

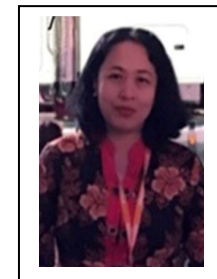
Andoyo Supriyantono  
andoyo@yahoo.com  
Papua University

Sri Hartini  
sri.hartini8877@gmail.com  
Papua University



Sientje D. Rumetor  
s.rumetor@unipa.ac.id  
Papua University

Trisiwi W. Widayati  
trieswd4@gmail.com  
Papua University



Elfira K. Suawa  
e.suawa@unipa.ac.id  
Papua University

Lukas Y. Sonbait  
lukas.sonbait@gmail.com  
Papua University



Noveling Inriani  
n.inriani@unipa.ac.id  
Papua University

Johanes Bosco Rengil  
johanrengil@gmail.com  
Papua University



## **THE POTENTIAL OF SAGO WASTE AS ANIMAL FEED IN THE DOA JAYA ABADI BUSINESS GROUP, MANOKWARI WEST PAPUA**

Andoyo Supriyantono<sup>\*1)</sup>, Sri Hartini<sup>1)</sup>, Sientje D. Rumetor<sup>1)</sup>, Trisiwi W. Widayati<sup>1)</sup>, Elfira K. Suawa<sup>1)</sup>, Lukas Y. Sonbait<sup>1)</sup>, Noveling Inriani<sup>1)</sup>, Johanes Bosco Rengil<sup>2)</sup>

<sup>1)</sup> Department of Animal Science, Papua University, Manokwari, West Papua, Indonesia

<sup>2)</sup> Master of Science student in Animal Science

<sup>\*)</sup>Corresponding authors: [andoyo@yahoo.com](mailto:andoyo@yahoo.com)

**Abstract.** The sago dregs produced by the Doa Jaya Abadi Business Group are abundant and not used by farmers in the area. The business group engages in sago processing and packaged sago production. The Papua University Postgraduate Service Team visited the business group to find out the potential of the sago waste produced. A total of 20 lecturers and postgraduate students took to the field to carry out community service activities. Community service activities begin with communication between the postgraduate director and the Doa Jaya Abadi Business Group chairman. The livestock sector group assessed the potential of sago waste using survey methods and interviews with the head of the Doa Jaya Abadi business group. The community service results revealed the presence of sago worms in the sago waste surrounding the business group. In addition, fermentation can transform sago waste into animal feed.

**Keywords:** Business group, Potential, Sago, Waste

## INTRODUCTION

Indonesia has the world's largest area of sago plants (*Metroxylon* sp.). Kertopermono (1996) reported that Indonesia had 1,528,917 ha of sago palm areas spread across several locations. The previous study identified the following locations for sago palm areas in Indonesia: Irian Jaya 1,406,469 ha, Ambon 41,949 ha, Sulawesi 45,540 ha, Kalimantan 2,795 ha, West Java 292 ha, and Sumatra 31,872 ha (Abbas et al., 2009). Sago is one of Indonesia's natural vegetable resources, and its use began to increase in the late 1970s due to the national food self-sufficiency utilization program. The sustainable potential for sago production is 5,000,000 tonnes per year, but only 200,000 tonnes per year have been utilized.

Sago has several potential uses, including as a food source and an industrial material. As a food source, we can process sago into various types of food for public consumption. Meanwhile, we can process sago into flour for industrial purposes. Sago flour's natural decomposition (biodegradability) allows for producing adhesives and plastics. The increase in sago production is directly proportional to the increase in waste production. We divide the waste from sago processing into solid, liquid, and gas waste. The sago refinery area directly channels the unoptimized solid and liquid waste into a simple system. This can lead to pollution in the surrounding waterways and potentially cause the river to become shallower.

The processing of sago yields sago dregs, a waste rich in carbohydrates and other organic materials, in a 1:6 ratio. Only now have sugarcane processing places accumulated this large amount of waste without proper use, leading to environmental pollution. Only the livestock near the Sago flour processing location directly consume the accumulated dregs.

In Manokwari, West Papua, a youth business group operating in the sago sector called the Doa Jaya Abadi Business Group, part of the Inspirational Young Papua Group, with Robert Supriyanto, dkk

Rumsayor as chairman. This business group produces packaged sago flour with sago supplies from three regions, namely Windesi, Wondama Regency, Waryap, South Manokwari Regency, and Sidey, Manokwari Regency. Estimates indicate that the sago land in the three areas spans over 100 hectares, originating from natural sago forests rather than farmers' cultivation. The local indigenous community produces the sago flour and then sends it to Manokwari for packaging into ready-to-use products.

To explore the potential of sago waste, the Postgraduate community service team conducted Sago-Based MSME-SPPIRT (Micro, Small and Medium Enterprises) Development and Empowerment activities, collaborating with Postgraduate Staff Mentors and Unipa Students to enhance both the quality and quantity of production. The theme of this service activity encompasses not just sago waste but also the quality and quantity of sago production.

## METHODS

Community service activities took place in Sidey village, Manokwari Regency, on Tuesday, 14 March 2023. Figure 1 presents a map of Sidey village.



Figure 1. Map of Sidey village (sources: <https://kampung-sidey.id/profile.php?id=7>)

Sidey Village is one of 12 (twelve) villages in the administrative area of Sidey District, Manokwari Regency. Sidey Village occupies an area of 4.46 km<sup>2</sup>, split into two neighborhood

areas (Rukun Tetanga). The administrative boundaries of Sidey Village are as follows: 1. North: Pacific Ocean; 2. East: Karat River/Waramui River; 3. South: Kampung Sidey Baru Village; 4. West: Kaironi Village.

Administratively, Sidey Village lies west of Manokwari Regency, 97.6 km from the district capital, 11.7 km from the district capital, and 92.7 km from the capital of West Papua Province, all accessible by land transportation. Twenty lecturers and postgraduate students (Figure 2) took to the field to carry out community service activities. Robert Rumsayor, the group chairman, represents the Doa Jaya Abadi Business Group.



**Figure 2. Community Service Team (source: personal document)**

Community service activities begin with communication between the postgraduate director and the chairman of the Doa Jaya Abadi Business Group. The postgraduate director is one of the mentors in developing Sago-based businesses. Therefore, the chairman of the Doa Jaya Abadi business group gave the postgraduate team permission and the opportunity to carry out community service activities. The team split into two groups before heading to the field: (1) the agricultural sector group, responsible for guiding and empowering the business group to enhance the quality and quantity of production, and (2) a livestock sector group investigating the potential of sago waste as animal feed.

The livestock sector group assessed the potential of sago waste using survey methods and interviews with the head of the Doa Jaya Abadi business group. We conducted interviews

at the activity location by observing the sago flour production process. The sago waste produced is integral to the sago flour production process.

## RESULTS AND DISCUSSION

In sago processing, there is waste or by-products in the form of bark and dregs. This extraction process produces pulp that accounts for approximately 14% of the total wet weight of sago stems (Flach, 1997; Rumalatu, 1981). Production centers typically pile up sago pulp waste without using it, leading to environmental pollution (Kompiang, 1995). The Doa Jaya Abadi business group leaves unused sago waste and needs to optimize it (figure 3b). Following the completion of the sago starch production process, Figure 3 illustrates waste disposal around the business premises.

According to Darma (2011), people in Papua need 40.92 hours to process one sago tree using traditional methods. This implies that even if you dedicate 7 hours daily, it will still take six days to complete. According to Haryanto et al. (2015), the average work capacity for processing sago is that two workers can only complete 2.5 m daily. In traditional sago processing, the stage that requires the most extended amount of time is crushing the stem pith, followed by starch extraction. In contrast, other activities do not need a significant amount of time. The average time required for pith crushing was 53.22% of the total time needed for processing and 38.92% for starch extraction. Thus, most of the processing time (92.14%) is devoted to these two activities (Darma, 2011). By using the introduced sago processing machine (figure 3 d, 3e, 3f), the time required for crushing the pith is shortened from 22 hours per tree to only 1-2 hours per tree, and the extraction time is shortened from 16 hours per tree to 4-5 hours.

According to Haryanto and Pangloli (1992), the average working capacity of two workers is only 2.5 meters per day, so it takes a minimum of six days to shoot a sago tree 15 meters high. According to Darma et al. (2009), most of the time required for processing sago starch is devoted to chopping and extracting sago starch. The average time needed for beating and extracting sago starch, respectively, is 53.22% and 38.92% of the total time required for processing. Traditionally, people use a tokok (adze) to crush the sago pith. We use a hammer-like tool that combines pounding and scraping movements to cut stem tissue into small sizes, facilitating the easy release of starch particles. In the meantime, we extract the tokokan results by squeezing them through a cloth-based filter.

## The Potential of Sago Waste

In Papua, sago plants are a source of carbohydrates and protein. The community has local wisdom to harvest the larvae of the beetle *Rhynchophorus papuanus* (Figure 3a) from cut sago stems and leave them in the forest for several weeks. According to Purnamasari (2010), sago worms have a very high protein content, with an amino acid content of around 97.54%. The sago caterpillars originate from cut sago trees, allowing the trunk to rot. The rotting stems will produce caterpillars. The sago stem is dismantled/opened with an axe to remove the caterpillars. The shape of the sago caterpillar varies; some are very small, and some are as large as the size of an adult's thumb. People usually eat sago caterpillars directly (still alive) or cook them first, such as cooking, frying, or turning them into satay.

Sago worms are high in nutrition, with a protein content of around 9.34% consisting of several essential amino acids, such as aspartic acid (1.84%), glutamic acid (2.72%), tyrosine (1.87%), lysine (1.97%), and methionine (1.07%). Sago worms have a soft texture, are slightly chewy and sweet, and are highly nutritious. In the past, people ate these sago worms directly without cooking them first, but as time progressed, Papuan people used to process these sago worms into sago worm satay. They usually eat Sago worm satay with papeda or sago bread, which they produce from sago trees.

Apart from sago worms, the community also uses sago beetles as an alternative food ingredient. Realm et al. (2020) research shows that sago beetles contain 10.39 g of protein and 17.17 g of oil per 100 g of fresh weight. Sago worms contain 40% essential amino acids, with a ratio of 0.60 between essential and non-essential amino acids. The limiting amino acids are methionine and cysteine. The main fatty acids found in sago worms are palmitic (42%), oleic (45%), and linoleic (3%) acids. Sago worms also contain vitamin E; 1 g of sago worm oil contains 51 µg of vitamin E, most of which consists of tocopherol (92%). Based on this research, it is also known that sago worm oil contains  $\delta$ -tocopherol (0.12 µg/g oil) and  $\beta$ -tocopherol in very high amounts (3.85 µg/g oil). Sago worms can be an alternative local food for community groups who cannot afford fish and its processed products (Nuban et al., 2020). Since ancient times, people have consumed sago worms in various places, including Maluku, Papua, and Kalimantan, in multiple forms of processed food (Leatemia et al., 2021).

People who have sago forests/plantations or live in places that have sago forests currently still eat sago worms as a food supplement. People widely use local feed resources to meet livestock protein needs. Sago worms, containing all essential and non-essential amino acids in sufficient quantities, can serve as an alternative protein source in animal feed,

particularly for free-range chickens, fish, and shrimp, replacing fish meal. Using sago worms as a natural source of protein for animal feed is an excellent effort to reduce the use of synthetic feed (Bustaman, 2008). Sago worm-containing rations have a relatively balanced quality with standard protein (casein), allowing sago worm protein to support body tissue growth, development, and maintenance (Purnamasari, 2018).



**Figure 3. a. Sago worms found on rotting sago stems; b. Sago waste is thrown away and not utilized; c. water tank as a water source to help the sago starch production process; d, e, f. sago flour processing machine**

## Sago Waste as Animal Feed

Haedar and Jasman (2017) used silage technology to make ruminant animal feed. The wet by-products category includes sago processing waste due to its 70–80% water content, which can quickly deteriorate if not processed promptly. Drying treatment incurs significant expenses, necessitating the development of alternative technologies to enhance the product's efficiency. Livestock prefers Silage technology, a microbial fermentation process that enhances feed's nutritional content (protein and energy) due to its relatively sweet taste. Silage is a process that preserves the freshness of feed ingredients with a dry matter content of 30-35%. Typically, this process takes place in a silo, a hole in the ground, or another container, and it requires anaerobic conditions (a vacuum of air) to enable anaerobic microbes to carry out fermentation reactions (Sapienza and Bolsen, 1993).

The initial stage of making silage is to chop the sago dregs using a chopping machine (Figure 3e), then reduce the water content of the sago dregs (using solar heat) for  $\pm$  6–8 hours depending on the intensity of sunlight so that the water content of the sago waste is around 50–55%, then processed into silage by mixing it with additives, namely molasses/molasses 15% to stimulate microbial activity in the fermentation process of making silage, as well as to increase the energy and protein content of the silage produced later. After being mixed evenly, please place it in a 50 kg bag (two layers) and compact it to minimize air (anaerobic fermentation process). Then, it is stored in a shady place (free of sunlight) for  $\pm$  3 weeks, depending on how fast the silage process is. After three weeks, a 500-gram sample of sago dregs silage was taken to analyze its nutrient content (Simanihuruk et al., 2011). Furthermore, it is said that silage treatment can increase the protein and energy content and also reduce the NDF and ADF content of sago waste. Based on the results of average dry matter consumption, dry matter and organic matter digestibility, live weight gain, feed use efficiency, and income over feed cost values, it was concluded that 40% sago waste silage using a 15% molasses additive could be used as an alternative complete feed mixture. When grass is challenging to obtain, it can be used as an alternative complete feed mixture for goats. Siswati et al. (2023) also concluded that adding 5% urea to sago dregs boosts the crude protein in cow feed. Community service activities carried out by Istikowati et al. (2021) in Pwmakuan Laut village show that community interest in the fermentation process of sago dregs for animal feed is very high.

Fermentation Technology for Making Poultry Feed. The goal of this method is to produce dry feed suitable for poultry. The potential limitations of using sago pulp waste as

poultry feed are its low crude protein and high oil fiber content. Fermentation technology processes the sago dregs waste to produce feed rich in protein and vitamins. This fermentation technology boosts the protein content of sago dregs by up to 14%. The stages of fermentation for sago dregs waste are as follows: 1. The sago dregs waste is first put into a chopping machine to reduce its size, then the next step is that the chopped sago dregs are dried in the sun until dry, then sifted to separate the sago starch from the fiber. 2. We moisten the dried sago pulp flour until it becomes wet, then steam it for 30 minutes or until it becomes sticky; 3. After allowing the steamed or cooked sago dregs to cool completely, weigh them, add 3% of the wet sago pulp's weight, stir until it's evenly distributed, then add *Aspergillus niger* (you can use tape yeast) at a rate of 3-5 grams/kg sago, and mix until it's homogeneous. 4. After adding *Aspergillus niger* to the sago dregs, place them in a clean, water- and oil-free container, close it tightly, and leave it for 48 to 72 hours before opening it. 5. Sago dregs that have undergone complete fermentation have the following characteristics: the aroma is very distinctively fruity or smells like sticky rice tape; the color is reddish; the texture is soft; and the taste is slightly sweet. We then dry the fermentation results in the sun or with a drying machine until they are ready for packaging or use as poultry feed. The fermentation process has several advantages, including having no negative side effects, being easy to carry out, requiring relatively little special equipment, and being relatively cheap.

## CONCLUSIONS

After undergoing a fermentation process to enhance its nutritional value, sago waste from the sago flour production process can be used as feed for ruminants and poultry.

### Suggestion

The involvement of farmers around business groups in utilising sago waste to be processed as animal feed or for other uses, such as briquettes and biogas, is highly expected to reduce sago waste.

## ACKNOWLEDGMENTS

Thank you to the chairman of the Doa Jaya Abadi business group for granting permission and holding discussions with the Papua University Postgraduate Community Service Team. We thank the business group members who set up the location and guided the team to the Sago Forest to gather more comprehensive data.

**BIBLIOGRAPHY**

- Abbas, B, Bintoro, M.H., Sudarsono, Surahman, M., Ehara, H. 2009. Genetic Relationship Of Sago Palm (Metroxylon Sagu Rottb.) In Indonesia Based On RAPD Markers. *BIODIVERSITAS*. 10 (4): 168-174. DOI: 10.13057/biodiv/d100402
- Bustaman, S. 2008. Potential of Sago Caterpillars and Prospects for Their Utilization . *Jurnal Litbang Pertanian*, 27(10): 50-54.
- Darma. 2011. Traditional processing of sago in Papua in: Proceedings of the 10th International Sago Symposium: Sago for food security, Bio-energy, and Industry From Research to Market, Bogor: 29-31 October 2011. Hal. 115.
- Darma. 2009. Starch Content and Production Potential of Natural Sago in Papua. *AGROTEK*, Vol.1, 6.
- Flach, M. 1997. Sago palm. *Metroxylon sago Rottb.* Promoting the conservation and use of underutilized and neglected crops. Rome: International Plant Genetic Resources Institute.
- Haedar and Jasman, J. 2017. Utilization of sago waste (Metroxylon sago) as a basic ingredient for poultry feed. *Equilibrium Journal*. 06(01): 5-13
- Haryanto, B. and Pangloli, P. 1992. Potential and utikization of Sago. Kanisius. Yogyakarta.
- Haryanto, B. Mubekti and Putranto AT. 2015. Potential and Utilization of Sago Starch in Supporting Food Security in South Sorong Regency, West Papua. *Jurnal Pangan*, (24)2; 97-106.
- Istikowati, W.T., Sutiya, B., and Sunardi. 2021. Utilization of Sago Waste as Animal Feed Ingredients in Pemakuan Laut Village, River Tabuk, Banjar Regency, South Kalimantan. *PengabdianMu*. 6 (2): 149-155.
- Kertopermono, A. P. 1996. Inventory and evaluation of sago palm (Metroxylon sp.) distribution. Sixth International Sago Symposium. Pekanbaru, December 9-12, 1996
- Kompiang, I.P. 1995. Collection of Research Results on Poultry and Various Livestock. Balai Penelitian Ternak, Ciawi.
- Leatemala, J. A., Patty, J. A., Masauna, E. D., Noya, S. H., and Hasinu, J. V. 2021. Utilization of sago grub (*Rhynchophorus ferrugineus* Olivier) (Coleoptera: Curculionidae) as an alternative source of protein. *IOP Conference Series: Earth and Environmental Science*, 800(1), 012028. doi:10.1088/1755-1315/800/1/012028
- Nuban, N. S., Wijaya, S. M., Rahmat, A. N., and Yuniarti, W. 2020. Traditional Food from Sago Caterpillars as an Effort to Overcome Malnutrition in Children. *Indonesian Journal of Nursing and Health Sciences*, 1(1), 25-36. Retrieved from <http://jurnal.lobalhealthsciencegroup.com/index.php/IJNHS>
- Purnamasari, V. 2018. Quality of Sago Caterpillar Protein (*Rhynchophorus bilineatus*). *Jurnal Biologi Papua*, 2(1), 12-18. doi:10.31957/jbp.556
- Realm, K., Andrea, I.-M., Euniche, R., Ratna, P., & Hans, K. B. (2020). Nutrient composition of the Indonesian sago grub (*Rhynchophorus bilineatus*). *International Journal of Tropical*
- Rumalatu. F.J. 1981. Distribution and starch potential of several sago (*Metroxylon sp.*) in the West Seram area. *Karya Ilmiah*. Fakultas Pertanian/Kehutanan IPB, Bogor.
- Sapienza, D.A. dan K.K. Bolsen. 1993. *Silage Technology (Planting, Making and Feeding It to Livestock)*. Penerjemah: Martoyondo Rini B.S.
- Simanihuruk, K., Chaniago, A., and Sirait, J. 2011. Sago dregs silage as basic feed for growing goats. *Seminar Nasional Teknologi Peternakan Veteriner 2011*. p: 542-550.
- Siswati, L., Nizar, R., dan Harmaidi, D. 2023. Potential for Utilizing Sago Waste for Cattle Feed in Meranti Islands Regency. *Jurnal Agribisnis*. 25 (2): 173-184.