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Nature Resources Contestation Between Native Papuans: Establishing a Collaborative Management of the Cyclops Mountain Nature Reserve Area in Papua, Indonesia

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Abstract

Collaborative natural resource management (*co-management*) *has become a prevalent method to maintain the sustainability of the environment. In co-management, it is crucial to involve several related parties to ensure a precise distribution of responsibilities and authority among all parties. Natural resource management and biodiversity protection in conservation areas require the involvement of local communities. Conflicts in resource use among the population, including the indigenous people, often hinder these efforts. In this regard, this study examines the contestation of the management and utilization of natural resources between local indigenous Papuans and indigenous Papuan migrants in the Cyclops Mount Nature Reserve* (*CMNR*). *Using a mini-ethnography method, the study qualitatively explored a wide range of information relevant to this issue. The study conducted in-depth interviews with informants from local and migrant communities, as well as observations from both participants and non-participants. The study reveals that the local indigenous Papuans utilized the area in a relatively sustainable manner. However, the indigenous Papuan migrants were unable to prevent the use of natural resources in the CMNR, leading to environmental damage. To avoid further environmental damage to the CMNR, this study recommends the need for collaborative management in the area by involving both local indigenous Papuans and indigenous Papuan migrants with support from the government.*

Keywords: *collaborative management, cyclops nature reserve, environmental sustainability, indigenous Papuan*

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Introduction

The formal designation of conservation area status by the state in specific regions is considered important for the preservation of biodiversity, particularly for endangered animals and plants. The state's intervention has also been reported to be essential in maintaining a balance between utilization and sustainability issues. However, as reported by Ostrom (2009), Ives et al. (2018), and Whitburn et al. (2020), this balance is often not achieved due to various factors. According to several studies, the establishment of conservation areas is not always effective in ensuring the sustainability of the environment, natural resources, and biodiversity due to irresponsible human intervention (Walters & Vayda, 2009; Heck et al., 2018; Adenle et al., 2020; Scullion et al., 2021; Bogoni et al., 2023). This is in line with the opinion that human intervention poses the greatest threat by causing damage to conservation areas and natural ecosystems (Wang et al., 2021; Leberger et al., 2020).

Other studies mention that the decline in the protective status of a majority of the world's conservation areas, including national parks, nature reserves, wildlife sanctuaries, and other types of nature conservation, can be attributed to the substantial growth in the global population, occurring naturally or due to inmigration (Henderson et al., 2019; Hunter, 2000; Dimnwobi et al., 2021). The escalating population exerts pressure on the exploitation of natural resources, while the reproductive capacity of nature remains limited leading to an imbalance between human needs and environmental carrying capacity (Galli et al., 2020).

To prevent the degradation of conservation areas, several studies have suggested the importance of involving communities, particularly the indigenous people, in their management (Agrawal & Gibson, 1999; Castree, 2004, Murray Li, 2010; Abas et al., 2022). In addition, their inclusion in the management of conservation areas is considered effective for several reasons, such as their heightened sense of concern for the sustainability of nature (IUCN, 2018; Popova, 2018). Several studies have shown that indigenous people play multifaceted roles as stewards of these areas, deriving sustenance and livelihoods, owing the

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land, and possessing traditional knowledge gained over generations through interaction and adaptation (Berkes et al., 2000; Ford et al., 2018; Garnett et al., 2018).

Despite their essential role, the ability of the indigenous people to manage and sustain natural resources and the environment is often negated by stressors, leading to continued environmental degradation. These stressors include difficulty in dealing with external pressures, those caused by the migration of people from outside their territories (Berkes & Folke, 1998; Schinkel, 2018; Rude et al., 2021). In the context of in-migration, several studies have suggested that the decline in nature conservation functions is related to the development of economic centers that trigger massive population migration from rural areas, leading to increased pressures and threats to conservation areas (Lewis et al., 2019; Ariken et al., 2020). The massive population migration also causes tenure conflict. Regarding this, many studies mention that such conflict involved local people and migrants from other islands or ethnic groups (Malamassam et al., 2021; Sollis et al., 2023).

In the case of Indonesia, studies conducted by Clough et al. (2009), Mehring et al. (2011), and Tothmihaly et al. (2019) in Lore Lindu National Park, Central Sulawesi, also report high pressure exerted by migrants from outside the island. In Jambi, Steinebach (2017) indicates the seizure of local farmers' agricultural land by outside farmers supported by private companies. Another study showed land grabbing for oil palm development in West Papua, such development was carried out without the consent of indigenous people (Runtuboi et al. 2021). Other similar reports indicate conflicts between migrants from Sulawesi who took over the use of marine resources in the North Sea of Papua and engaged in forest encroachment through the opening of the trans-Papua route (Hugo, 2002; Kambu et al., 2022).

Studies on conflicts between local people and migrants in natural resource management seem to have focused more on migrants from outside the region or the island with different ethnic or racial backgrounds. There are limited reports on conflicts in natural resource management between local people and migrants who have the same ethnic or racial background, as it happens in Papua, Indonesia.

Papua is an area of Indonesia with a wide forest area and rich in biodiversity. A number of conservation areas have been designated by the Indonesian government to ensure the sustainability of its natural resources (BKSDA Papua, 2022). Traditionally, in Papua, aside from the claim of the state, the land, including natural resources, is generally controlled and owned collectively by tribal or clan groups, with natural boundaries that have been agreed upon, respected, and recognized together since the ancestors.

In order to gain an understanding of the relationship between the idea of conservation area management, which involves the community, natural resource degradation, and the issue of tenure conflict over conservation areas that occur between local communities and migrants from the region with the same ethnic background, this study examines how contestation of natural resource use occurs among indigenous Papuans in the conservation area of Cyclop Mountain Nature Reserve (CMNR), Papua, and its implications for the sustainability of community-based CMNR management.

Methods

The study of natural resource utilization by local indigenous and migrant indigenous Papuans, as well as the conflicts that occur between them, was conducted in old villages and new settlements located in and around CMNR. Local indigenous Papuans who had lived in the CMNR area for generations typically inhabited 12 old villages around the region (Figure 1). These communities belonged to the Sentani community and culture group in the Mamta-Tabi customary area, located between two watersheds, the Mamberamo River and the Tami River, part of the Mamberamo Regency and Keerom Regency. Migrant indigenous Papuans living in the 8 new settlements belonged

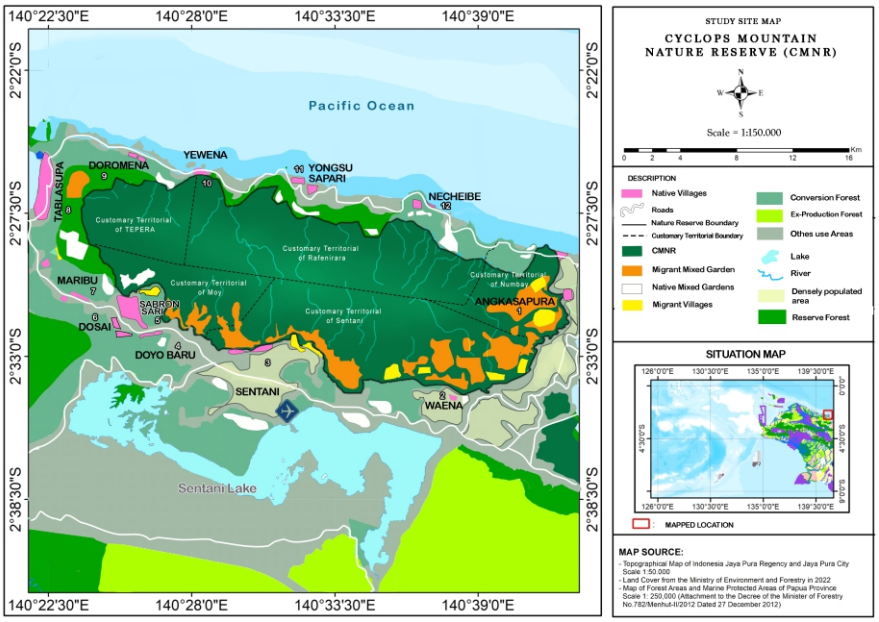

Figure 1 Study site.

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culturally to the Dani community and culture in the La Pago customary area and the Ekari community and culture in the Me Pago customary area (Figure 2). Some Papuan migrants joined and lived close to native people in the old villages.

This study used a qualitative method by conducting observations and in-depth interviews (Gephart, 2018; Aspers & Corte, 2019) with 12 clan chiefs from local indigenous people and eight clan chiefs from indigenous Papuan migrants. It was a kind of mini-ethnography method that, according to Muecke (1994), can examine certain issues in a relatively short time. The data collected in observation includes activities of local indigenous peoples and indigenous Papuan migrants in managing and utilizing natural resources in the CMNR, such as hunting and gathering, as well as the practice of gardening in the forest area. We also observed and participated in patrols with government officers to see the boundaries of the CMNR. As part of our observations, the study mapped several essential locations, such as gardens, water sources, hunting and gathering locations, settlements, village halls, markets, schools, and health facilities.

In choosing the informants purposively, the study began to interview the community leaders. Based on information received from the community leaders, the study selected other informants with the snowball sampling technique. Referring to Tongco (2007), the informants selected in this study were those who directly have access to the management and utilization of natural resources in the cyclops area, such as the clan chiefs. The clan chief has the legitimacy to provide information on matters related to customary rules and the issues related to community life in his village. At the same time, elders were addressed by the clan chief because they could talk about customary rules, specifically from a historical aspect. These interviews explored the use and management of natural resources and biodiversity by local communities and migrants, including traditional ecological knowledge owned and practiced, as well as their social interactions.

In relation to current and future natural resource management issues, group interviews were also conducted with each group. The group interviewed consisted of clan members selected during the observation process, namely those with access to the CMNR area for hunting, gathering, clearing garden land, collecting timber, and living around the CMNR area. Each group consists of more or less 10 people. In determining group members, we also ask for advice and input from the group chief. It consists of indigenous groups living in 12 villages that are directly adjacent and have access to natural resources in the cyclops mountains, as well as 8 Papuan migrant villages that make settlements within the cyclops nature reserve area. The data analysis of this study followed the interaction model of analysis of Miles et al. (2014), which emphasized on the simultaneous process of data collection, data reduction (condensation), data display, and verification/conclusions.

Results and Discussion

Cyclops Mountain Nature Reserve CMNR is one of the conservation areas in Papua Province, Indonesia, located at E140°22′–E145°43′ longitude and S2°25′–2°33′ latitude. Cyclops mountain was first designated as a conservation area by the Indonesian government since 1954, with the status of a protected area and ecological laboratory (BKSDA Papua, 2022). In 2012, the status was changed to nature reserve with the Decree of the Minister of Forestry Number 782/Menhut-II/2012, December 27, 2012, with an area of 31,479.89 ha.

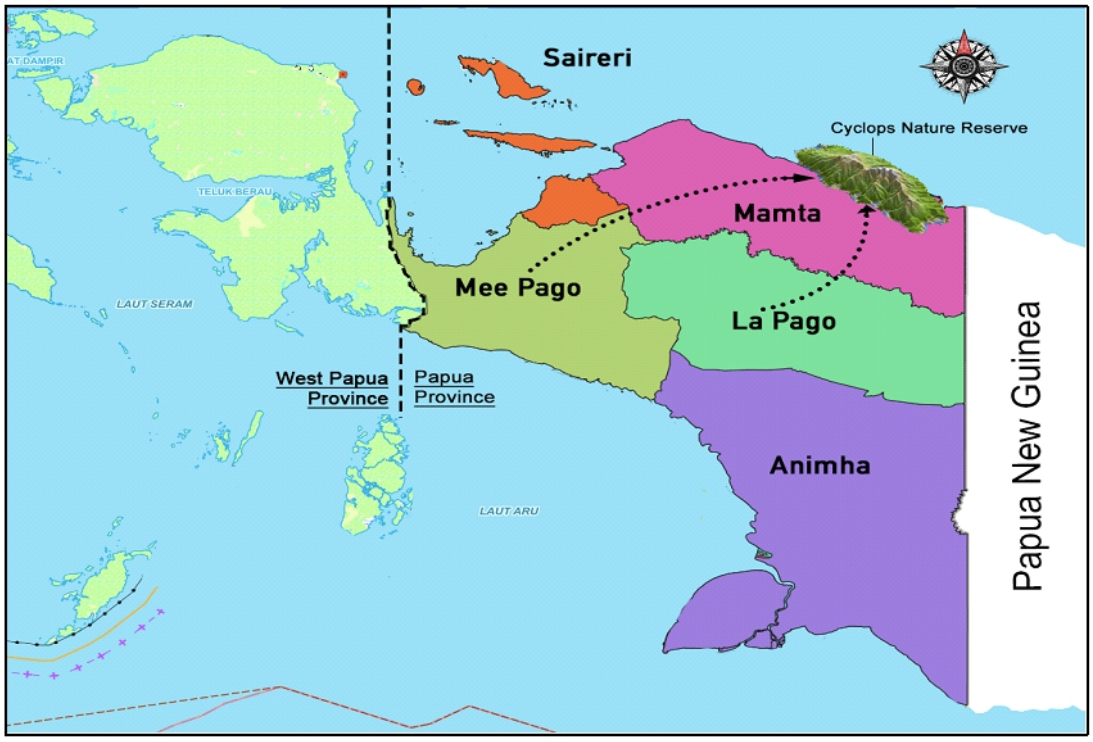

Figure 2 Local Papuan migration from La Pago and Mee Pago to CMNR area in Sentani.

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The cyclops mountain is a miniature representative of the north coast ecosystem type of Papua. Based on the global 2000 ecoregion classification, CMNR consists of 3 ecoregion types, namely Northern New Guinea Mountain Forest, Northern New Guinea Lowland Rain, and Freshwater Swamp Forest (Antoh & Raunsay, 2019). According to previous studies, CMNR has a diverse range of endemic flora and fauna. Several studies have also discovered various very rare species in the world, such as *Echidna zaglossus, Acanthophis antarcticus* (common death adder)*, Lepidoptera Geometridae Larentiinae, Paphiopedilum glanduliferum,* and *Paphiopedilum wilhelmina*e (Figure 3) (Simmons et al., 1967; Flannery & Groves, 1998; Mirsky, 2004; Noske & Spaeth, 2009; Riedel et al., 2010; Schmidt, 2018; Shaverdo et al., 2021). In 2017, the number of species recorded in the CMNR area was 85,000s (BKSDA, 2017). Other studies also stated that the soil in the cyclops mountain and northern sea waters contained several types of materials. These materials find application in manufacturing industries, such as metals and iron (Zglinicki & Szamałek, 2020). All of those studies indicate that CMNR could become an important part of the world's ecological laboratory for study and scientific development.

Natural resources and biodiversity in cyclops mountain have long been used by local indigenous people who live in the vicinity (Figure 4; location of villages, see Figure 1). These people have long practiced hunting and gathering activities as their livelihood system. In a broader context, the

Figure 3 Endemic species found in CMNR. a. *Echidna zaglossus*, b. *Lepidoptera geometridae* Larentiinae, c. *Acanthophis antarcticus* (Common death adder), d. Sowang wood (*Xanthosthemos novaguineese* Valeton), e. *Paphiopedilum glanduliferum*, f. *Paphiopedilum wilhelminae* (Baillie et al., 2009; Wilujeng & Simbiak, 2015; BKSDA, 2017).

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cyclops mountain range is the sole source of clean water supply for more than 600,000 people in Jayapura Regency, Jayapura City, and Keerom Regency.

Along with natural population growth due to inmigration and development activities around the area, symptoms of environmental degradation have begun to appear in CMNR. In the last decade, at least 3 flash floods and landslides have occurred, causing material losses and several human casualties. These events have also resulted in changes to the landscape of the CMNR area.

Tenure system and customary territory division in the CMNR area The territories where indigenous people live are spread across five customary areas, including the Sentani, Moi, Tepera, Ravenirara, and Numbay customary areas, as shown in Figure 4. Indigenous people in the Sentani customary area controlled and held customary rights in the south part of the CMNR, Moy in the southwest, while those in the Tepera customary area controlled and had customary rights in the western to a small part of the northwest area. Inhabitants of the Ravenirara customary area controlled and had customary rights in most of the northern area, this is the largest area. Indigenous people in the Numbay customary territory were regulated and had customary rights in the eastern part of the territory.

The control of customary territories in the cyclops area by local communities was based on evidence of land tenure from ancestors conveyed orally from one generation to the next. In addition, the recognition from local indigenous groups and customary rights owners who live around the cyclops mountains also strengthened the claim of territories. The boundaries of regions owned by each group were marked by natural characteristics, such as rivers or certain types of long-lived plants that had been planted by their ancestors, such as *matoa* trees (*Pometia pinnata*), *merbau* (*Intsia bijuga*), and soang wood (*Xanthosthemon novaguineensis valeton*), one of the endemic wood species in cyclops.

Generally, there were similarities in the land ownership or tenure systems in the five customary territories in the CMNR area. Land in the CMNR area was considered the property of certain *Keret* (clan) in each customary region. Certain clans that first cleared land and settled in certain areas were recognized as landowners. The people used natural resources by following various rules set by the customary leaders of the landowning clan. Violators of the rules received customary sanctions determined by leaders called *Ondoafi* or *Ondofolo*.

In the tradition of community groups around CMNR, it was believed that community leaders must be people who own land (territory). The people believed that land was not only a treasure but also a symbol of honor, prestige, and power. An *Ondoafi* or *Ondofolo* had full rights over the land belonging to the clan. Outsiders used land belonging to the clan with permission given by the *Ondoafi* or *Ondofolo*, who also gave land to other people outside the village through grants or use permits. These leaders also had special authority in regulating or changing the function of land, for example, when the land was released by custom to the government or other parties, people encroaching were sanctioned or fought by members of the landowning clan.

Regarding land ownership, Mansoben (1995) stated that indigenous communities in Papua did not recognize individual land ownership; land, forests, and other resources were collectively controlled (Siregar, 2002; Ondikeleuw &

Figure 4 Sketch of the region in the CMNR region.

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Ma'rif, 2015; Dhiksawan et al., 2018). In the case of people in the CMNR area, the leaders regulated the management and use of the land. Each group controlled a certain area, and the use was regulated by a *Keret*, which was considered to be the oldest clan and the first to arrive at the location. In the Sentani customary area, there were 97 clans, with 3 being the oldest. In the Moi customary area, there were 41 clans, and 2 of them were the oldest. In the Tepera customary area, there were 30 clans, with 2 of them being the oldest. The Ravenirara area had a total of 9 clans, with 1 being the oldest, while the Numbay customary area had 12 clans, of which 2 were the oldest.

The description above mentions an important issue that local indigenous community groups have utilized and managed the land, the forests, and other natural resources communally. They guard and closely monitor the resources; they regulate and implement the rules for every member of the communities to responsibly utilize the resources. Such management systems have long been practiced since their predecessors.

Forestland classification and the utilization of the CMNR area by local indigenous people The cyclops mountains have long been a source of livelihood for the surrounding indigenous peoples in meeting their daily needs and exchanging food among the local indigenous people. For example, pork, mole (*Geomyidae),* vegetables, sweet potatoes, areca nuts, sago, bows and arrows, and various types of wood to build houses, boats, and other public facilities. Residents also set up gardens around their villages or in parts of the forest that have traditionally been allowed to be used as garden land. Communities in the northern part of the CMNR are also involved in fishing in the sea and hunting or gathering forest products (Figure 5).

Indigenous communities around the CMNR area had conceptual similarities in terms of managing and using natural resources called *aniyo era yo*, which was the core concept of the environmental management and utilization system based on traditional knowledge formed through a long process of interaction and adaptation (Kopeuw, 2017). In general, at least 8 terminologies were known in the land use of forest areas according to the people (Table 1).

In forest areas that were primary forests, all groups around the CMNR area determined that the regions were prohibited from being used. They have the same rules and have been agreed upon together since their ancestors. These forest areas were considered sanctuaries for water resources or sacred places. In addition, people were forbidden to hunt and collect timber. Outside of primary forest areas, the local indigenous peoples utilized the land for cultivating staple crops, including cassava (*Manihot esculenta*), taro (*Caladium*), banana (*Musa paradisiaca*), pineapple (*Ananas comosus* (L), and batatas (*Ipomoea batatas*). Some other uses included growing various vegetables, such as ferns (*Diplazium escelentum*), papaya (*Carica papaya* L), cassava, batatas, gedi (*Abelmoschus manihot*), and genemo (*Gnetum gnemon*). Those areas that can be planted are areas outside primary forests, open land, far from spring water sources, and land whose surfaces tend to be more sloping. The areas can also be planted if permission has been granted by the tribal head or clan that owns customary rights.

Gardening activities were carried out through shifting

Figure 5 A. Hunting in the savana, B. Gathering Batatas, C. Processing sago.

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Table 1 Local terminology of forest land-use in CMNR

Land use	Terminology					Function
	Sentani	Tepera	Ravenirara/ Ormu	Moy	Numbay	
Forest (primary forest)	*Aghla hollo*	*Tingkera waukera*	*Tena*	*D'pen*	*Nan hbur*	Primary forest for protection of water resources; sacred places; forbidden forest area
Forest area for garden	*Hegkhe khela*	*Sena*	*Wana*	*Hasu ksop*	*Uum regh*	Hunting and gathering area; people looks for timber for house or boat; people do gardening by shifting cultivation for a period of 5 to 10 years.
Ex-garden forest (secondary forest)	*Hegkhe anuauw*	*Seke*	*Hemeseke*	*Asunenbuh*	*Uum regh*	
Savana	*Ellah anuauw*	*Moko*	*Jei*	*Ungpay*	*Usds nhacau mhariagd*	Hunting ground
"Fern forest"	*Feuwurama*	*Nokojei*	*Amang*	*Drebetkatuei*	*Chai*	Location where people collects fern leaves as vegetable. People also make hunting equipment from fern stems
Sago forest	*Fiuwu khela*	*Ou Pau*	*Nachifavoh*	*Dbetpay*	*Nass waub*	Place where people collects wild sago
Sago garden	*Fiuwu bhuko*	*Pau*	*Atubuia*	*Pi kebuso*	*Nass waub*	Place where people plants sago
Coconut garden	*Kho bukho*	*To pau*	*Nu wafo*	*Nau kbuso*	*Umm niu*	Place where people plants coconut
Areca nuts garden	*Bhelauw bhuhò*	*Burau pau*	*Fukwa wafo*	*Burau mika*	*Umm fuk*	Place where people plants Areca nuts

cultivation. Newly cleared forest areas for gardens were used for 1 to 3 years. After the land was considered less fertile, the people opened new gardens in other forest areas. The former garden land that had been reforested could be cleared and planted again after 5 to 10 years. They will return to the garden at the location after 510 years. During that period, they considered the soil to be fertile again. At the same location, the garden land that had been used was planted with long-term crops, such as areca nuts or coconut trees. There were 25 trees planted when the garden was opened. The plant symbolizes that the location is a former garden and is in fertilization.

A part of the forest land was grassland in the form of savanna. As mentioned in the Balai Besar KSDA Papua (2020), the savanna area in CMNR reached 665.73 ha, which was spread over several separate locations. In this area, local indigenous communities conducted hunting activities. Wildlife hunted included wild boar/*obbo* (*Sus scrofa*) and ground rat/*hamoi* (*Echymipera kalubu*). The Sentani indigenous people recognized the concept of *Obbohamoi Peijande*, which meant only hunting certain types of animals in places set aside for hunting.

Concerning hunting activities, there was a rule to close some forest or savanna areas from hunting activities. In the closed area, hunting was prohibited for a certain period, between 6 months and 1 year. This rule was called *Phara* among the Sentani people, which was intended to ensure that the animals to be hunted were abundant when the ban was lifted. Large numbers of hunted animals were usually needed for major events, such as ceremonies or the inauguration of a traditional leader called *Ondofolo*.

The fulfillment of people's basic food needs was not only met using the tubers grown in the garden but also the sago plants taken from the sago forest (wild sago) as well as from gardens where sago plants were cultivated. The location of the forest, which was far from the village, encouraged the cultivation of the plant in locations relatively close to their homes. Apart from sago plantations, people also sowed certain plants whose fruits were needed and even had high economic value, such as coconut, areca nut, or matoa trees. The fruits were harvested not only for personal consumption but also for sale to urban areas. In addition to these various resources that could be used from the forest areas and gardens, there were also areas where many ferns were found. From this place, people collected fern leaves, which were processed for consumable vegetables. Fern plants grow in clusters around the main forests and also in valleys with high humidity. These areas are usually called fern forests.

The description above shows that traditionally, local indigenous communities that have lived for a long time on the outskirts of the cyclops mountains have managed and utilized the natural resources to meet their livelihood relatively in a good manner and sustainably. They emphasize the principles of sustainability and conservation of nature and biodiversity.

In-migration into the CMNR area *Papuan migrant population around CMNR* Population growth in the area around CMNR was relatively low. However, since the 1980s, population growth has been relatively high due to in-migration to the CMNR area by Papuans from the La Pago

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and Mee Pago customary areas (Figure 2). The data in Figure 6 shows that population growth had approximately quadrupled between 2000 and 2020. In addition, there were also a limited number of other residents from outside Papua.

The population composition between local indigenous and migrant Papuans had changed drastically. Figure 6 shows the dominance of migrant Papuans in several villages around CMNR in 2000 and 2020. These people mainly dominated the urban areas of Sentani (Sereh, Nolokla) and Jayapura City (Gurabesi, Waena, Angkasapura) in the southern and eastern parts of CMNR. Data shows that very few migrants lived in the northern part.

The areas around the CMNR in the western, southern, and eastern parts were the most desirable migration destinations because, apart from the availability of natural resources that could be managed and used to meet the needs of life, the ease of access to the city center was a major attraction. Apart from urban attractiveness, the availability of education, health, entertainment, economy, and employment facilities strongly encourages them to migrate. In addition, the political situation and armed conflict were also the reasons for some indigenous Papuan migrants to leave their areas of origin. A map of the cyclops region (Figure 1) shows that most migrant settlements and farms were located within CMNR.

Migration to the CMNR area Since 1980, some of the La Pago and Mee Pago customary area residents have migrated to Jayapura City and Jayapura Regency, including the CMNR area (Figure 2). Economic, education, health, inter-tribal wars, and social and political unrest in their place of origin were the reasons for migration. In addition to these reasons, the perceived ease of finding a livelihood in the destination area was a strong reason to migrate (Timisela et al. 2020).

In the CMNR area, the indigenous Papuan migrants lived in the hills and slopes of the cyclops mountains. Gardens were planted, pigs were raised, and vegetables were harvested and sold in markets in the Sentani area. The CMNR area's topographical conditions made it easy for migrants to farm compared to their homes, for instance in the Baliem Valley, which was steep and rocky, where obtaining fertile land suitable for gardening had often led to conflicts.

The indigenous Papuans migrants from La Pago and Mee Pago area could live around the CMNR area after obtaining a residence permit and permission to use the land from the local indigenous Papuans leaders. This permit was given orally and was temporary. This means that the landowner can withdraw the location at any time.

People and livelihoods in the La Pago customary territory The indigenous Papuans from La Pago, who migrated to the CMNR area, lived in the mountainous highlands of more than 2000 meters above sea level. Such a high-altitude location served as an area for growing *ippere* (tubers), such as batatas, taro, and cassava, and *o-ken* (fruits), including watermelon, pineapple, orange, passion fruit, and melon. Vegetables such as *ippere ka* (tuber leafs), cucumber, cabbage, or tamarillo were also cultivated, as shown in Figure 7. Pigs (*wam*) and chickens were also raised by them, as well as hunting, gathering, or catching shrimp in the river.

Farming activities were carried out on fertile lands that were communally owned. In the Dani tribe, for example, land was owned by clans led by a large clan chief called *Ap-Kain* and a warlord known as *Ap-Menteg*. By custom, the area owned was marked by natural boundaries, such as rivers, valleys, or mountains. Each family that opened a garden was equipped with knowledge about territorial boundaries to avoid *wim falegma* (tribal wars) due to disputes between landowning clans. When a tribal war occurs due to a dispute over land use, the dispute is usually resolved by holding a stone-burning party called *helikir-ikogo* (Howay, 2019).

People in the La Pago area generally recognized the concept of shifting cultivation. Land utilization for gardening was carried out in rotation, where La Pago indigenous people did not continuously cultivate in the same place. Cultivation was moved to a newly cleared land when the previous area was considered infertile, usually after being used 2 to 3 times. The garden land was typically left for 35 years before being used again. The land used for gardening was usually located in valley areas and hills not far from settlements.

The Baliem Valley is the only best location for agriculture. Apart from the fertile soil, the Baliem Valley

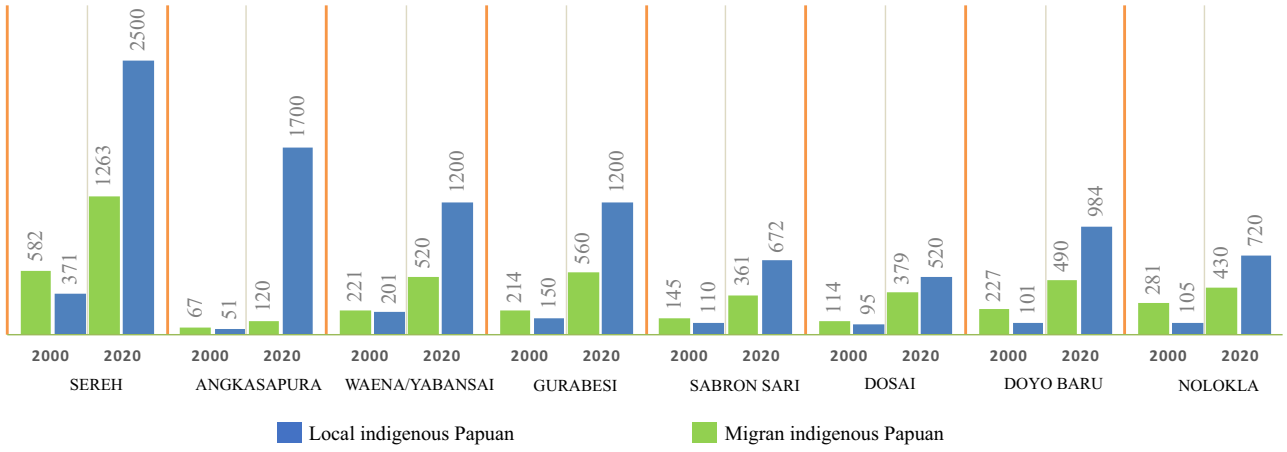

Figure 6 Population composition between local indigenous and migrant Papuan, 2000 and 2020 (BPS Papua, 2020).

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Figure 7 Gardening in Baliem Valley.

flows the Baliem River as the primary source of water. It is not uncommon for this location to be a struggle between tribes or clans that causes tribal wars to get the location of the garden. This condition causes some tribal groups to choose to garden on higher plains, steep hills, and prone to landslides. In this location, the process of clearing land for the garden requires more family and family participation, extra energy to reach the garden location, and a complex process of plant treatment. Nevertheless, there is no other option to keep doing it to meet the needs of the family and as a livelihood.

Gardening activities were carried out in groups on land used as a *wen* (garden) after first obtaining permission from the customary rights owner. These activities began with clearing the area by burning bushes, weeds, or trees that were considered to interfere with plant growth, dredging the soil, making beds, and planting seeds (Figure 8). The garden land was demarcated with a fence called a *leger* as a marker of ownership and to protect them from wild animal pests, specifically wild boar. The fence was made of wooden branches or twigs. Although the fence did not look sturdy, the people believed that the plants were safe from wild animals because they had been given a spell (*wesameke*). The native farmers of La Pago always clean weeds or nuisance plants in the garden area 3 to 5 times in 1 planting to harvesting cycle.

People and livelihoods in the Mee Pago customary territory
Migrants in the CMNR area who came from the Mee Pago customary area in their area of origin lived in settlement areas with altitudes between 1,200 and 2,000 m above sea level. Their livelihood system depended on *owaada* (gardening), raising *ekina* (pigs), and catching fish and shrimp in lakes or rivers.

The people performed gardening in groups, and garden locations were chosen in places close to water sources and were carried out by not destroying the forest, including forest areas recognized as belonging to other clans. The Mee Pago people have rules for clearing land for gardens, which their ancestors passed down. The land designated as a prospective plantation is outside the sacred forest. The location of the prospective plantation is in an open area, such as hills overgrown with a lot of weeds and a few trees. They will only cut down trees when necessary and with collective agreement. The size of the garden varies. The size of the collective garden is between 35 ha. Land clearing for gardens usually began with a ritual of respect for nature, the ruler of the universe, and the ancestors, called the *Yuwo* ritual. The staple crops grown included sweet potatoes (*notta*), taro (*nomo*), cassava, peanuts, green beans, pumpkins, pineapples, bananas, and oranges.

The people from the Mee Pago area also conducted hunting and gathering activities in the forest area. Among the people of the Mee Pago customary area, the Moni tribe was one of the major tribes that managed and used forest resources, which were divided into at least 2 categories: *Mbai Emo* (large forest) and *Mbaipa* (small forest). Large forests were sacred areas believed to be the abodes of *epawado* (ancestral spirits) and *eniya* (evil spirits). The small forest was where animals such as *kuskus* (Masupialia) were hunted and birds were caught, including the green pergam bird (*Ducula aenea*). Rattan and pandanus fruit were also gathered (*Pandanus tectorius*), which was carried out on a limited basis within the territory of each clan.

The description above indicates that indigenous Papuan migrants from Mee Pago, in their home areas, seem to have lived in harmony with nature, they could rely on the local resources for living. However, similar to the migrants from La Pago area, many people migrated to Jayapura and Sentani areas due to, among others. the lack of educational facilities, health, social conflicts (tribal wars), and armed violence. For a part of the people, migration to Jayapura and/or Sentani areas was an option to live better.

Contested forest resource utilization and degradation of the CMNR area *CMNR forest use by migrant Papuans* In the CMNR area, some of the indigenous Papuans migrant obtained permission to live and farm from the *Ondoafi* or *Ondofolo* of the local indigenous communities, with consideration as fellow Papuans and their status as migrants. The agricultural practices of migrants from La Pago and Mee Pago were like those of their homes. They have the same way concerning the pattern of clearing land for prospective plantations. Forests were cleared for prospective gardens by cutting down several large trees and then burning the land and unused branches. In the CMNR area, the felled trees were then used as "firewood" and sold as charcoal to certain vendors or large restaurants in Jayapura. The making of charcoal, particularly for sale, was not a habit practiced in the migrant's home areas but was carried out due to the high market demand and the opportunity to collect timber. A part of the CMNR buffer zone, which was previously filled with trees, had been transformed into banana, pineapple, or other crop gardens.

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Figure 8 The people of Mee Pago, from left to right: gardening, fishing, and selling shrimp at the market.

After building houses and gardens, however, the borrowed land was used indefinitely and made into unilaterally owned land. These properties were also handed over to their families and relatives without permission from the customary-land owners. In addition to expanding the land, semi-permanent houses were built, and forest products were forcefully taken, including cutting down trees for timber, intentionally without the permission of the customary-land owners. These activities tended to expand and damage the environment of the CMNR area, specifically those located in the southern part (Figure 9).

The local indigenous communities had tried various means to prevent further damage by giving direct warnings. However, these activities continuously caused damage. The rules and restrictions that had been enforced by the local indigenous communities of Sentani and others to maintain environmental sustainability in the CMNR area were no longer applicable. The Papuan migrant groups tended to ignore the principles of sustainability and conservation when utilizing forests and natural resources, which in the long term, could harm the environmental condition of the CMNR.

Lumbangaol (2022) stated that in the Sentani and Doyo Baru areas, the gardens of indigenous Papuan migrants were located far from settlements, behind trees deliberately not cut down to disguise their existence. The head of Numbay Resort (Center for Natural Resources Conservation/BKSDA Papua) stated that for their new plantations, Papuan migrants tended to clear the forest towards the CMNR core area.

Environmental degradation and natural disasters Changes in the use of the CMNR area led to several consequences in the form of threats to the sustainability of natural resources. WWF's findings in 2018 shows that deforestation reached 9,470.9 ha between 1998 and 2018, covering 2,469.09 ha of areas categorized as highly critical, 3,563.52 ha of critical, 244.71 ha of moderately critical, and 3,193.58 ha of potentially critical areas (WWF, 2018). Land clearing and illegal logging caused the forest to lose its function. When extreme rainfall occurred in 2014, 2017, and 2019, floods and landslides caused damage downstream, specifically in the southern area of CMNR (Figure 10).

Hundreds of houses, places of worship, shops, markets, bridges, roads, drainage, and airstrips were severely damaged, and a total of 105 people died. This disaster also caused 9,691 people around CMNR to temporarily evacuate in post-disaster posts prepared by the government, with material losses reaching IDR506 billion.

Compared to the southern CMNR area, in the northern part, where there was almost no forest change due to gardening activities and illegal logging, the high rainfall in the same year did not cause a destructive impact. Figure 11 shows a photo of dense forest conditions and relatively stable river flows. In addition, no reported landslides and flooding occurred in the south part of the CMNR area.

Efforts to protect CMNR area The population dynamics and resource utilization that take place in the CMNR have caused this conservation area to be vulnerable to damage. Responding to this issue, the CMNR management has made several efforts to protect the conservation area and to assure its sustainability. These efforts include creating and establishing regulations and implementing programs related to protection and conservation in partnership with the local community. As indicated in Table 2, these efforts include economic empowerment, health and education programs, participatory mapping of the customary areas within the CMNR (Figure 12), joint patrol of the conservation area, and reforestation activity. All activities involved many stakeholders, including government, military, national and international NGOs, and students.

Despite the various efforts made, most of the programs implemented could not last long. Program implementation was still partial and not accompanied by efforts to monitor and evaluate its sustainability. In addition, programs engaging the people did not sufficiently comprise indigenous Papuan migrant groups who also used natural resources in the CMNR area. The program seemed to emphasize cooperation between CMNR managers and local Papuans. The engagement of migrant Papuans in environmental management received less attention.

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Figure 9 Erecting houses, burning the land for garden, and cutting trees for timber in the area close to core zone of CMNR.

Figure 10 Forest degradation that led to landslide and floods in Southern part of CMNR in 2019.

Figure 11 Environmental conditions in the northern part of the CMNR during extreme rainfall in 2019.

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Table 2 Efforts and programs to protect CMNR

No	Efforts/programs	Participants
1	Economic empowerment, health, and education	CMNR management, local indigenous communities and local, national, and international organizations: Yayasan Lingkungan Hidup (YALI) Papua, Yayasan Pendidikan Lingkungan Hidup Cyclops (YPLHC), Wahana Lingkungan Hidup Indonesia (WALHI), Yayasan Pemberdayaan Masyarakat Desa (YPMD), WWF Region Sahul Papua, Conservation International (CI), and USAID Serasi.
2	Participatory mapping of customary areas	CMNR Management and local indigenous communities
3	Joint patrol with local indigenous communities	CMNR management, local indigenous communities, Center for Natural Resources Conservation (BKSDA), National Search and Rescue Agency, Regional Agency for Disaster Management (BPBD), Provincial Environment Office, Indonesian National Armed Force, Indonesian National Police
4	Reforestation	CMNR management, local indigenous communities,Youth Care for the Environment, the Hiroshi Nature Lovers Club, Papua Provincial Environment and Forestry Service, etc.

Figure 12 Participatory mapping of customary areas in CMNR and joint surveillance in the CMNR area.

CMNR environmental management issues, the present and future management of conservation area Data and analysis described above indicate four crucial issues related to the management of CMNR: Indigenous people and the sustainable management of conservation area, increasing population pressure over the conservation area, insecurity tenure, and the need to involve local and migrant indigenous Papuans.

Indigenous people and the sustainable management of conservation area Nature is the primary source of survival for indigenous people, who depend most of their lives on the services available in nature. Therefore, local communities will continue to strive to maintain the sustainability of nature with knowledge inherited by their predecessors. Indigenous peoples know how to manage and utilize nature while maintaining natural resources and biodiversity sustainability.

This study shows that local indigenous people have long utilized the natural resources in the CMNR area and were able to utilize the resources in a relatively sustainable manner. Similarly, indigenous Papuan migrants, in their places of origin in the La Pago and Me Pago areas, also utilized existing natural resources and were able to manage their environment in a relatively sustainable manner. This fact aligns with Abas et al. (2022), who mention that to maintain the sustainability of nature as a source of life, local indigenous communities practice conservation values in their daily lives and distribute this knowledge to their children directly in the wild. Garnett et al. (2018) also mention that most rare and endemic species tend to be more protected in areas within the territory of local indigenous peoples. In line with these, Fa et al. (2020) states that indigenous peoples are essential in maintaining natural sustainability and preserving biodiversity in their controlled landscapes.

Specifically, the study found that in utilizing and managing forest areas, local indigenous Papuans classify forest areas into categories with their respective functions, for example forest areas that should not be used for cultivation activities because they function as water source areas or where they collect food and other necessities. This is in line with Delang's (2006) opinion based on his research on the Pwo Karen tribe in Thailand that the Pwo Karen tribe in Thailand tends to maintain the natural condition of the forest as their source of livelihood. Ceddia et al. (2015) also state that the land use classification practiced by indigenous peoples for generations could significantly reduce deforestation and environmental degradation.

Despite the ability of the local indigenous Papuan to

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manage the natural resources in the CMNR, the study also identified that they were unable to protect the environment from being overexploited by migrants, especially indigenous Papuan migrants who migrated to the area around the CMNR in recent decades. This is in line with several studies in many countries showing that the ability of indigenous peoples to preserve the natural environment is often weakened due to external pressures, one of which is the presence of migrants in significant numbers (Khan et al., 2021; Maja & Ayano, 2021).

Increasing population pressure on the CMNR and insecurity tenure As mentioned earlier, the study identified that the population increase around the CMNR, mainly due to the in-migration of several indigenous Papuan migrant groups from various places, has led to increased pressure on the conservation area, such as the widespread clearing of land for gardens and even the occurrence of various illegal activities within the CMNR area carried out by indigenous Papuan migrants. This is in line with several previous findings conducted by Marquette (2012), Liu and Yamauchi (2014), Suhrke (2016), and Osipov et al. (2018), which suggest that population growth, specifically those coming from outside, was the main factor causing inharmonious relationships between humans and the environment. Yang et al.'s research on several nature reserves in eastern and southern China (2019) suggests that expanding settlements around nature reserves increases human activities and threats to many nature reserves. In the case of the CMNR area, the increased environmental pressure was not caused by immigrants from outside the island with different ethnic backgrounds but by indigenous Papuan migrants. The population of indigenous Papuan migrants has increased beyond the number of local indigenous Papuan residents.

Many indigenous Papuan migrants practiced uncontrolled gardening and illegal logging activities that contributed significantly to severe environmental damage. By only obtaining temporary permits from local indigenous Papuans who claim to be the owners of the area, the indigenous Papuan migrants then did not have secure land rights over the land they cultivated. This insecure tenure of land in the CMNR area seems to have encouraged them to carry out resource utilization activities without paying attention to long-term sustainability. This is like the study finding of Damnyag et al. (2012) that insecurity tenure affected deforestation in Ghana. Earlier, Gunawan et al. (2004) also showed that deforestation and land degradation in Indonesia's Citarum watershed were partly related to tenure insecurity. Similar findings were obtained by Robinson et al. (2014) based on the results of a meta-analysis of several articles, showing that land tenure security was associated with less deforestation.

In the case of CMNR, the practice of using natural resources and the environment by indigenous Papuan migrants for commercial purposes has even resulted in some local indigenous Papuans doing the same, resulting in greater environmental damage. In this situation, Popova (2014) and Toledo (2013) state that local indigenous people are powerless to defend their conservative values.

Co-management: Opportunity for CMNR area management Environmental problems in the CMNR area require comprehensive efforts to find the best solution while maintaining a harmonious relationship between indigenous peoples and their environment to ensure the use and management of the environment and sustainability in the CMNR area.

In this regard, to achieve sustainable management of the CMNR area, there is no other way but to start by building a collaboration among stakeholders who are directly related to the conservation area. Collaboration between the government and the community will be the key to sustainable management of the CMNR. The government must collaborate with local communities, especially local indigenous Papuan groups and indigenous Papuan migrants. This is in line with the opinion of Berkes (2006) and Mooij et al. (2019), who state the effectiveness of a collaborative management approach (co-management).

Regarding the involvement of indigenous Papuan migrants, providing tenure security to them, as well as what is already owned by local indigenous Papuans, is an important thing to do. The provision of security tenure will certainly be one of the important factors to achieve better management of the CMNR environment. In line with this, several cases have shown positive results from providing tenure security to the community.

Gunawan et al. (2023) reported that the condition of the forest in the upstream Citarum watershed, West Java, has improved after the forest management officially collaborated and provided tenure security in the use of forest areas to residents who previously encroached into forest areas. Other studies in China, Uganda, and Vietnam have also shown that forest quality improved due to tenure security, thereby encouraging rural development (Aggarwal et al., 2021). Kabubo-Mariara et al. (2010) also suggest that tenure security is important for sustainable environmental management.

Conclusion

The study found that indigenous groups such as the indigenous Papuan have the knowledge and ability to utilize and manage the environment in their respective environment in a relatively sustainable manner. However, when these groups move to other areas and settle in a new environment, knowledge about sustainable environmental utilization and management does not automatically become a source of knowledge practiced in the new environment. In the case of CMNR, the definite rights to cultivate land in a new settlement that indigenous Papuan migrants do not have seems to encourage them to occupy the land and practice an unsustainable utilization of the environment. Contestation in the use of natural resources can occur between groups even with the same ethnic background. To avoid further degradation and by assuming that is the proper way to manage the environment sustainably, this study recommends quick efforts through collaborative forest management between the government and indigenous Papuans, both local and migrants. Such collaborative management must include

the knowledge and practice of the indigenous system of forest management. This is a form of respect for indigenous people in their regions.

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