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Analysis of Taro (*Colacasia esculenta* L.) Cultivation System in South Manokwari Regency, West Papua Province

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Abstract

Taro (*Colacasia esculenta* L.) is a tuber crop contains high carbohydrates and grows widely in tropical and subtropical. In Indonesia, this plant is utilized as an alternative and functional food. The purpose of this study was to describe the taro cultivation system practiced by local farmers in South Manokwari Regency, West Papua and to identify factors that influence the taro cultivation system. The research method used is descriptive method with qualitative approach to understand the description of taro cultivation system in South Manokwari district. The approach of cultivation system indicators includes cropping patterns, cultivation management, cultivation production, constraints faced and the sustainability of taro cultivation system. The results showed that there are two types of taro cultivation systems in southern Manokwari district, namely monoculture and polyculture. The mixed polyculture taro cultivation system is more widely applied and is more suitable and efficient because it increases land productivity and ecological stability in reducing pest and disease attacks.

Key words: Cultivation system; monoculture; polyculture; taro.

Introduction

Taro is a tuberous plant widely cultivated in Indonesia as a staple food, alternative and functional food that contains important carbohydrates needed as energy in daily activities. This plant has a high economic value because tubers, petioles and leaves can be utilized as food for humans and livestock; medicinal ingredients (Danuminarja, 1978) and industrial raw materials.

In Indonesia, taro has been cultivated in Sumatra, Java, Kalimantan, Sulawesi and Papua. Taro can grow in tropical and subtropical areas at temperature of 21-27°C, rainfall of 1750 mm per year, and moist soil with a soil pH ranging from 5.5-6.5 (Kay, 1973). Taro able to grow widely in flooded or dry land conditions and even under shade (Andarini and Risliawati, 2018). Taro is easier to cultivate and harvest than rice; its growth is fast; its utilization is wide; it is adaptive to climate change; and it has the potential to increase income, farmers' welfare and food security. However, taro has not been maximally utilized in Indonesia including in Papua. Taro is very potential to be developed in food security as well as increasing the income of farming families.

In some areas in Papua, taro is utilized by local communities as a source of local food and alternative food (Rauf and Lestari, 2009) and has become a leading local food besides sagoo (Baransano et al., 2019). However, taro is slowly decreasing production and even less attention than other local foods. Indow et al. (2021) reported

that local foods including taro are still favored by local West Papuan communities in the lowland zone (Yamboi village, Ransiki district, South Manokwari), highlands (Sakumi village, Anggi Gida, Arfak Mountains) and small islands (Wititindau village, Rumberpon district, Wondama Bay) but the frequency of local food consumption is slowly decreasing as long increased rice consumption. The existence of government programs that enter local communities allows the flow of cultural modernization to cause the use of local food to be slowly decreasing by introduction plant from outside Papua. In addition, changes in the subsistence economic system towards an economy based on market needs where the high demand for bananas and sweet potatoes compared to taro impact on the cultivation of local local taro and the development of their cultivation systems.

The crop cultivation system is a human effort to utilize natural resources with various methods to produce plants with the aim of human needed. This system is of course carried out by paying attention to climatic conditions, land and is more environmentally friendly. In Papua, the development of local food sources to fulfill and increase local food consumption is adjusted to the cultivation system, climate and topography (Nainggolan, 2016). In the coastal areas and bird's head areas of Papua, traditional farmers apply shifting cultivation systems with the main crops of taro and *Dioscorea* spp, complemented by other crops such as cassava, banana and sweet potato (Haynes, 1989).

In Papua, taro is called *bete* and has a wide range of morphological diversity in stem color, tuber shape and color. Areas in Papua that have high taro diversity are Ayamaru and Maybrat (Southwest Papua); Nabire, Biak, Yapen, Nimboran and Jayapura (Papua); Merauke (South Papua) and in South Manokwari Regency (West Papua) (Sluyters, 1957). At Yamboi villages, South Manokwari District, taro as alternative food and cultivated with banana and sweet potato as the main crop (Indow et al., 2021; Wahyudi et al., 2024). Based on Rauf et al. (2014) research, local taro called Ransiki taro is widely cultivated in yard land and garden land. Based on the experience of local farmers, yield of taro tubers and other tubers better in the garden than in the yard. This may be due to the presence of soil humus in the garden that supports the formation of tubers. However, taro has received less attention than banana and sweet potato and is only cultivated in traditional monoculture or polyculture systems. These systems are highly dependent on their interaction with favorable environmental factors. How the traditional taro cultivation system practiced by local farmers in maintaining the local taro germplasm needs to be studied and become important information to improve the cultivation system so as to increase the yield and quality of taro tubers in South Manokwari Regency.Second-Level Heading.

Research Method

The research was conducted from April 10 to April 16, 2025, located in two districts namely Ransiki and Momiwaren, South Manokwari Regency, West Papua Province. The research was conducted in these two locations because they are represent the taro cultivation systems carried out by local farmers in South Manokwari, which has a high diversity of taro morphology.

The research method used is observation. The data collected included primary and secondary data. Primary data was obtained through direct observation and interviews with local farmers in Ransiki and Momiwaren districts as many as 8 respondents; while

secondary data as supporting data obtained from related literature reviews. Interviews were conducted with local farmers who cultivate taro, namely indigenous Arfak farmers and Biak farmers (local people). Direct observation was carried out on the land by observing the condition of the cultivation land, the cultivation process and other aspects related to the taro cultivation system and also interviews with local farmers to find out the cultivation activities.

The data obtained was analyzed qualitatively to understand taro cultivation patterns, cultivation processes and aspects related to taro cultivation carried out by local farmers. This qualitative analysis is described descriptively.

Results and Discussion

Brief Overview

Geographically, South Manokwari Regency is located at 1°5′ - 2°5′ South latitude and 133°45′ - 134°25′ East longitude. The topography varies from coastal lowlands to highland at 5 m above sea level to 2300 m above sea level. The area is approximately 2812.44 km2 which is divided into six districts namely Oransbari, Ransiki, Momiwaren, Isin Plain, Tahota and Nenei. The average air temperature reaches 26.9 °C every month with an average humidity of 86.3%, the average rainfall is 1000-5000 mm/year (BPS, 2024). Ransiki and Momiwaren Districts are located in the coastal lowland area to the hillside with an altitude of 15,461 m above sea level, with an area of approximately 273.24 km2 and 456.18 km2 respectively.

Local farmers in Ransiki and Momiwaren districts grow taro as a side crop in addition to the main crops of banana and sweet potato. The types of taro cultivated vary widely. Based on its morphology, the types of taro cultivated by local farmers are purple stem taro, green stem, yellowish white stem with varying tuber colors, namely white, yellow, purple, and pink tubers. Taro planting at early rainy season and harvesting is done when the plants are 6 - 8 months after planting. Taro cultivation is carried out by native Arfak farmers, namely the Sough and Hatam tribes; and other local farmers from the Biak tribe. Taro is cultivated for the main purpose of family consumption and the surplus can be sold to meet the needs of life.

Models of Taro cultivation System

Haynes (1989) reported that local farmers in coastal areas and islands in the Bird's Head region of Papua apply crop cultivation in a shifting cultivation system with crops mainly keladi (*Xanthosoma sagitifolium*) or taro (*Colasacia esculenta* var *esculenta*) and uwi (*Dioscorea* spp) planted beside with cassava (*Manihot esculenta*), banana (*Musa*, spp) and sweet potato (*Ipomoea batatas* L. Poir). Ransiki and Momiwaren districts are located in the coastal plain area. However, in this research location, local farmers mostly apply taro cultivation system as a companion plant to the main crops of sweet potato and banana while the monoculture cultivation system is only carried out by a few local farmers.

In the Momiwaren district, taro cultivation is practiced by the indigenous Arfak people namely the Sough and Hatam tribes. In the crop cultivation system, they apply a shifting cultivation system in accordance with the principle of "*Igya Ser Hanjop*" (local language). *Igya Ser Hanjop* is the local wisdom of the Arfak Tribe, including the Sough and Hatam Tribes, which has been going on since the time of their ancestors in nature conservation and also as a food store. *Igya ser Hanjop* divides the customary area into

four parts namely *Bahamti, Nihamti, Susti and Situmti*. Areas that are allowed to open gardens or cultivate crops in areas licensed by the Arfak chief or on private and family-owned land. The *Bahamti* area is a conservation area in the form of primary forest where activities are strictly prohibited. The *Nimahamti* area is a secondary forest area that was previously used as plantation land but was rested for a long period of time (20 years). This area is forced to be used as plantation land if there is no land available and has received permission from the head of the Arfak Grand Tribe. While the Susti and Situmti areas are areas that are allowed as food-producing areas for the Arfak community with a shifting cultivation system. Both of these areas are private or family-owned areas.

Based on observations and interviews with several local farmers in the research location, there are two taro cropping patterns applied, namely polyculture and monoculture.

Taro Polyculture System

A polyculture farming system is a form of farming system that cultivates different types of crops at the same time and place. The principle of polyculture farming is to mimic the diversity of natural ecosystems or vegetation by planting different types of crops in time and space simultaneously.The polyculture planting pattern of taro means that taro is cultivated as an intercrop or insertion crop and not as a main crop. Based on observations in the districts of Ransiki and Momiwaren, it was found that local farmers mostly (62%) apply the polyculture and traditional taro cultivation system (Figure 1). Taro is grown side by side with sweet potato, banana, peanut, cassava, corn and even fruit and leaf vegetables. Taro cultivation in polyculture is carried out on garden land in valley areas, mountain slopes or in home yards under tree stands. This polyculture farming system is mostly applied by the indigenous Arfak people, namely the Sough and Hatam tribes; and local farmers of the Biak tribe. In implementing a shifting cultivation system with a polyculture farming system, local Arfak farmers must follow the Igya Ser Hanjop rules, namely opening plantation land in the Susti area. The polyculture farming system applied by these local farmers is a mixed cropping pattern, namely planting taro together with several other types of plants such as bananas, sweet potatoes, peanuts, corn and vegetables without considering the planting distance. This system is mostly applied by indigenous Arfak farmers because for them the garden is a food barn so it needs to be planted with various types of local food sources of carbohydrates, protein, vitamins and fats. Plantation land clearing is carried out in mutual cooperation by family members because the garden land belongs to the family. Plantation land clearing is carried out in the dry season, starting with the slash and burn system, namely cutting down several trees and shrubs using simple tools, namely axes and machetes after which they are left to dry for 2-5 days and then burned. The ash from the burning is left on the land because local farmers understand that the ash can fertilize the land. After burning and cleaning, local farmers plant taro seedlings and other seeds directly on the land using tugal made from local tree trunks called *kingi, minyei and brap* (local language). The planting of taro seedlings is done at the beginning of the rainy season, on open land and in direct sunlight. In managing the farm, local farmers generally and intensively apply the conservation tillage (CT) method (Syed, 2018). Local farmers do zero tillage (Salem et al., 2015) or no tillage (Alberto et al., 2010; Pareja-sánchez et al., 2017). Sweet potato cultivation dominates

the farm area while taro is only cultivated on a small scale at certain points. The types of taro cultivated are dryland taro and water taro whose seeds are obtained from suckers or stolons separated from the mature plant, or seed by barter system. In the taro cultivation system, the arrangement of the garden in an effort to maintain the balance of nutrients (soil organic matter) has not been done properly. Plant waste is left in the field as a source of organic matter. Fields that have been planted with taro and other crops are left until harvest time, without fertilizing and controlling plant pests and diseases. However, at certain times local farmers come to the garden location and that is when weed control measures are taken by manual weed control around the plants. Local Arfak farmers generally harvest taro after harvesting sweet potatoes. While local Biak farmers already know the harvesting age of taro, it is estimated that taro is ready to be harvested around the age of 4-6 Months After Planting. Local farmers harvest taro when the number and size of the leaves are decreasing and the tubers are visible on the surface of the soil. At this harvesting age, the weight of the tubers reaches 2-3 kg. If the taro tubers are harvested later than the harvesting age of 4-6 BST, rotting occurs at the bottom of the taro tubers. The harvested taro tubers are consumed by the family and also sold to the market. The production of taro produced in the managed land area is very low because the planted population is small. Local farmers in Ransiki and Momiwaren districts rotate their fields after two vegetable crops or one planting season of sweet potato and taro. Rotation is done after it is known that the yield of taro tubers and other crops is declining and the land is rested for 3-4 years.

Based on the observed results, local farmers in Ransiki and Momiwaren districts also apply a complex agroforestry (25%) taro polyculture cultivation system which consists of several types of trees cultivated by farmers. This agroforestry system aims to increase land productivity by optimizing landing through a combination of trees and annual plants. The combination of plants causes interaction and interrelationship between trees and annual plants with environmental factors such as sunlight, nutrients and water. Based on the observation results, local farmers plant taro under mango, jackfruit and areca nut stands. For local farmers, planting taro with this system is an alternative because taro has good survival ability when planted under the shade. In this system, local farmers do not do soil cultivation, taro seeds in the form of suckers or stolons originating from the parent plant are planted directly in the land using a ditch at a depth of ± 20 cm with a close planting distance of 40 cm x 40 cm. Planting is done under shading from mango, jackfruit, rambutan and areca nut trees that have aged more than 10 years old. Before planting taro, pruning of shade is carried out to regulate sunlight so that taro plants get enough sunlight. During planting, local farmers do not fertilize, weed control is done manually by pulling out weeds or grasses. Irrigation carried out in this cultivation system only relies on rain. In this cultivation system, taro can be harvested when the plants are 4-5 months after planting.

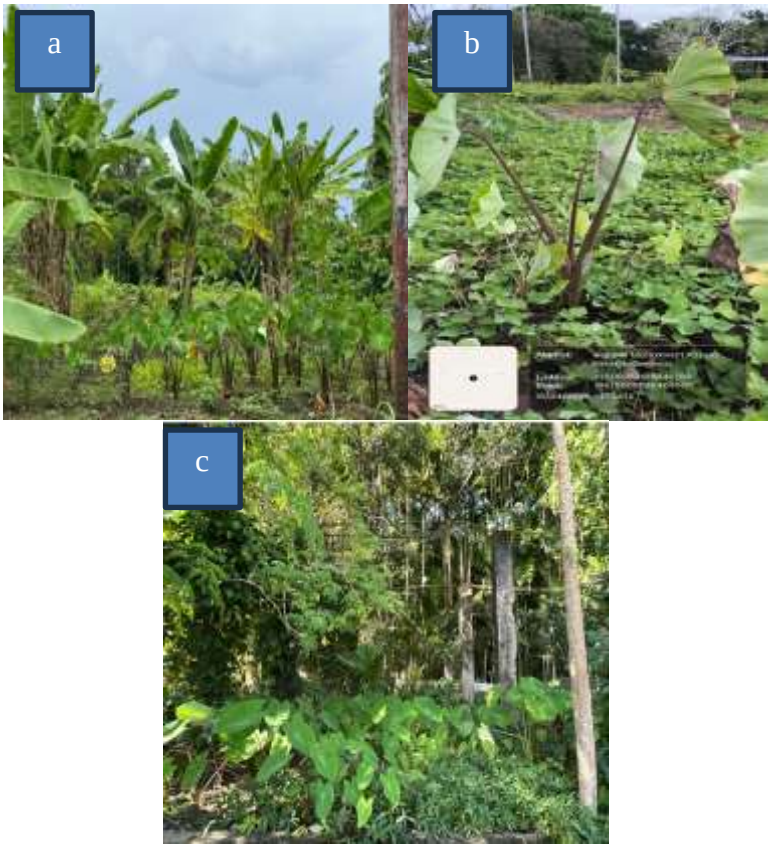

Figure 1. Polyculture Taro Cultivation System; a). with banana (*Musa* spp), b). with *Ipomoea batatas*, c). Agroforestry complex system.

Taro Monoculture System

Taro cultivated in a monoculture system is easier to manage, harvest and increase land productivity. The application of this planting pattern can maximize the yield of taro tubers. Local farmers in Ransiki and Momiwaren districts have implemented a monoculture taro cultivation system (12.5%) but its less compared to the polyculture planting pattern. The land of taro planting is around 20 m x 20 m. The main purpose of taro cultivation is for family consumption or used as pig feed.

The monoculture taro cultivation system is mostly carried out by local farmers from the Biak tribe in the Ransiki district. Planting taro seeds in this system is directly on the land using a digger at a depth of ± 25 cm, with a planting distance of 75x75 cm. The seeds obtained come from suckers and stolons with 2-3 leaves or 3 months old and come from mature plants. The types of taro planted vary based on stem morphology, namely dark purple, purplish green, green stems and yellowish white stems with different tuber colors. As with the polyculture taro cultivation system, local farmers plant taro at the beginning of the rainy season, without tillage and do not carry out intensive maintenance, not fertilizing and controlling taro pests and diseases. Weed control is done manually by pulling out weeds growing around the taro plants. Irrigation of taro plants only relies on rain. Harvesting of taro tubers at 6-7 months after planting, which is indicated by the appearance of tubers on the surface of the soil. Harvesting is not done in its entirety but according to the needs of farmers and does not exceed the

harvest age of taro tubers. Taro tubers that are harvested beyond the harvest age often experience tuber rot. The average tuber weight reaches 2-3 kg/plant.

Figure 2. Monoculture Taro Cultivation System

Problems of Taro Farming in South Manokwari Regency

Based on observations and interviews with local farmers, there are agricultural problems faced in the field. The main problem is Plant Pest Organisms (OPT), namely pests, diseases and weeds. Pests found in taro cultivation systems in monoculture and polyculture likely ants and grasshoppers. The disease that attacks taro plants is leaf blight caused by the fungus *Phytophora colocasiae* and reduces yields by up to 95%. Symptoms of this disease attack are small, dry, blackish spots that spread widely into blight (see figure 3.). This disease attacks local farmers' taro plants that are cultivated in polyculture and monoculture, but the intensity of the attack is still in the low category. Control measures taken by local farmers are to cut the leaves of the affected plants and burn them. Types of weeds, namely other plants that interfere with taro plants, are also found in many local farmers' gardens. The weeds that are often found and have the largest population are sedges and cogongrasses in both polyculture and monoculture cultivation systems.

Another obstacle faced by local farmers in agricultural land is when the long dry season causes limited water availability in farmers' land resulting in plants dying. Another impact is that farmers cannot replant taro.

Figure 3. Plant pests on taro plant. a). Weeds of grass and ferns on taro plants. b), Diseases in taro plants

Conclusion

Local farmers in Ransiki and Momiwaren cultivated diverse morphologies of stems and tuber colours taro. They cultivate taro in polyculture and monoculture both in garden areas and in home yards. The most widely applied taro cultivation system is

polyculture (62%) by local farmers of the Arfak Indigenous tribe, namely the Sough and Hatam tribes and the Biak tribe. The cultivation system is in accordance with their local wisdom and is traditional with simple technology without intensive plant maintenance. This system is more widely applied in garden land, while the complex agroforestry system is in the yard. Monoculture taro planting is only 12.5% by local farmers from the Biak tribe. Taro tuber harvest at 4-6 month after planting.

The obstacles in cultivated taro are pest and diseases attacks, but are still in the low category while attack of weeds are grasses and cogongrass. Soil and climate suitable for taro cultivation but market demand is lacking so that it has an impact on the lack of interest in monoculture cultivating taro on a wider area in the Ransiki and Momiwaren districts

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