

Ethnobotanical knowledge of Marind-Anim Tribe in utilizing sago (*Metroxylon sagu*) in Merauke, Papua, Indonesia

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Abstract. Kadir A, Suharno, Reawaruw Y, Komari, Mahuze A. 2021. Ethnobotanical knowledge of Marind-Anim Tribe in utilizing sago (*Metroxylon sagu*) in Merauke, Papua, Indonesia. *Biodiversitas* 23: 264-272. Sago (*Metroxylon sagu* Rottb.) is one of the biological resources utilized by several communities, mainly in New Guinea and Moluccas region. In Papua (Indonesia New Guinea), sago is a source of food and is also used for the living needs of local people for generations. This study aims to explore the ethnobotanical knowledge regarding the utilization of sago by the Marind-Anim tribe in Merauke, Papua, Indonesia based on local wisdom. Data were collected using survey method and the analysis was done using qualitative approach. The research was conducted in 7 villages representing 6 sub-districts (Merauke, Sota, Tanah Merah, Kurik, Animha, Marind) in Merauke District. The results show that sago is an important resource for the Marind-Anim community to fulfill a wide range of needs from foods, building materials, and cultural activities. Each sub-tribe has a different perspective in grouping sago based on local knowledge. The difference is based on an understanding of the size of the tree trunk, the absence of thorns on the leaves, the height of the plant, the shape and size of the leaves, and the color of the stems/leaves. Based on local knowledge, there are at least five clusters of sago in the Merauke area across the villages surveyed. In Merauke, sago is processed into a traditional food called *Sep*, which is different from the people in the northern region of Papua, who process it into *Papeda*. In addition to *Sago Sep*, the community also knows other types of sago processing, namely *Sago Ebayak*, *Sago Kwetahuk*, and *Sago Simoli*. The community has conducted conservation efforts based on local knowledge in *Sar*, *Quality Sar*, and selective cutting. The goal of such efforts is to maintain the sustainability of sago in meeting the needs for foods.

Keywords: Local community, Marind-Anim tribe, Merauke, sago

INTRODUCTION

Sago (*Metroxylon sagu* Rottb.) is a tree species from the family of Arecaceae (palm group). The plant is native to tropical southeastern Asia, including Indonesia, Malaysia and New Guinea Island. Indonesia has the largest area of sago forest globally with 1.28 million hectares, or 51.3% of the total sago area globally (Metaragakusuma et al. 2017). In New Guinea Island, sago is one of the most important biological resources (Ellen 2006) and Indonesian New Guinea or Papua (Kadir et al. 2020).

Most of the sago areas in Indonesia are categorized as sago forests, i.e., sago plants that grow naturally without or limited intensive human intervention and external inputs (Metaragakusuma et al. 2017; Sidiq et al. 2021). The sago plant is believed to be domesticated in New Guinea, including Papua (Ellen 2006), although the certainty is unknown. Biogeographic evidence suggests that sago plants have spread from their center of origin in New Guinea and Maluku to different regions westward of Wallacea Line through human activity (Ellen 2006; Pasolon 2015; Vita 2017). In the eastern and central part of Indonesia, sago is found in Sumatera, Kalimantan and Sulawesi although it is not as extensive as in Papua. Until

2013, the total area of sago farming in Indonesia was only around 128,106, especially in Riau (Sumatra), while the rest was still in the form of natural sago forest (Sasaoka et al. 2014; Metaragakusuma et al. 2017; Vita 2017).

Sago is rich in carbohydrates, making it a staple food in some regions in Indonesia such as Maluku, Papua, and parts of Sulawesi (Ehara et al. 2000; Sidiq et al. 2021). Sago can also be used as a raw material for other foodstuff such as “bagea”, pearl sago, pastries, noodles, biscuits, crackers and laksa (Karim et al. 2008; Adrian 2018; Konuma 2018). Sago has a high carbohydrate content, high calories, superior in dietary fiber content (3.69 to 5.96%), and a low glycemic index (GI) value (28), so it is included in the category of functional food (Kusuma et al. 2013; Maya et al. 2020). Sago also has the potential as a source of nutrition for diabetic patients (Kusuma et al. 2013), and is used as other traditional medicine. In addition, sago can reduce metabolic risk factors, including post-prandial hyperglycemia, impaired blood glucose homeostasis and antioxidants (Suryanto et al. 2018). Traditionally, sago can be used to treat skin diseases, chickenpox, sheep, wounds, and abrasions. In addition, the leaves are used to reduce pain during menstruation, while the roots are used to treat gout and impotence (Syahdima et al. 2013).

The utilization of natural resources depends on socio-cultural characteristics of local community (Kadir et al. 2020). Many indigenous communities are highly dependent on natural resources to fulfill their livelihoods (Khan et al. 2018; Konuma 2018; Kadir et al. 2020). Therefore, local communities have regulated their use locally (Basiago 1999; Mensah and Castro 2004). This is the case in the utilization of sago which is done wisely concerning the local wisdom of the community since careless utilization and overexploitation of sago will affect the long term sustainability of sago, the environment and the community itself (Berners-Lee et al. 2018; Sidiq et al. 2021).

The Marind-Anim tribe is one of the tribes in the southern part of Papua that is still practicing strong tribal identity. They call *Anem* for men and *Anum* for women. The name Marid-Anim is widely used to refer to the identity of tribe, but the Marind-Anim prefers to use the word "Malind Anim", which means "native to this land" as a real human being. The area of their territory is called Anim-Ha and the word Marind is often used to refer to the tribe (Simbiak et al. 2019). According to Muller (2011), the Marind-Anim tribe is the first Papuan indigenous group known in detail by the outside world. The Marind-Anim inhabits a vast plain of southern Papua, ranging from the Muli Strait (Marianne Strait) to Papua New Guinea (PNG) border. Administratively, the area is within the Okaba, Kimam, and Muting Sub-districts in Merauke District, Papua Province. Some areas are savanna lowland with flora similar to the Australian continent. However, the swampy land in the area is overgrown with sago trees in especially

around the watersheds of Buraka, Bian, Eli, Kumbe, and Maro.

The Marind-Anim people are not an agrarian group of people, but rather their major livelihoods are from hunting and gathering forest products and catching fish in rivers (Tunjung 2018). From a cultural-ecological perspective, they are highly dependent and adapted to their natural environment, including food provision. However, the rapid population growth rate is likely to affect food availability for Marind-Anim people. Therefore, the utilization of local food must be followed by sustainable methods. This study investigates the utilization of sago (*M. sago*) by the Marind-Anim tribe in the lowland area of Merauke, Papua, Indonesia. This information is important to know whether local wisdom of the Marind-Anim tribe can sustain their livelihood, especially food security.

MATERIALS AND METHODS

Study area and period

The research was conducted in several villages in Merauke District, Papua Province, Indonesia including Wasur Village (Merauke Sub-district), Rawa Biru Village and Yanggandur Village (Sota Sub-district), Tambat (Tanah Merah Sub-district), Wapeko (Kurik Sub-district), Sanegi (Animha Sub-district), and Koiburse (Malind Sub-district) (Table 1; Figure 1). Initial field surveys were conducted from November to December 2019, and the subsequent surveys were carried out in December 2020, and May-June 2021.

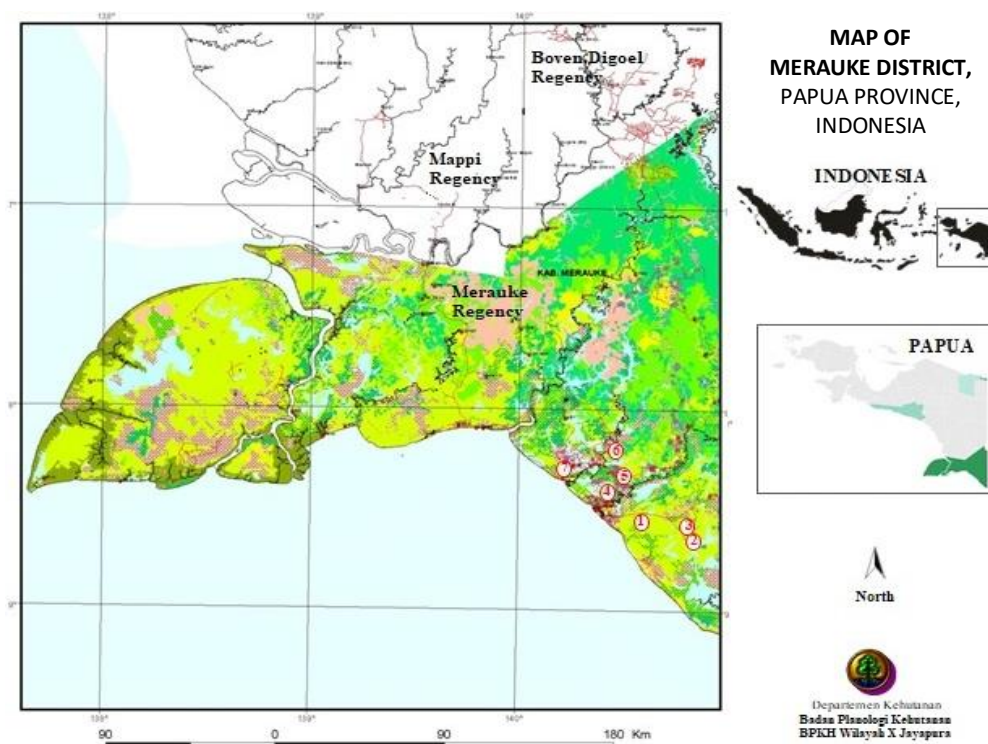


Figure 1. Map of the study locations in Merauke District, Papua Province, Indonesia: 1. Wasur, 2. Rawa Biru, 3. Yanggandur, 4. Tambat, 5. Wapeko, 6. Sanegi, and 7. Koiburse Village

Table 1. Geographical information of research locations in seven villages in Merauke District, Papua Province, Indonesia

Sub-district	Village	Coordinate	Altitude (m asl.)	Temperature (°C)
Merauke	Wasur	S: 08°31'41.6"; E: 140°38'44.8"	44	28
Sota	Rawa Biru	S: 08°40'16.4"; E: 140°50'57.7"	17	31.5
Sota	Yanggandur	S: 08°32'11.5"; E: 140°52'07.6"	27	31
Tanah Miring	Tambat	S: 08°20'37.0"; E: 140°36'20.5"	14	29
Kurik	Wapeko	S: 08°10'18.0"; E: 140°24'34.3"	6	30
Animha	Sanegi	S: 07°59'32.2"; E: 140°16'37.7"	15	29
Marind	Koiburse	S: 08°33'11.4"; E: 140°17'88.8"	4	31

Ethnobiology survey of sago utilization

This research was conducted collaboratively using interdisciplinary science with qualitative approaches to obtain comprehensive results. Data was collected through field observation, field interviews, Focus Group Discussion (FGD), and Participatory Rural Appraisal (PRA) by combining ethnographic and ethnobiological approaches. The PRA method allowed villagers to share, analyze, and improve their lives and communities' knowledge and make concrete plans and actions together (Schwartz and Lederman 2011). In addition, this approach was made to express the local community's point of view, which is considered native people.

Interviews were conducted by direct dialogue with key informants and respondents to collect relevant information including personal opinions, attitudes, and experiences. Key informants were selected based on their capacity as sago activists who understand things about sago based on the totem in Merauke. Respondents were 92 people in total. Information technology tools were used in data collection including tape recorder and handy camera. We used non-participant observation techniques, namely without being directly involved in the lives of the people observed and separately domiciled as observers.

The data of the results of the study were analyzed in a qualitative descriptive manner. In addition, observational data was tabulated in tables and descriptive analysis through socio-cultural studies.

Sago diversity dan soil data

The diversity of sago types based on local knowledge was extracted from 7 villages. Morphological characteristics were then arranged scientifically to find similarities and dissimilarities among sago types across the villages. The parameters observed included the character of the stems, leaves, smell, and starch color. Furthermore, the observational data was analyzed using Operational Taxonomy Units (OTUs) to investigate the similarities. Soil samples were also collected from 7 villages. The analysis of soil samples was conducted at soil laboratory of SEAMEO Biotrop, Bogor, West Java, Indonesia.

RESULTS AND DISCUSSION

The importance of sago for Marind-Anim people

Sago (*Daah*, local name) has a high socio-cultural value for the people in Papua. The results of observations show

that sago has cultural value and is utilized in various customary activities, such as wedding parties, building houses/settlements, human death ceremonies, child baptism, ear prick events, etc. According to Widjono et al. (2000a,b), Sasaoka et al. (2014), Kadir et al. (2020) and Arwam et al. (2021), sago is a staple food that provides living needs as an integral part of the function of forests and life activities for the community. Because of the importance of sago, most coastal communities live in areas where sago grow, such as rivers and swamps, to ease access to the resource.

The livelihood system of local people in the Merauke District is adapted to natural conditions (Kadir et al. 2020). Kadir et al. (2020) also stated that local communities in southern Papua, including Merauke District, have lived in wetland environments, especially rivers and swamps. The social life of the Marind-Anim community in Merauke District is generally based on kinship relationships. This kinship relationship is established within their tribes as well as other tribes. Kinship relationships are needed to form a harmonious atmosphere in the community. Traditionally, sago is included in the classification of clan values of Marind tribe, namely the Mahuze clan. The results of the interview revealed that most of the people are farmers. Their activities are gardening, hunting and fishing. In traditional farming systems, the community involves all family members to do mutual work (Suharno et al. 2016). The involvement of family members is important, because it acts as a learning processes regarding agricultural systems which can be carried out at all age levels. In this way, younger community members can also directly receive farming experience from the elders.

In addition to sago, other important plants utilized by the Marind-Anim community in Merauke include coconut (*Onggat*), mango (*Wiwih*), *Piper methysticum* (*wati*), betel (*Dadamih*), orange (*Yalok*), taro (*Kemb*), sweet potato (*Hiskhw*), cassava (*Kasbi*), gedi (*Dalgole*), thorny tuber (*Naal*), and un-thorny tuber (*Ihw*) and breadfruit (*Balau*). Other crops have low economic value but are also used by local communities as food and necessary for local indigenous traditions. Meanwhile, the men usually also hunt in the forest to catch wild boar (*Sus scrofa*) and deer (*Cervus* sp.), collect anthill (*Myrmecodia* sp.), rattan (*Calamus* sp.), honey, and bark of gambier (*Uncaria gambier*). Hunting products, as well as forest products such as rattan, gambier, anthill, and honey, are usually sold to the middlemen who come from the city. The community also make house roof from woven sago leaves (*Ebta*),

skeleton tong of bamboo (*Kalalad*), rope for woven from the trunk of the inner coconut smelt (*Onsask*), while the pillar of the house is made of “gaba-gaba” (*Yales*) which is sago that is still young and dry.

Sago harvesting by Marind-Anim

Sago plant is harvested based on the appearance of flowers. According to the community, sago to be cut down is those aged 8-10 years. The process of sago harvesting by the Marind-Anim community is just like the people of Papua in general. People use equipment called *Kaghol*. *Kaghol* usually consists of sago midrib (*Aphn*), sago filter (*thigh*), and sago beater (*Khweg*) to extract sago starch. To separate sago fibers from the stem it uses a tool called *Ambuk/Maur* whose stalk is made of wood or bamboo and the tip of the stalk is made of iron.

The sago starch processing method takes special energy and skills, which is not an easy matter. There are different roles between men and women. Women usually go to the forest to make sago in groups in the morning. When far away from the village, they will bring food supplies and spend the night in *bivouac*. In addition to sago, women also collect firewood, look for medicinal plants, and take cassowary or maleo eggs (*Macrocephalon maleo*) for daily needs. Meanwhile, men spend more time sago cutting, animal hunting and forest products gathering. Their targets include wild boar, deer, anthill from trees, rattan, honey, and gambier bark.

The use of sago plants

The overall components of the sago plant consist of stems, barks and leaves (Flach 1997; Mathur et al. 1998; Schuling 2009). The Marind-Anim tribe utilizes these parts according to their needs. Besides stem extracted for sago starch, sago leaves are used by the community for roof of the house, while the barks are used as the floor of the house and bridge construction (Table 3). According to Konuma (2014) sago plants have many uses. In Thailand, the roots and fruit of sago can also be used as herbal medicine while the sago pulp can be used as fertilizer. In fact, sago pulp can be used as food material for livestock (Suebu et al. 2020), mushroom planting media (Sangadji et al. 2008; Rasyid et al. 2020), raw materials in industry (Singhal et al. 2008), medicinal ingredients (Syahdima et al. 2013; Jusoh et al. 2016), and other uses (Sudrajat and Yusnita 2002; Singhal et al. 2008).

In addition to sago products, the co-products of sago plants are fungi (Abbas et al. 2011) and sago caterpillars (Purnamasari 2010). Sago fungus (*Volvariella* sp.) are found in the decay of waste of sago trees after starch extraction process (Abbas et al. 2011). Sago caterpillars are often found on sago stems that are still in logs. Sago caterpillars are one type of beetle larva of the *Rhynchophorus* sp. group. In addition to having cultural value, sago caterpillars also contain high nutrition (Purnamasari 2010; Twikromo 2020). Related to economic needs, sago can overcome the food crisis experienced by the local community. In terms of health, the community also believes that sago can also affect the health of digestors and reduce the risk of bowel cancer.

Table 2. The role of men and women in the processing of sago by Marind-Anim tribe in Merauke District, Papua, Indonesia

Activity	Role	
	Man	Woman
Selecting of sago tree worth cutting down	++	+
Cutting down sago tree	++	-
Transporting sago trunk to processing site	++	-
Removing sago bark	++	+
Splitting sago trunk	++	+
Chopping the trunk	+	++
Scraping sago	-	++
Squeezing to extract sago starch	-	++

Notes: - not involved; + occasional roles; ++ main role

Table 3. Utilization of sago plant parts by Marind-Anim tribe in Merauke District, Papua, Indonesia

Part of sago plant	Use
Top bar	Processed into sago starch/juice; rotten stem is eaten by caterpillars
Stem bark	Utilized for the construction of home floors, walls of houses, and bridges times/rivers
Leaf	Roof and walls of house
Sago trunk	Walls of house, extracted for sago starch
Rachis (leaf stalks)	Woven mats, cattle pen walls
Fruit	Not used
Sago pulp	Left to grow mushrooms, compost
Root	Boiled for therapy

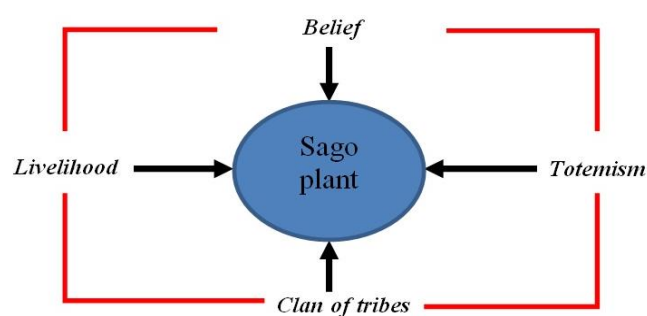


Figure 2. The interrelationship between tribes, totemic systems, beliefs, and the livelihood of the Marind-Anim people in Merauke, Indonesia

Knowledge of sago food processing

Marind-Anim people consider sago as their special food. Although many of the community of Marind-Anim have left sago as a daily local food, sago is still widely used at important indigenous events. The utilization of sago becomes important traditionally when there are customary event activities. According to Suharno et al. (2016), the existence of “wati”, sago, and pig plants is an integral part of qualifying for its sacredness at the Marind-Anim indigenous events.

Marind-Anim tribe processes sago differ from other regions in Papua. In Merauke, sago is processed into various forms of food referred to as *sago sep*. This is different from other tribes in the northern region of Papua who are more familiar with sago-based food products called *papeda* (sago porridge). *Papeda* is a typical food that has been common in most coastal areas of Papua. *Papeda* cuisine is made by dissolving starch flour with hot water to form a porridge, while *sago sep* is made by cooking sago flour with a mixture of other food ingredients. Other food sources used to make *sago sep* are usually meat (pork or deer) or fish.

In the processing of *sago sep*, first foodstuffs must be prepared according to people's tastes. Ingredients that are often used include sago, coconut, and meat (it is usually pork) and bananas. Materials for burning *sago sep* include banana leaves (*yaal*), bush bark (*paal bus*), bamboo sticks (*ndakla*), firewood (*takah*), stone (*katal*), coconut coir (*patakah*), coconut shell (*manggon*), bamboo (*Suba*) and water (*adaka*). The preparation of these ingredients is carried out by men both teenagers and adults. They share the task by using the equipment. Mothers carry out the preparation of the cooking process. It is cooked by using burning coal (*barapen*, live coals). *Sago sep* processing is done for customary events such as grief, marriage, conflict resolution, etc.

The results of observations showed that, in addition to *sago sep*, the people of the Marind-Anim tribe also know the typical foods of sago including *Sago Ebayak*, *Sago Kwetahuk*, and *Sago Sinoli*. *Sago Sep* cuisine is usually done for large-scale traditional event activities, such as being served in customary events related to grief or special banquets. Other cuisines such as *Sago Ebayak*, *Sago Kwetahuk*, and *Sago Sinoli* are made for everyday consumption at a family scale. *Sago sep* in Marind-Anim community is important as a form of gratitude and a symbol of family which will strengthen the community relationship.

Sago and totemism

In anthropological literature, there is a totem. A totem is a mantra that connects a group of humans with a group of animals or natural phenomena. A totem is a particular animal, plant, or natural phenomenon seen as the first ancestor of one clan or other genealogical units (La Hisa et al. 2018). Although the Marind-Anim people are familiar with religion, the totemic practices continue today. Totems are closely related to their belief systems in the past. Marind-Anim society is divided into big clans and sub-clans. Each clan has a totem of its ancestors. For example, the Mahuze clan holds totem sago. For the Mahuze clan, sago is seen as something sacred and should be treated well following customary provisions. Sago is very important in the social and cultural life of the Marind-Anim people (Figure 2), especially by Mahuze tribal clan who was considered first clan to plant and preserve sago. Therefore, the Mahuze clans think of sago as their totem, recognized by all clans in Merauke lowlands.

As the rights holder of the sago totem, the Mahuze clan is entitled to the management system and maintain sago preservation. It is practiced as maintaining the presence of sago, caring for the tree, safety, maintaining the quality of the sago tree, production, and maintaining sago flour. Sago is highly valued in the lives of the local community so that sago is not used as a political tool in the community. The management of sago in the livelihood system of the Marind-Anim people is done entirely by the Mahuze clan by performing special rituals. Before other clans plant sago, first the indigenous elders of the Mahuze clan are invited to start a name pen to facilitate the growth and development of sago pith. Similarly, for harvesting, the clan elders are first asked to carry out the procession of taking pith. The purpose of the involvement of the Mahuze clan is to ensure that the planted sago tree can grow and produce many and quality starch products.

Table 4. Physical and chemical characteristics of soil in sago forest land area in Merauke District, Papua

Soil physical and chemical characteristics	Location			Average
	Wasur	Rawa Biru	Wapeko	
pH (H ₂ O)	5.7	5.0	5.2	5.3
pH (CaCl ₂)	4.5	4.3	4.5	4.4
Organic C (%)	0.75	5.30	1.75	2.60
N total (%)	0.12	0.51	0.12	0.25
C/N ratio	6.25	10.39	14.60	10.41
P ₂ O ₅ available (ppm)	8.5	7.1	12.0	9.02
K-dd (cmol.kg ⁻¹)	0.23	0.70	0.51	0.48
Ca-dd (cmol.kg ⁻¹)	1.98	2.02	3.65	2.55
Na-dd (cmol.kg ⁻¹)	2.04	2.55	1.35	1.98
Mg-dd (cmol.kg ⁻¹)	1.30	1.47	1.12	1.30
CEC (cmol.kg ⁻¹)	7.32	25.86	11.32	14.83
Base saturation (%)	84.40	24.74	65.90	58.68
<i>Al-H_{ad}KCl IN:</i>				
Al-dd (me.100g ⁻¹)	0.00	0.20	0.00	0.07
H-dd (me.100g ⁻¹)	0.10	1.12	0.10	0.44
Soil texture				
Sand (%)	15.8	10.4	38.2	21.47
Silt (%)	45.7	51.0	18.7	38.47
Clay (%)	38.5	38.6	43.1	40.06
	silty clay	silty clay	clay	clay

Note: Soil analysis was conducted at SEAMEO Biotrop Soil Laboratory, Bogor

Table 5. The clustering sago plants based on the local knowledge of the Marind-Anim people in Merauke

Sub-tribe	Village	Sub-district	Type of sago according to local wisdom	Primary character for differentiating type
Marori (Marind)	Wasur	Merauke	<i>Elitel, Mbuof, Uliba, Ipul, Yuk, Yuforngi</i>	Leaf size and shape, stem size, stem height, stem color; Prickly sago was not found.
Kanum (Marind)	Rawa Biru	Sota	<i>Paretar, Yuper, Ulibab</i>	The size and shape of the leaves, the size of the stems, the color of the stems; the color of starch, thorny sago is not found.
Kanum (Marind)	Yanggandur	Sota	<i>Pariter, Rifer (Discent Pariter), Yuper, Bekauw (Discent Yuper)</i>	The size of the leaves, smooth or coarse leaves, fine or coarse, stem size, height, stem color, starch color is influenced by the way of processing.
Mandobo, Wambon, Marind	Tambat	Tanah Miring	<i>Osih, Bayat, Kerikit, Jambun, Nggarak, Desom, Wambilim</i>	The existence of thorns, the tightness of thorns, stem size, height of stems, strong/absence of tree stems, leaf size, leaf strength, leaf surface, midrib color, size smelt.
Marind-Deg	Wapeko	Kurik	<i>Daah</i>	There is no differentiator, society does not distinguish the group of sago types.
Marind-Deg	Sanegi	Animha	<i>Mboh, Alitil, Nggaruf-Mboh, Nggaruf-Alitil, Waliba, Yuk, Tath</i>	Stem size, u leaf, plant height, existence of thorns, color of smelt, flower size
Marind (Marind)	Koiburse	Malind	<i>Mboh, Melibah, Alitil, Oleg</i>	Stem size, plant height, leaf size, leaf shape, leaf size, starch color

Habitat and grouping of sago according to local knowledge

In Merauke District, sago plants are found in low-lying areas and grow in swampy areas or around watersheds. The soil in this area is fertile (Table 4). The results of soil analysis in sago forest areas showed that soil pH ranges from 5.0-5.7 (H₂O) with an average of 5.3, soil organic C content of 0.75-5.30%, total nitrogen (N) 0.12-0.51%, ratio C/N from 6.25 to 14.6, and phosphorus (P) is available from 7.1 to 12.0 ppm. In addition, cations such as calcium (Ca) can be exchanged ranging from 1.98 to 3.65 cmol.kg⁻¹, magnesium (Mg) from 1.12 to 1.47 cmol.kg⁻¹, kalium (K) from 0.23 to 0.70 cmol.kg⁻¹, sodium (Na) from 1.35 to 2.55 cmol.kg⁻¹, and KTK (cation exchange capacity) from 6.95 to 26.69 cmol.kg⁻¹ (Table 4). Most areas have soil textures of clay and silty clay.

Based on the observations, sago plants in this area have a height of 8-10 meters. According to Flach (1997), the sago plant resembles a coconut tree with a long greenish leaf with a height of ± 10-20 meters (Flach 1997; Flach and Schuiling 1989). Djumadi (1989) stated that the genus of *Metroxylon* is classified into two groups, namely those that flower or bear fruit once (hapaxanthic) and those that flower or bear fruit more than once (pleoanthic). The first group has important economic value because the starch content is high. This group consists of five species, namely *M. sago* Rottb., *M. rumphii* Mart, *M. micracanthum* Mart, *M. longispinus* Mart, and *M. sylvestre* Mart. While the second group consists of two species, namely *M. filariae* and *M. elatum* which mainly grow in relatively high altitudes. This group has limited economic value because the starch content is low.

The Marind-Anim people can distinguish the diversity of sago based on their traditional knowledge. This happens in all villages in Merauke. For example, in Wasur Village people know 6 types of sago, Rawa Biru village 3 types, Yanggandur 4 types, Tambat 7 types, Wapeko 1 type, Sanegi 7 types, and Koiburse 4 types (Table 5). However,

based on the analysis of similarities of morphological characteristics (OTUs analysis), there are 5 clades (clusters) of sago (Figure 4), namely *Mbuof*, *Yuk*, *Elitel*, *Uliba*, and *Yuforngi*. The first variant group includes the *Mbuof* sago in Wasur village which has similarities with several other types such as *Wambilim*, *Desom*, *Bayat*, *Nggaryk*, *Kerikit*, *Jambun* (Tambat village), *Daah* (Wapeko), *Nggaruf-Alitil*, *Waliba*, *Alitil* (Sanegi), *Ulibab* (Rawa Biru), *Rifer* (Yanggandur), *Alitil* (Koiburse). The second variant is *Yuk* in Wasur village which is similar to the type of *Yuk* (Wasur village), *Mboh*, *Melibah* (Koiburse), *Osih* (Tambat), *Mboh*, *Yuk*, *Nggaruf-Mboh* (Sanegi), *Pariter*, *Yuper* (Yanggandur). Third group *Elitel* is one clade with *Yuper* (Yanggandur). Fourth, *Uliba* is one clade with similarities with *Paretar* from Rawa Biru village.

Most people do not know thorny sago because it is limited to Tambat village. According to the community, this information is still limited because it is also just found prickly sago in their village. Based on the research results, it is known that the type was only planted a dozen years ago. The seedlings come from a riverbank that may have drifted from the headwaters of the Bian River. This river has upstream in the central part near the Boven Digoel District area, far from Merauke. The research results in the Muting Sub-district area, one of the access districts to Boven Digoel, found variants of prickly sago. This case should be a concern because the development of this type of thorn sago affects the region. If the prickly sago population increases it will shift local sago diversity. Rahayu et al. (2013) revealed that on the Island Padang Meranti Islands, three types of sago plants were found known by traditional communities.

All these types of sago can be grown in wetland areas or swamps. Although this plant can be grown in dry areas, it will produce less quality sago flour. The highest sago trees reached 4-7 m. Based on the results of interviews, the community revealed that sago plants were able to grow up

to more than 8 meters in the past, but sago forests had experienced fires. As a result, there is damage to sago forests and hampered forest recovery.

The meaning of sago in the people of the Marind-Anim tribe is considered a symbol of life. Sago is exceptional food, so it should not be wasted, not sold carelessly, and the rest of the product should not be disposed of carelessly and must be buried because sago is highly respected. Nevertheless, sago consumption and utilization have widespread, which affects the number of populations of this plant. Nowadays, people consume sago if there is a customary event while most of them consume rice or other tubers for daily consumption.

Concept of traditional conservation development of sago in Merauke

The Marind-Anim community has had a basic concept of customary and hereditary in understanding the importance of sago plants for their tribe. The basic understanding that sago is their ancestors is a way to respect their tribes and ancestors. They know it as a totem in which each clan has different totem status for the entire Marind-Anim tribe in Merauke.

Sago is a totem of the Mahuze clan. They have the rights to the existence, sustainability, customary, and institutionally arranged regulations, including sago conservation efforts. The entire tribe of Marind-Anim trusts the Mahuze clan for the sake of it. Mahuze clan live scattered in almost all villages in Merauke. The results of observations in the field showed that the community had practiced traditional conservation management systems for

generations, although it differs among villages. Several basic concepts used in the management and conservation of sago include: The system of harvesting moratorium or "sasi" called *Sar* by the Marind-Anim tribe as an integral part of managing sago plants and other customary activities. Mote and Mahuze (2016) explained that the Marind-Anim people of the Marori sub-tribe implemented the *Sar* system, which prohibits taking resources within a certain period. The set time can last 2-4 years and relates to respect for relatives who have died.

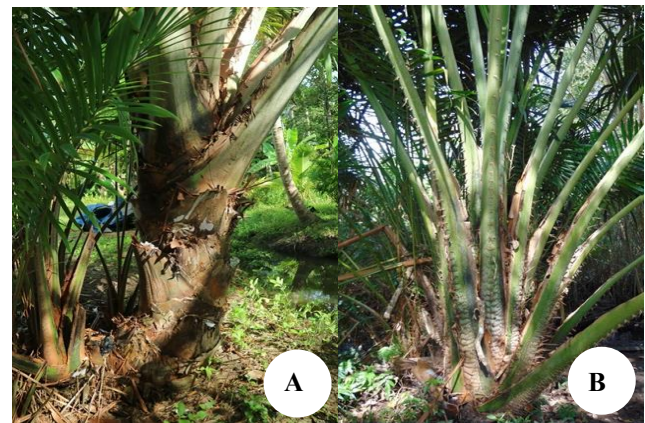


Figure 3. Diversity of sago types based on the local knowledge of Marind-Anim people in Merauke District, Papua. A. Sago *Mbuof* (without thorns) in Wasur. B. Sago *Desom* (thorny) in Tambat village, Merauke (Photograph: Suharno 2021)

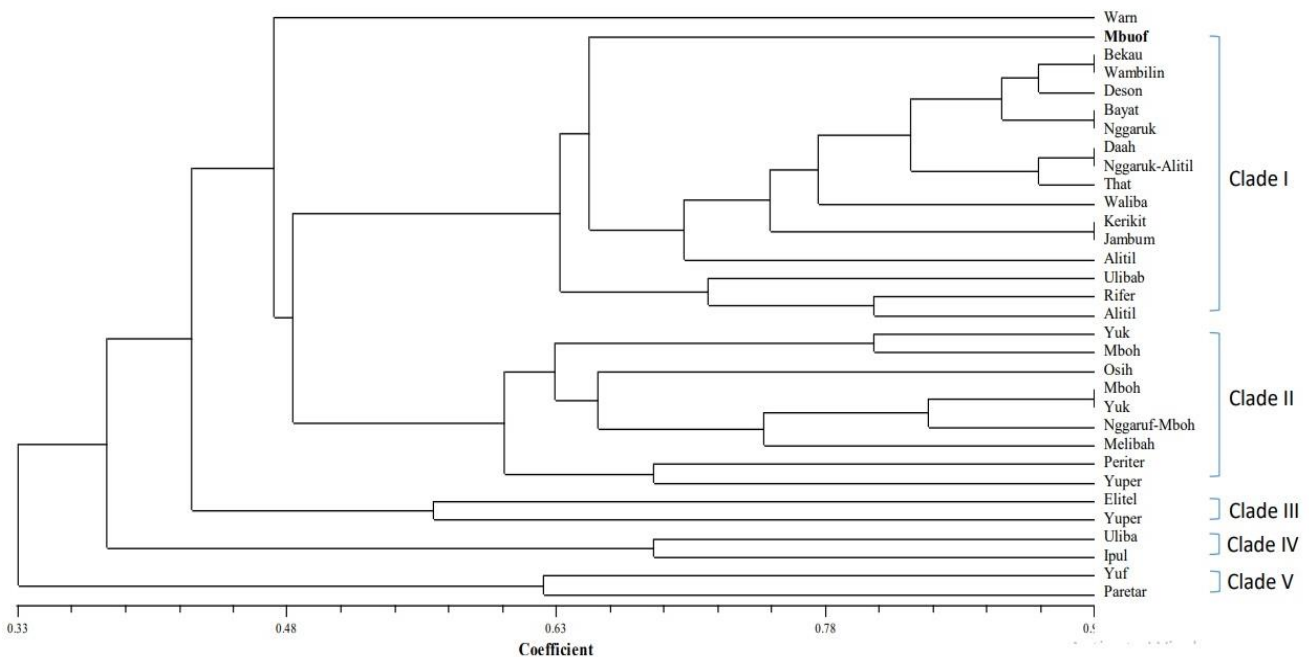


Figure 4. Clustering of sago based on characteristics according to local knowledge with OTUs analysis

The determination of *Sar* is decided after 40 days of death. The hamlets that used to take natural products are declared closed so that natural resources in the hamlets can recover naturally. *Sar* is one of the local wisdom of the Marind-Anim people in organizing natural resources. *Quality Sar*, conducted by several villages in Merauke to keep sago plants growing and developing naturally until the sago plants are considered worthy of being harvested. If an area can grow and develop sago plants, then *Sar* is applied to meet the local community's needs in the future time. *Sar* is initiated when the community sees the sago in an area is no longer productive because the stock of sago trees is limited. It will be planted and maintained for several years. In these conditions, no one should enter the sago plant area. Sago planting can be done in certain seasons, usually when the water rises (rainy season) in January - May each year. *Cut and plant system*, carried out by the people of Rawa Biru village (Sub-district of Sota) and Sanegi (Sub-district of Animha). During the harvesting process by cutting sago trees, two saplings of sago palms that are closely related and worthy of planting are taken. Then, the saplings are planted in other potential locations. People think that the plants chosen for cutting usually have a lot of saplings. Based on experience, to obtain good plant growth, the tillers must be conditioned to be adequate (but not too many), so that the growth of the next generation will be better, including related to the best starch quality in their offspring.

The *Sar* concept is a conservation effort based on local wisdom to preserve the existence of sago forests in Merauke. Sago-based food products can be developed to maintain the availability of local and national food. Nevertheless, to realize this goal, this study shows that the existence of sago plant forests, products, and the preservation of sago plants should be done sustainably at a local scale.

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