to increase their sago production and additional income from starch sale.

With improved processing techniques, sago has the potential to become an important economic crop for Manus, both for domestic consumption and export market by establishing a value chain that will have direct link between consumer and producers.

To produce better and more consistent starch quality, a good sieve (100-150 micron) is essential to the local community. A piece of nylon filtration screen (1 m x 1 m) will help the locals a long way.

With the current status of sago value chain, a more practical approach is needed to commercial sago starch production in Manus province. A community-based pilot sago starch value chain with a nucleus entrepreneur with marketing as a catalyst is recommended.

References

Bourke, R.M. and Harwood, T. (eds) 2009 Food and Agriculture in Papua New Guinea. ANU E Press, The Australian National University, Canberra.

National Statistical Office (NSO) [Papua New Guinea] and ICF. 2019 Papua New Guinea Demographic and Health Survey 2016-18. Port Moresby, Papua New Guinea, and Rockville, Maryland, USA: NSO and ICF.