

BUKTI KORESPONDENSI ARTIKEL

Sonbait LY, Manik H, Warmetan H, Lina Y, Wambrauw D, Sagrim M, Djitmau DA, Wanggai J, Rettob BB & **Murdjoko A** (2021) The natural resource management to support tourism : A traditional knowledge approach in Pegunungan Arfak Nature Reserve , West Papua , Indonesia. Biodiversitas 22:4466–4474.

Berikut adalah proses pengiriman artikel, proses, komentar reviewer, perbaikan dan korespondensi dengan pihak editor jurnal yang dilakukan oleh penulis korespondensi seperti di bawah ini:

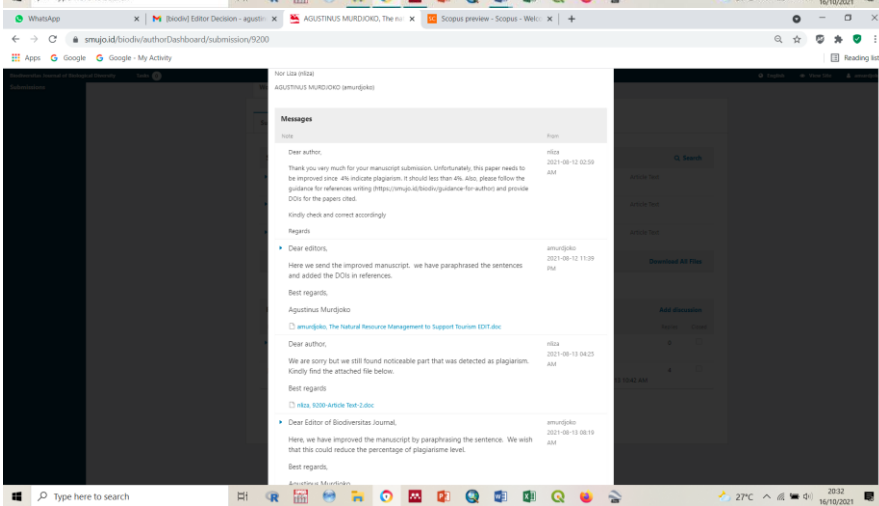
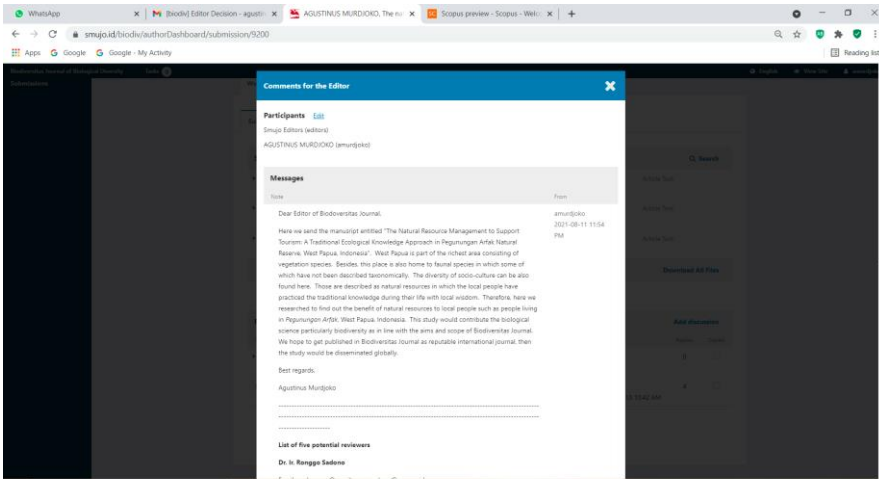
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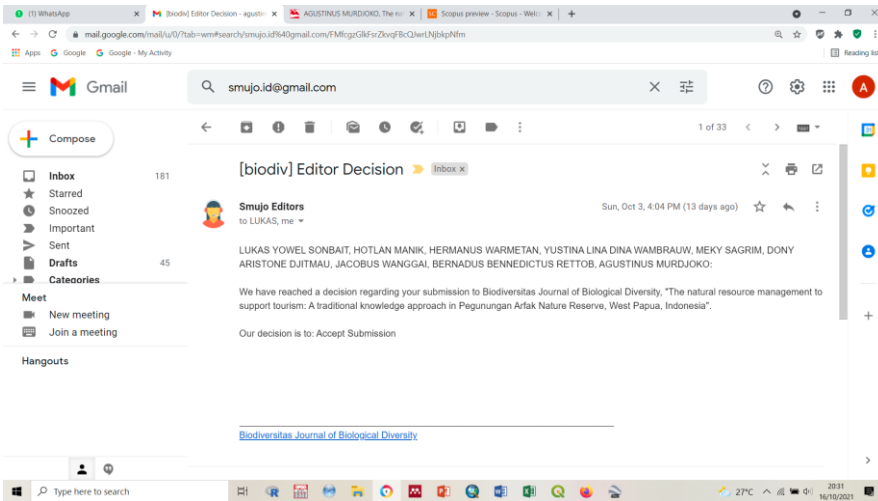
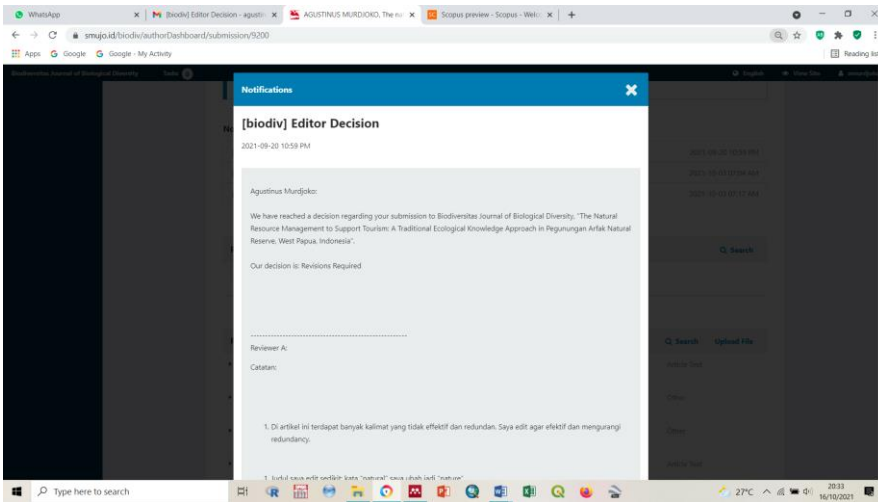
Pengiriman pertama

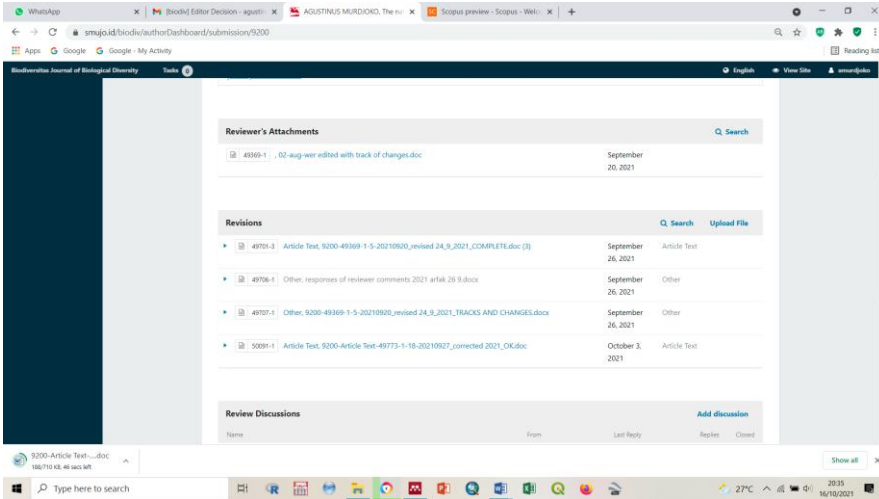
The image shows two screenshots from a web browser. The top screenshot is the login page for Biodiversitas Journal of Biological Diversity. It features a green header with navigation links (Home, About, Policy, Submissions, Current, Archives, Announcements) and user options (Smujo, Career, Register, Login). The main content area has a login form with fields for Username (filled with 'amurdjoko') and Password (masked with dots). There are checkboxes for 'Keep me logged in' and a 'Forgot your password?' link. A 'Login' button and a 'Register' button are at the bottom of the form. To the right, there is an 'Information' section with links for 'For Readers', 'For Authors', and 'For Librarians', and a 'Journals List' containing several journal titles.

The bottom screenshot is a Gmail inbox. The selected email is titled '[biodiv] Submission Acknowledgement' and is from Ahmad Dwi Setyawan (smujo.id@gmail.com) to AGUSTINUS MURDJOKO, dated Thursday, August 12, 9:03 AM. The email body contains a thank-you message for submitting a manuscript titled 'AM The Natural Resource Management to Support Tourism: A Traditional Ecological Knowledge Approach in Pegunungan Arfak Natural Reserve, West Papua, Indonesia' to Biodiversitas Journal of Biological Diversity. It mentions an online journal management system and provides a submission URL: <https://smujo.id/biodiv/authorDashboard/submission/9200> and the username 'amurdjoko'. The email concludes with a contact offer and the sender's name, Ahmad Dwi Setyawan.



Keputusan editor





Surat respon terhadap komentar reviewer dan revisi

Manokwari, 26 September 2021

Dear Biodiversitas Journal of Biological Diversity,

On behalf of the authors, we thank reviewers for giving constructive comments and inputs, so we could improve the manuscript. The manuscript has been improved as inputs of reviewers as attached and we send two files, the first one is a complete file (9200-49369-1-5-20210920_revised 24_9_2021_COMPLETE), the second one is tracks and changes version of Word (9200-49369-1-5-20210920_revised 24_9_2021_TRACKS AND CHANGES). Here, we also responded to the comments of the reviewer as written below:

Comments / inputs / suggestions of reviewers	Responses
1. Di artikel ini terdapat banyak kalimat yang tidak efektif dan redundan. Saya edit agar efektif dan mengurangi redundancy.	Thank you very much for giving constructive inputs and improving the sentences.
2. Judul saya edit sedikit: kata "natural" saya ubah jadi "nature".	We agree with the editing of the title.
3. Di baris 45-47 tertulis: An ecological perspective has the meaning of an economic perspective.	We have corrected the sentence by rewriting the sentences as shown in lines 44 – 46.
4. Di baris 53-54 tertulis: The implementation of the ecological model in Manokwari District is likely to produce offerings to the improvement of expansion in the area (Pattiselanno 2016). Kalimat ini sulit difahami. Saya coba edit seperti ini: The implementation of the ecological model in Manokwari District is likely to produce lessons for the improvement for the area development (Pattiselanno 2016).	We thank you for improving the sentences in the introduction. We agree with the revised sentences.

5.	<p>Di baris 55-59 tertulis: The growth of tourism can provide more value not only to the environment and the economy of the local community but also to the social welfare of society in general, although behind the potential possessed in the PANR region, so far there is still a lot of decline in the area due to habitat degradation, consumption of meat, eggs and fur collections from various animals is still found due to poaching, the absence of definite data on the number of endemic animal populations that exist there will be even harder to find.</p> <p>Kalimat di atas terlalu panjang dan sulit difahami maksudnya. Saya coba edit seperti ini: The growth of tourism can provide more value not only to the environment and the economy of the local community but also to the social welfare of society in general. Despite the potential possessed by the PANR region, this region has problems due to habitat degradation, collection of eggs, poaching, and the absence of accurate data on the number of the existing endemic animals.</p>	<p>We appreciated the improvements of the reviewers and we agree with the improved sentences.</p>
6.	<p>Di baris 112-113: This type of orchid is very unique, with the introduction of orchids, the floriculture will be “degraded” by the presence of types of orchids and ornamental plants introduced.</p> <p>Dalam kalimat di atas ada kata “degraded”, apakah maksudnya terjadi penurunan kualitas? Atau sebaliknya, “improved” meningkat kualitasnya?</p>	<p>We focused on the impact on the floriculture either could be improved or degrade the original orchids. Hence, this program should be carefully conducted as we have warned here.</p>
7.	<p>Di baris 155-156 tertulis: The wood taken in this area is used as a pillar/column of the house and bark as a wall material for the millipede house. Millipede adalah nama binatang. Jadi istilah ini saya ganti: a thousand-foot house, a traditional house with elevated floor supported by many columns.</p>	<p>Thank you for giving the technical term in this manuscript. We agree with the editing.</p>
8.	<p>Di baris 203-205 tertulis: The selected leaves are then slowly “eroded” on the outside. Apakah yang dimaksud eroded itu “digaruk/digosok” untuk menghilangkan bagian terluar? Kata “eroded” saya edit menjadi “scrubbed”.</p>	<p>We are in line with the use of “scrubbed” in this sentence.</p>
9.	<p>Di baris 217-218 tertulis: Bamboo is split and hung at the top, meaning that the offender will get a life “reward”.</p> <p>Reward adalah balasan dalam arti positif. Mungkin yang dimaksud adalah “punishment” atau “penalty” yaitu hukuman atau balasan dalam arti negatif.</p>	<p>We are extremely grateful to the reviewer as corrected the term in this manuscript. We agree to use “punishment” as we mean the use of Bamboo to warn and who commit the rule will get punishment.</p>
10.	<p>Di baris 222-223 tertulis: . The type of fine that the offender must pay, according to Hatam-Moile culture is</p>	<p>We mean the <i>kain timor</i> as traditional dowry in this area.</p>

	in the form of Timor or pig. Apa yang dimaksud dengan Timor? Apakah rusa Timor, atau kain Timor?	
11.	Dalam sub bab terakhir, semua kalimat persis sama dengan di abstract. Sebagian kalimat tersebut saya buang, dan sebagian saya edit.	We express gratitude to the reviewer for improving the sentences.

Reviewer B:

Comments / inputs / suggestions of reviewers	Responses
1. The first part of the title seems to suggest the author is dealing with how conservation can be used to support tourism. However the second part of the title "A traditional ecological knowledge approach..." can be interpreted either as involvement of the local community in conservation or the use of traditional ways of conserving natural areas. Clarity is needed on this count. While many studies exist for the first interpretation, the second is a novel area of research.	Thank you very much for giving the comments on this part. The background of traditional knowledge has been added in introduction as we improved it.
2. In the Abstract, the meaning of the same term 'use of traditional Knowledge' emerges as a greater dependence on hunting and gathering as a means of sustenance. Again, there is a lack of clarity.	We have improved the abstract and manuscript related to the concepts of traditional knowledge. We particularly added in the introduction part.
3. Local wisdom based tourism area model (line 43-47) is not clearly spelt out. What does it comprise?	The local wisdom here is part of traditional knowledge which has been part of their life. Then, the concept of local wisdom is applied in natural management for gaining economic profit. Therefore, this research highlighted the description of the implementation of traditional knowledge.
4. Ecological perspective is the economic perspective (line 45-46). How? Please lay down the link between ecology, economic benefits and tourism clearly as well as the direction of flow that you are trying to examine.	Thank you very much for correcting the statements. We have added the explanation regarding the link between ecological and economic benefits during nature management in this purpose as tourism. We have rewritten the sentences as shown in Line 44 – 47.
5. Lines 22-24 as well as lines 55-57, the author talks of role of tourism on welfare of community and in lines 170-171, tourism's impact on the environment is mentioned, especially how the Arfak plain birds were saved because the local community abandoned hunting them, with more tourists coming. So again, there is a confusion about what exactly is the main argument.	We have improved the statement in Line 22-24 in the abstract. The sentences in Line 55-57 mean that those are the anticipation of tourism management if not wisely conducted. Therefore, such unfavorable influence on tourism activity could be minimized. Moreover, this article would figure out the traditional knowledge to maintain traditionally sustainable management as we pointed out in the results and discussion. For example, the use of <i>Igya Ser Hanyob</i> and traditional zones in this area during the utilization have been part of their life for generations. The explanation could be seen in lines 140-176 as we have also improved the sentences.
6. Introduction of exotic Orchids for tourism has had an adverse impact on the endemic plants - is this significant?	In this part, we would like to give the assumption that exotic orchids could affect the original orchid as the competition during the ecological process. Hence, this assumption was addressed to the anticipated adverse impact of floriculture.
7. So what is the major attraction for tourists- the butterfly, the Arfak Plain bird, the orchids or the rich socio-cultural dances and distinctive life style? Maybe some percentages can be given regarding the same?	Thank you for giving the comments in this part related to the major attraction during tourist activity. However, we have described the points of culture, fauna such as bird watching, vegetation, and so on in the results. In this research, we implemented the photovoice as we mentioned in the method based on references : 1. Castleden H, Garvin T, First Nation Hayaht (2008). Modifying Photovoice for community-based participatory

	Indigenous research. <i>Social Science and Medicine</i> . 66: 1393–1405. - doi: 10.1016/j.socscimed.2007.11.030 2. Peterson D, Hanazaki N, Li F (2019). Understanding Canoe Making as a Process of Preserving Cultural Heritage. <i>Ethnobiology Letters</i> . 10: 59–68. - doi: 10.14237/ebl.10.1.2019.1363
8. In Methodology, Objectives, hypothesis and tests used as well as assumptions used (Line 92) have not clearly been spelt out.	Thank you very much for checking the method, objective, hypothesis, and assumption. We have already improved the introduction including objectives and hypothesis as in Line 58 – 70.
9. Results seem to be more a description of the existing land tenure system and the associated demarcation of the forest area as well as the socio-cultural wealth of the area, backed by photographs only. No statistical data is provided.	Thank you very much for comment this part. We here applied the description method as part of the photovoice procedure. Some studies have also implemented such as Peterson D, Hanazaki N, Li F (2019). Understanding Canoe Making as a Process of Preserving Cultural Heritage. <i>Ethnobiology Letters</i> . 10: 59–68. - doi: 10.14237/ebl.10.1.2019.1363. We have improved the sentences concerning the data analysis using the visual approach in Line 95 – 99.
10. The claim that tourism income contributes substantially to education of local community is not backed by suitable data. This needs to be added.	Thank you very much for your comment on this part. As we said previously that this research gained data using interviews and images. Then, we described the data in this research as in the discussion part. Hopefully, in future research, we would be able to conduct an economic study regarding tourism as a business for local people.
11. The article needs to be professionally written and proof reading should be proper. e.g. in line 121-I am curious to learn how the homestay rates are "musically" determined by the community?	Thank you for the suggestions, we have improved the English and sentences. Particularly the rate of homestay has been rewritten as shown in Line 116 – 127.

We hope that the improvement of this manuscript could be considered by the editor, so this manuscript could be published in *Biodiversitas Journal of Biological Diversity* as one of the reputable international journals and this manuscript could contribute to science particularly the biodiversity management in a tropical ecosystem.

Best regards,

Agustinus Murdjoko

The natural resource management to support tourism: A traditional knowledge approach in Pegunungan Arfak Nature Reserve, West Papua, Indonesia

Faculty,

Abstract. Pegunungan Arfak Nature Reserve (PANR) is administratively located in three districts of West Papua, namely Manokwari, Manokwari Selatan, and Pegunungan Arfak that has diversity of protected flora and fauna. Therefore, it is crucial to study the local products for the development of ecotourism models based on local wisdom in supporting the potential economy of communities in the Pegunungan Arfak reserve. The data were obtained from direct interviews with communities around the nature reserve area, through related government agencies in Manokwari District. The finding of this research highlighted that local people in Pegunungan Arfak (the Hatam-Moile sub-tribe) still use traditional knowledge for their livelihood. Most of the activities were the utilization of natural resources such as flora and fauna. They understand how to manage the natural resource to earn economic benefit along with the implementation of their traditional concept to promote the sustainability of nature. The biodiversity and social-cultural richness of local people in Pegunungan Arfak have value to be developed together with traditional ecological knowledge in sustainable nature management where local people earn benefit and nature is conserved simultaneously.

Keywords: ecotourism, endemic species, ethnobiology, New Guinea,

Running title: The natural resource management in Pegunungan Arfak

INTRODUCTION

Pegunungan Arfak Nature Reserve (PANR) is a conservation area containing high biodiversity which was the first biological collection site in Papua developed by European Lesson Researchers, Beccari and Albertis. The results of the FAO survey in 2005 found more or less 2.770 species of both flora and fauna. The most popular and sought-after species of animals include various species of butterflies. The species of bird-wing butterfly (*Ornithoptera* spp.) have become the international butterfly collector hunt in this region. The diversity of butterflies is still quite high, including 6 species of wing-bird butterflies (*Ornithoptera arfakensis*, *O. robchildi*) that attract the attention of researchers and foreign tourists when visiting the PANR. In the PANR area, there are an estimated 110 mammal species with 44 species that have been recorded, 320 species of birds, of which 5 (five) are endemic to the Arfak-Tambrau Mountain Area such as, *Arfak astrapia* (*Astrapia nigra*), *parotia* (*Parotia sefilata*), and *namdur polos* (*Amblyornis inornatus*). In addition, the Pegunungan Arfak are mountainous areas covered by 68,325 hectares of tropical rain forests (Kartikasari et al. 2012; Pattiselanno and Lubis 2014; Sutarno et al. 2017; Manangkalangi et al. 2019; Pattiselanno et al. 2019).

This biodiversity can be seen as a renewable natural resource that can be relied upon as the support for conducting development and ecological conservation (Mittermeier et al. 1998; Alamgir et al. 2019).

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Besides that, biodiversity is very useful for traditional societies that are multi-ethnic with various cultures and various biological product needs (Pattiselanno and Krockenberger 2021). Thus, the *Pegunungan Arfak* reserve area is very potential as a place for visiting the ecotourism attraction development in Manokwari District. The local wisdom-based tourism area management model is an effort to strengthen the local economy and natural resource conservation in Manokwari District. People's core tourism emphasizes the management of tourist areas demanding community participation in various sectors. One of the goals during tourism activity is to ear economic benefit, but the ecological condition in the management area must be taken into account resulting in the balance of the economic and ecological process. Understanding of the economic perspective in the management of tourism areas economic factors play an important role given that without economic benefits, tourism business actors, including people in tourist destinations, will not be interested in participating in tourism development (Arobaya et al. 2020). The ecological perspective means that in many ways tourism relies on its main capital in the environment, both natural environment and cultural environment. Consequently, the ecological elements that are the main capital of tourism must be preserved to function sustainably. Thus, it is necessary to apply the model as a form of the trial conducted on the socialization of the model, to raise public understanding of tourism economic perception, and to grow public understanding of the ecological standpoint. The implementation of the ecological model in Manokwari District is likely to produce lessons for the improvement of the area development (Pattiselanno 2016). The growth of tourism can provide more value not only to the environment and the economy of the local community but also to the social welfare of society in general. Despite the potential possessed by the PANR region, this region has problems due to habitat degradation, collection of eggs, poaching, and the absence of accurate data on the number of the existing endemic animals.

Local people (99% native to the *Arfak* tribe), who are in the vicinity of the nature reserve, still use wood for their livelihoods and clear the forest for cultivation which leads to habitat damage and decline in animal populations. Traditional knowledge has been part of local community activity where it must be figured out to support the development of nature management (Santos et al. 2019; Benner et al. 2021). The areas of West Papua including *Pegunungan Arfak* consist of high biodiversity and cultural aspects, indeed the local people have utilized the natural resources for centuries to support their livelihood (Sutarno et al. 2017). For example, the diversity of animals and other ecotourism potentials in the region are promising selling points for the economic improvement of the community through ecotourism. The economic benefit from ecotourism allows local communities to abandon hunting and illegal logging practices and maintain local wisdom. Therefore, it is necessary to conduct basic research to figure out the local commodity for the development of ecotourism models based on local wisdom in supporting the potential economy of communities around the *Pegunungan Arfak* reserve, Manokwari district. The research explored the traditional knowledge in this area that has been applied for generations to utilize natural resources. The concepts would be valuable to be integrated with government programs in nature management based on traditional knowledge.

MATERIALS AND METHODS

Study area

The study was conducted from May to August 2017 in *Syoubri* village located at 133°54'40.67"E, 1°6'26.68"S and in *Kvau* village at 133°54'15.56"E, 1°10'57.61"S, in the Sub-district of *Minyambou*, the District of *Pegunungan Arfak*, West Papua Province, Indonesia. It is the buffer zone of the PANR with an area of 68,325 hectares, located in the territory of the Bird's Head of West Papua Province. *Syoubri* village and *Kvau* have a distance of around 45 km from Manokwari city of West Papua Province and about 62 km from the *Anggi* capital of the Mountain Sub-district *Arfak* with an elevation of the research study of around 1700 m a.s.l. The location of research in *Syoubri* village and *Kvau* can be seen in Figure 1.

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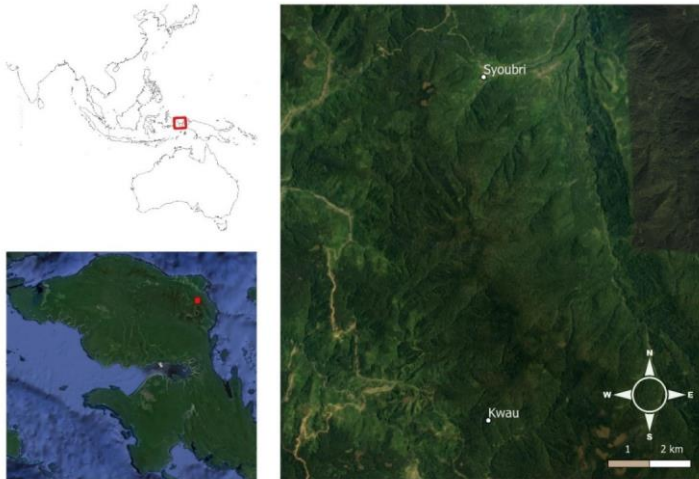


Figure 1. Research location of Syoubri and Kwau villages (white dots on the main map), Sub-district of Minyambouw, District of Pegunungan Arfak, West Papua Province, Indonesia.

Procedures

We collected data by conducting semi-structured interviews and site visits as direct observations. The interview was started by asking the key informants, namely, head villages of Syoubri and Kwau, elderly people, and landowners, to collect socio-culture data and traditional ecological knowledge, and to obtain eligible informants during data collection (Pawera et al. 2017). The data of socio-culture were name, profession, age, gender, education, and position in social structure, while traditional ecological knowledge was the utilization of flora, fauna, and the forest. We also asked how they traditionally managed the area as a tourist destination when they prepared accommodation, local guide, souvenir, and their awareness of the sustainability of nature. Besides, we gathered the information of those who have already assisted during tourism development in this area such as non-governmental organizations (NGOs) and local government. Moreover, the process of assistance was also figured out. We collected the information using written questions and we also requested them to show the tourist places.

Data analysis

The data were analyzed by examining them directly in the field, setting conclusions and assumptions, and recording with ethnozoological and ethnobotanical descriptions. The explanations were also illustrated by means of images that were taken during the site visit. The result of the interview would be matched with those images to find out the traditional ecological knowledge during tourism management. The images during data collection comprise the story of local people's activities and can be used to visually validate the information (Castleden et al. 2008; Peterson et al. 2019).

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RESULTS AND DISCUSSION

Results

The local concept for natural resource management

Residents living in *Kwau* and *Syon* villages are native to *Arfak* from the *Hatam-Moile* sub-tribe. They live on the move, participating in gathering and hunting activities in their clan's customary regions. They formed the first settlement in *Mokvam* village from their home village in *Minyambouw*. *Kwau* village was formed because when the access to the highway was not opened, *Kwau* village was the closest exit for people from *Warmare* to Manokwari City. The communal formed another new settlement in *Syoubri* hamlet which was closer to the main road. The formation of these new villages is thought to be closely related to their communal customary land tenure system based on the clan. So, each village tends to be occupied only by several clans whose customary lands are located side by side. Settlement patterns of village formation are so closely related to the land distribution system with the concept of *Igya Ser Hanyob* which means "let's stand guard the boundaries".

The tourist attraction in the village are unique landscape, and unique flora and fauna, and culture.

Therefore, the introduction of orchid cultivation and other types of ornamental plants are considered.

Thus, the conservation consists of *ex-situ* and *in-situ* conservation of endemic orchids. This species of orchid is unique, so the floriculture will impact on the endemic orchid by the presence of introduced species of orchids and other ornamental plants.

The most famous tourist attraction in this village is the smart bird's nest (*Namdur*) constructed from twigs, flowers, and other colorful materials and a variety of birds of paradise. Based on the guest book in the guest house (homestay), bird researchers from various parts of the world have come to *Kwau* villages, such as bird researchers from America, England, Germany, Sweden, Netherlands, Africa, Australia, China, Italy, Singapore, France, and others. Lodging rates for foreign tourists are IDR. 250,000 per day/person, domestic IDR. 200,000, and service guests IDR. 100,000. In addition to lodging rates, rates for tourist guides are also set at IDR. 250,000 / day. In addition to the homestay, the local community has also built an observation lodge for smart birds and birds of paradise with a rate of IDR. 100,000 per observation.

The rates of homestay and observation cottage are determined by the local community based on the birds' musicality. Income from sales of homestay services and observation huts is managed for the village treasury, church cash, donations for the education of school children, and the manager of homestays and observation huts. Several key figures of the *Kwau* village community say that the community has realized that smart bird and Cenderawasih tours can bring the village's income from the bird-watching homestays and huts, as well as tourist guide services.



a. Homestay in *Kwau* hamlet 1 (IDR 50,000/day)



b. Homestay in *Kwau* hamlet 2 (IDR 200,000/day)

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c. Homestay in *Syoubri* hamlet 1 (IDR 100,000/day)



d. Homestay in *Syoubri* hamlet 2 (IDR 100,000/day)

Figure 2. Lodging facilities for domestic and foreign tourists

Traditional ecological knowledge

The *Arfak* and *Hatam-Moile* communities in particular are familiar with the distribution of forest areas based on natural biophysical characteristics such as elevation, topography, and climate and the rules for their use. The division of this forest area includes the concept of *Igya Ser Hanjob*, from the *Hatam* language which means "we stand guarding the limits". This concept is a rule and warning for the large tribal people of *Arfak* which consists of the sub-tribes *Hatam*, *Meyakb*, *Moile*, and *Sougb*. For the people of the *Arfak* tribe, "guard and do not cross the boundaries that are determined when utilizing forest products". Finally, the concept of *Igya Ser Hanjob* is interpreted broadly by the community as the slogan "let's keep the forest for the common good".

The *Igya Ser Hanjob* system is divided by categories of zoning, viz. *Tumti*, *Babamti*, *Nimabanti*, and *Situmti*. *Igya Ser Hanjob* zoning is a traditional conservation technique that has been applied by the *Arfak* community for generations. The area is divided into 4 zones based on the nature and characteristics of the land (Figure 2), namely: (1) *Situmti* is a zone used by people living and gardening; (2) *Nimabanti* is a zone that was previously opened by the community to carry out gardening activities, and after the harvest is over, the land will be abandoned. In this zone, there are many ferns and fast-growing plants. This zone is a secondary forest; (3) *Babamti* Zone is a zone that is overgrown by large trees. This is a zone that can be converted into a new zone because the forest floor is not completely covered with moss. In this zone, there are still primary forests; and (4) *Tumti* zone (Figure 3). This zone is generally located at the top. Because this is a primary forest and the floor is covered with moss, arresting violators in this zone cannot be done.

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Figure 3. Forest distribution system based on biophysical characteristics in the Arfak community.

The Arfak community generally divides the forest zone (*bigbebei* = forest) into three parts, namely: (1) *Bahamti* is a primary forest area whose location is higher than the community settlement. This foggy area has a cold temperature. In this area, it is not allowed to build villages and gardens. This area is the location for taking certain types of timber, pandan leaves, and rattan. The timber taken in this area is used as columns, the bark as wall material, the pandan leaves as roof material, the fruit as a repellent, and the small rattan as binders in the construction of a thousand-foot house, a traditional house with elevated floor supported by many columns; (2) *Nimabamti* is a forest area that is very moist and overgrown by moss both on the ground and in trees. This area has a topography that is difficult to reach from the village, and cold temperatures, so not all plants can thrive, especially food crops; (3) *Susti* is a secondary forest area that was previously used as a garden area that has been abandoned and has grown into a forest again. Ex-plantation areas with cleared land can be categorized into sustenance areas. After having been abandoned for 4 years, the diameter of the tree has reached an average of 40 cm with a total tree height of 8 m. This area is a source of wood for fuel (firewood) and a garden fence. The species of woody plants that dominate this area are *Piper* spp. and *Dodonea viscosa*. *Dodonea* sp. There are two types of plants grown in this area, namely red bark and black bark. This area is divided into 2 parts, namely: *Susngöisi* (former gardens that have been abandoned for a year, and the plant buds have begun to grow); and *susmaban* (former gardens that have been left for more than five years, and the plants have reached a diameter of > 30 cm). *Arwob* wood (*Dodonea viscosa*) with a small diameter that is used to build a thousand-foot house is also taken from this region.

In addition to using plants, the ethnic group of *Kwau* and *Syoubri* village and its surroundings also utilize animals to fulfill their daily needs, such as food and health needs. At present, local, domestic and foreign tourists who are looking for the native habitat of Arfak plain birds and black souvenirs will come to the *Mokvam* plains. This is what causes the community to gradually, with assistance from the government and NGOs, has developed this area into a natural tourist destination. Various species of birds that were once hunted animals are now no longer the target of the game. Currently, in forest areas that used to be

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hunting areas, with the deliberation of all villagers and determined as village decisions, hunting is not permitted in any form and any type of hunting equipment.

Cultural norms and values owned by the community are realized through traditional ceremonies, dances, and handicrafts. Traditional ceremonies are a form of public expression of joy and sadness. The community's joy can be expressed during the reception ceremony and wedding parties, while sadness is expressed when grief occurs. The best-known dance of the Hatam-Moile tribe is the Tari Tumbu Tanah (traditional dance). This dance is performed in conjunction with traditional ceremonies such as guest reception, wedding, and death ceremonies. The dance is accompanied by songs whose lyrics are in the form of rhymes selected according to the type of celebration.

This Tumbuk Tanah dance is very well known in Manokwari and throughout the bird's head region in West Papua Province. This dance is interesting and unique because its movements mimic the movements of snakes above the ground. This dance is also known as snake dance because for them snakes are their symbols of greatness. The movements in the Tari Tumbu Tanah resemble snakes following the rhythm of the song sung by the dancers (Figure 4). This Tari Tumbu Tanah spreads throughout the bird's head region, Papua, and it is done especially by the large Arfak tribe in Manokwari (Mnu Kwar), which consists of several sub-tribes, namely Hattam, Meyakh, Sough, and Moile. There are also several tribal clusters including Karon, Saukorem to Ayamaru, Aitinyo, and Aifat in Maybrat and South Sorong Regencies. Generally, these tribes know Tari Tumbu Tanah, only in different versions and methods according to the character of each tribe in the Tanah Buring. The Hattam people call Tari Tumbu Tanah in the local language Ibibim, for the Meyakh people, Mnuka while the Sough people Lenyohora. For them, this dance is usually held for greeting guests, weddings, the victory of the war, and others.



Figure 4. Ceremonial activities: a.b. community activities make traditional ceremonies; c. the Tari Tumbu Tanah; d. the group of Tari Tumbu Tanah.

The most popular crafts made by the people in Mokenam village and its surroundings are poken that are made mostly by women. Noken raw materials come from herbaceous plants (local name: konica) which

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reach 3-4 meters high and fiber from pineapple leaves. *Noken* raw materials derived from herbaceous plants are from old *konica* stems taken for about 1 m in length and then dried to dry and then taken by the skin. Then the skin is separated according to the fiber groove and then twisted in a circle until it forms a thread and is ready to be used as raw material for making *noken*. The other raw materials are pineapple leaves. The work process begins with choosing pineapple leaves that are of medium age (not too old and not too young). The selected leaves are then slowly scrubbed on the outside, and dried. Then the fibers are separated according to the fiber path and then twisted until they form strands of yarn that are ready to be used as raw materials for *noken*. In addition, the customary wedding procession starts from the proposal, payment of the dowry, wedding ceremony, and the ceremony take the bride to the male side. The dowry that applies to the people of *Hatam-Moile* are kain timor, toba cloth, *paseda* (clam bracelets), large hanging beads, shop cloth, sarong fabric, pigs, and large weapons. At present, the types of dowry have been given in the form of money, cattle, wall clocks, radio, and cars. The bride who has just been paid, can be delivered to the family of the man.

According to one of the *Wonggor* clan woman, (*Wonggor* clan knows religion, i.e., Christianity), they did not request a dowry to the man who wanted to woo the *Wonggor* clan. Instead, the man who proposed to the *Wonggor* clan was obliged to live in the women's clan. This was pioneered by Mr. Benyamin *Wonggor*, who introduced Christianity to the *Arfak* tribe, especially on the *Moknam* plain. People use signs that come from plants as a marker. For example, in a forest area where hunting and other damaging activities are prohibited, the community gives signs: *Riyepa/ig yok monga* (snares), meaning that you cannot trap wildlife; *Nimaia*, in the form of bamboo tied with ropes, meaning that they cannot hunt with weapons; Bamboo is split and hung at the top, meaning that the offender will get a life punishment.

Another example, if people give a sign to a building or land using bamboo, especially bamboo with a small size, it means a very strong warning for anyone who deliberately violates the prohibition sign. If the violator of the ban is caught red-handed, then he or she will be processed customarily. The party making the prohibition sign is the party that determines the number of customary fines that must be paid by the violator. The type of fine that the offender must pay, according to *Hatam-Moile* culture is in the form of kain timor or pig. Currently, the payment of fines is carried out with the equivalent of money. If the violator accidentally enters the prohibited area, a fine would be the consequence.

Discussion

The *Arfak* community is very strict in maintaining customary boundaries between one clan and another. Members of one clan with other members of the clan may not carelessly enter and carry out activities in indigenous territories controlled by other clans, without permission from the clan chief who controls customary territories (Sutarno et al. 2017; Pattiselanno et al. 2019). Tourist products in the PANR area are three aspects known as triple-A (Attractions, Amenities, Accessibility). Tourist products can be interpreted as anything that can be sold as a tourism commodity (Sutarno et al. 2017; Carson et al. 2018; Peterson et al. 2019). Tourist attractions consist of the potential of flora, fauna, landscapes, and artificial attractions in the form of art and community culture (Figure 3). Based on the criteria for flora diversity in various ecosystems in the PANR, the quality is very good because FAO survey in 2005 identified 2.770 species of orchids. Various species of wing-bird butterflies (*Ornithoptera* spp.) which become the favorites of international butterfly collectors live abundantly in this region. There are 6 species of wing-bird butterflies (*O. Arfakensis* and *O. rohchildi*) which attract the most attention of researchers and foreign tourists when visiting the PANR (Figure 5). The species of endemic *Pegunungan Arfak* avifauna have high economic value in their habitat since foreign researchers began to search for them in the early 1990s (Sutarno et al. 2017). In the PANR, it is estimated that there are 110 species of mammals with 44 species that have been recorded, 320 species of birds, of which five are endemic to Papua that is a huge potential as an ecotourism attraction.

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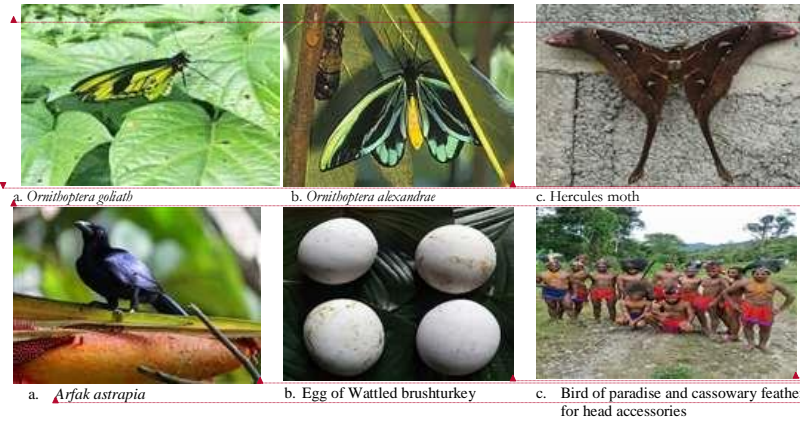


Figure 5. Fauna and its use in ecotourism

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Figure 6. A place of observation for the ecotourism of birds of paradise.

The landscape in the PANR is a combination of various physical components of the ecosystem with the surrounding vegetation, creating a very beautiful panorama as part of the tourist attraction. Landscapes which have an important role in attracting tourists are well-kept in the PANR. One of the attractions in the PANR is the forest that stretches across the region making the PANR a favorite place of tourists because they can get a sensation or a tough natural challenge when tracking from the starting point of the journey to the finish line (Figure 6). In the mountains, tourists can also enjoy the superior natural beauty of the PANR, especially the smart bird sanctuary, the various species of bird of paradise, and the culture of the community can be used as a support for the development of nature tourism. Cultural tourism attractions that can be sought around the PANR include folk art (*Tari Tumbu Tanah*). The supporting factors of tourism here are the natural conditions of this place including the tradition of local people. Local people in Papua still preserve the traditional knowledge during their life and some of them have adopted the tradition to the environment (Ungirwalu et al. 2014, 2017, 2019). Moreover, Papua has the highest floristic richness in the world (Murdjoko et al. 2016, 2021b, a; Cámara-Leret et al. 2020; Tawer et al. 2021). The faunal richness has attracted naturalists since centuries ago leading to the promotion of this place as a tourist destination. The local government has attempted to design the development of tourism programs by providing infrastructure such as roads and socialization to local people to take part. The local government and non-government organizations (NGOs) have performed the development of tourism for a couple of years. However, possible barriers should be anticipated by identifying both external and internal factors. The social and political conditions in Papua are more or less dynamic, so the local government should guide the local people to support the development. The cost of living in this area is fairly higher than in other cities in Indonesia. Therefore, governmental intervention should be conducted to support the economic condition, so the living cost particularly in this area would be lower.

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Tourism as a potential sustainable product of nature

The finding of this research revealed that local people in *Pegunungan Arfak* (the *Hatam-Moile* sub-tribe) still maintain traditional knowledge for their livelihood support. The biodiversity and social-cultural richness of local people in *Pegunungan Arfak* should be developed using traditional ecological knowledge in sustainable nature management which provide economic benefit to local people and conserve the nature at the same time. The development of socio-culture in Papua is in agreement with the declaration of West Papua Province programs that have been stated in Manokwari Declaration to conserve nature and culture (Cámara-Leret et al. 2019). Then, the implementation of those programs could promote nature and culture conservation in which the local people could also benefit from such programs. However, the application of tourism activities must be accompanied by Environmental Impact Assessment (EIA) that is controlled by the government. This is very useful to ensure the tourism activity would minimize adverse impact on the environmental conditions particularly socio-culture and nature.

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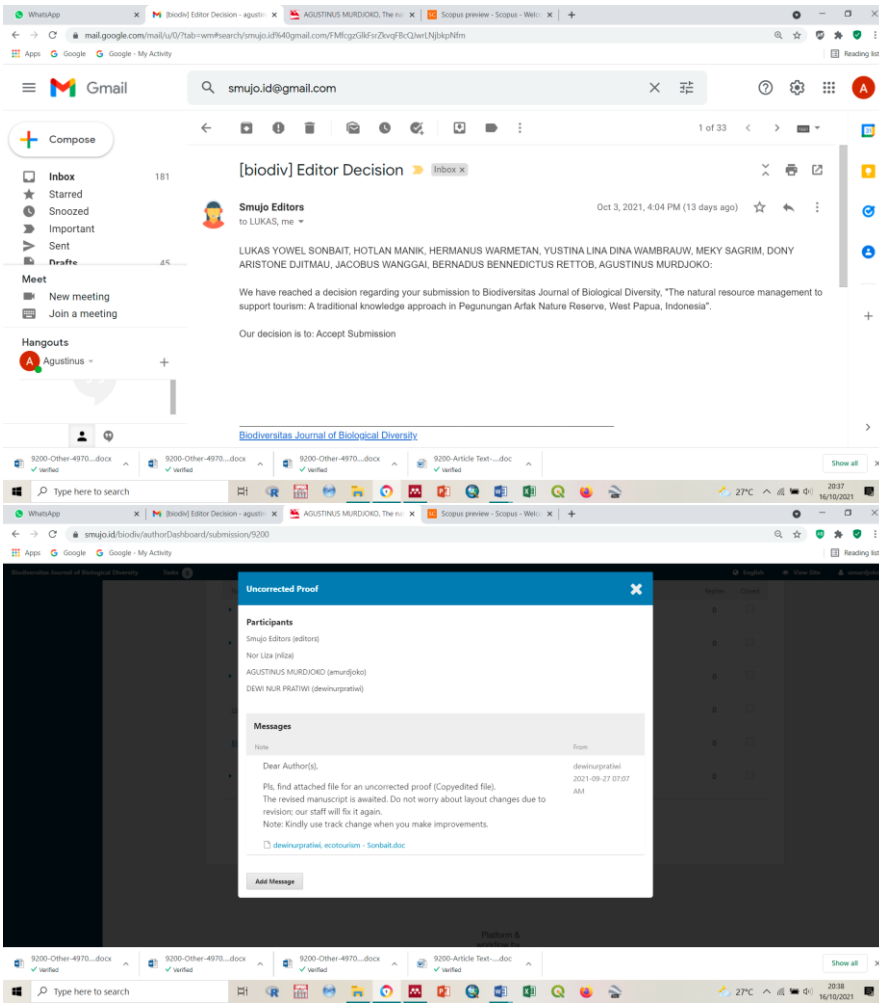
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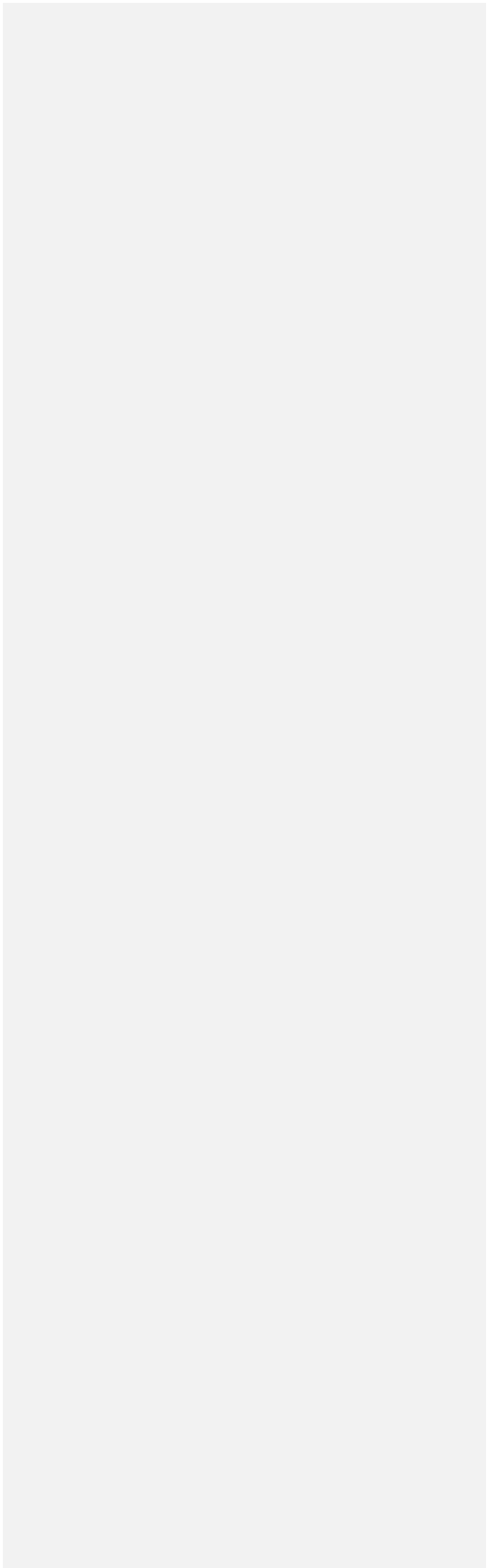
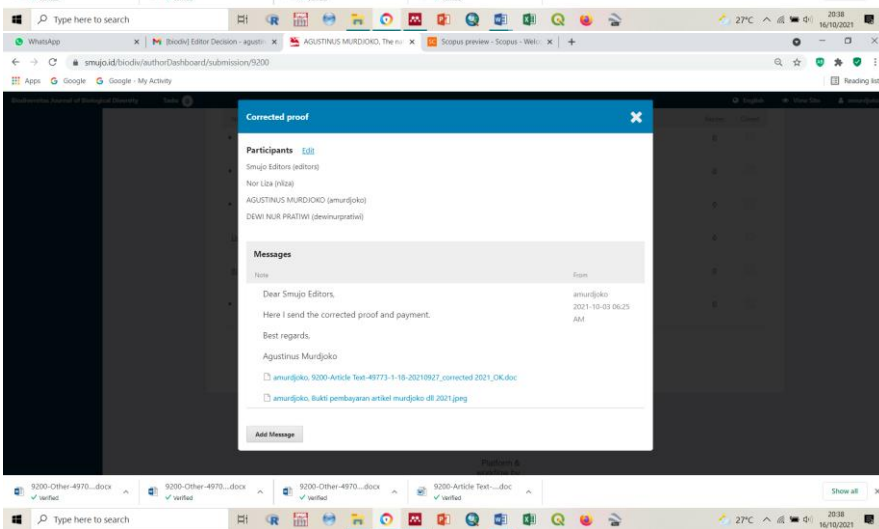
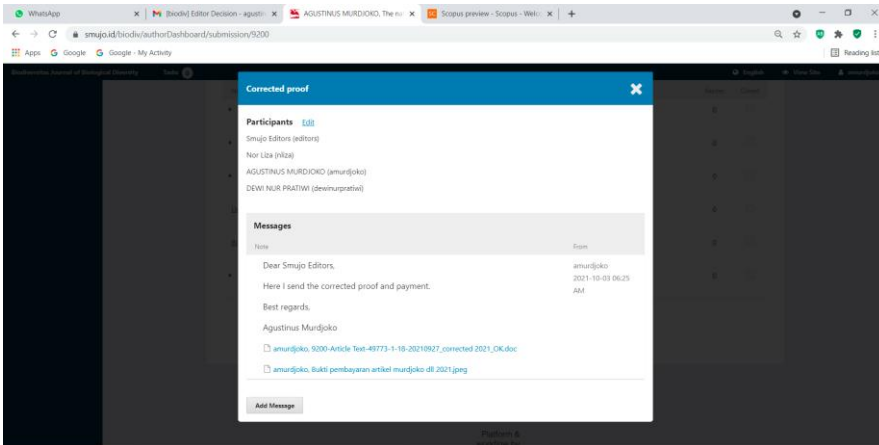
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The natural resource management to support tourism: A traditional knowledge approach in Pegunungan Arfak Nature Reserve, West Papua, Indonesia

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Abstract. Sonbait LY, Manik H, Warmetan H, Wambrau YLD, Sagrim M, Djitmau DA, Wanggai J, Retto BB, Murdjoko A. 2021. The natural resource management to support tourism: A traditional knowledge approach in Pegunungan Arfak Nature Reserve, West Papua, Indonesia. *Biodiversitas* 22: xxxx. Pegunungan Arfak Nature Reserve (PANR) is administratively located in three districts of West Papua, namely Manokwari, Manokwari Selatan, and Pegunungan Arfak that has diversity of protected flora and fauna. Therefore, it is crucial to study the local products for the development of ecotourism models based on local wisdom in supporting the potential economy of communities in the Pegunungan Arfak reserve. The data were obtained from direct interviews with communities around the nature reserve area, through related government agencies in Manokwari District. The finding of this research highlighted that local people in Pegunungan Arfak (the *Hatam-Moile* sub-tribe) still use traditional knowledge for their livelihood. Most of the activities were the utilization of natural resources such as flora and fauna. They understand how to manage the natural resource to earn economic benefit along with the implementation of their traditional concept to promote the sustainability of nature. The biodiversity and social-cultural richness of local people in Pegunungan Arfak have value to be developed together with traditional ecological knowledge in sustainable nature management where local people earn benefit and nature is conserved simultaneously.

Keywords: ecotourism, endemic species, ethnobiology, New Guinea

INTRODUCTION

Pegunungan Arfak Nature Reserve (PANR) is a conservation area containing high biodiversity which was the first biological collection site in Papua developed by European Lesson Researchers, Beccari and Albertis. The results of the FAO survey in 2005 found more or less 2.770 species of both flora and fauna. The most popular and sought-after species of animals include various species of butterflies. The species of bird-wing butterfly (*Ornithoptera* spp.) have become the international butterfly collector hunt in this region. The diversity of butterflies is still quite high, including 6 species of wing-bird butterflies (*Ornithoptera* Arfakensis, *O. robchildi*) that attract the attention of researchers and foreign tourists when

visiting the PANR. In the PANR area, there are an estimated 110 mammal species with 44 species that have been recorded, 320 species of birds, of which 5 (five) are endemic to the Arfak-Tambrau Mountain Area such as, Arfak *astrapia* (*Astrapia nigra*), *parotia* (*Parotia sefilata*), and *namdur polos* (*Amblyornis inornatus*). In addition, the Pegunungan Arfak are mountainous areas covered by 68,325 hectares of tropical rain forests (Kartikasari et al. 2012, Pattiselanno & Lubis 2014, Sutarno et al. 2017, Manangkalangi et al. 2019, Pattiselanno et al. 2019).

This biodiversity can be seen as a renewable natural resource that can be relied upon as the support for conducting development and ecological conservation (Mittermeier et al. 1998, Alamgir et al. 2019). Besides that, biodiversity is very useful for

traditional societies that are multi-ethnic with various cultures and various biological product needs (Pattiselanno & Krockenberger 2021). Thus, the Pegunungan Arfak reserve area is very potential as a place for visiting the ecotourism attraction development in Manokwari District. The local wisdom-based tourism area management model is an effort to strengthen the local economy and natural resource conservation in Manokwari District. People's core tourism emphasizes the management of tourist areas demanding community participation in various sectors. One of the goals during tourism activity is to earn economic benefit, but the ecological condition in the management area must be taken into account resulting in the balance of the economic and ecological process. Understanding of the economic perspective in the management of tourism areas economic factors play an important role given that without economic benefits, tourism business actors, including people in tourist destinations, will not be interested in participating in tourism development (Arobaya et al. 2020). The ecological perspective means that in many ways tourism relies on its main capital in the environment, both natural environment and cultural environment. Consequently, the ecological elements that are the main capital of tourism must be preserved to function sustainably. Thus, it is necessary to apply the model as a form of the trial conducted on the socialization of the model, to raise public understanding of tourism economic perception, and to grow public understanding of the ecological standpoint. The implementation of the ecological model in Manokwari District is likely to produce lessons for the improvement of the area development (Pattiselanno 2016). The growth of tourism can provide more value not only to the environment and the economy of the local community but also to the social welfare of society in general. Despite the potential possessed by the PANR region, this region has problems due to habitat degradation, collection of eggs, poaching, and the absence of accurate data on the number of the existing endemic animals. Local people (99% native to the Arfak tribe), who are in the vicinity of the nature reserve, still use wood for their livelihoods and clear the forest for

cultivation which leads to habitat damage and decline in animal populations. Traditional knowledge has been part of local community activity where it must be figured out to support the development of nature management (Santos et al. 2019, Benner et al. 2021). The areas of West Papua including Pegunungan Arfak consist of high biodiversity and cultural aspects, indeed the local people have utilized the natural resources for centuries to support their livelihood (Sutarno et al. 2017). For example, the diversity of animals and other ecotourism potentials in the region are promising selling points for the economic improvement of the community through ecotourism. The economic benefit from ecotourism allows local communities to abandon hunting and illegal logging practices and maintain local wisdom. Therefore, it is necessary to conduct basic research to figure out the local commodity for the development of ecotourism models based on local wisdom in supporting the potential economy of communities around the Pegunungan Arfak reserve, Manokwari district. The research explored the traditional knowledge in this area that has been applied for generations to utilize natural resources. The concepts would be valuable to be integrated with government programs in nature management based on traditional knowledge.

MATERIALS AND METHODS

Study area

The study was conducted from May to August 2017 in Syoubri village located at 133°54'40.67"E, 1° 6'26.68"S and in Kwau village at 133°54'15.56"E, 1°10'57.61"S, in the Sub-district of *Minyambou*, the District of Pegunungan Arfak, West Papua Province, Indonesia. It is the buffer zone of the PANR with an area of 68,325 hectares, located in the territory of the Bird's Head of West Papua Province. Syoubri village and Kwau have a distance of around 45 km from Manokwari city of West Papua Province and about 62 km from the *Anggi* capital of the Mountain Sub-district Arfak with an elevation of the research study of around 1700 m a.s.l. The location of research in Syoubri village and Kwau can be seen in Figure 1.

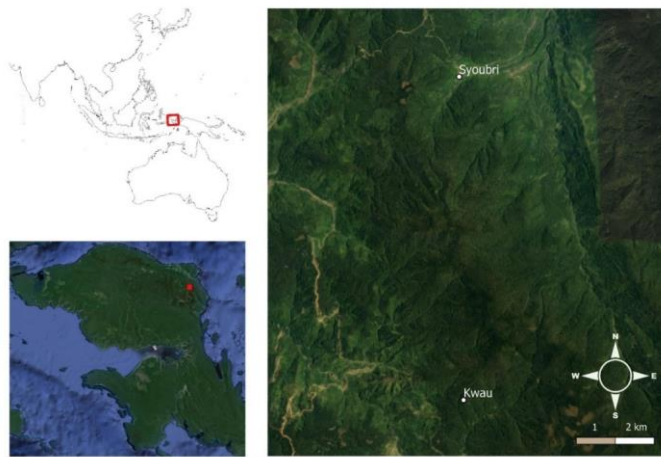


Figure 1. Research location of Syoubri and Kwau villages (white dots on the main map), Sub-district of Minyambouw, District of Pegunungan Arfak, West Papua Province, Indonesia.

Procedures

We collected data by conducting semi-structured interviews and site visits as direct observations. The interview was started by asking the key informants, namely, head villages of Syoubri and Kwau, elderly people, and landowners to collect socio-culture data and traditional ecological knowledge and to obtain eligible informants during data collection (Pawera et al. 2017). The data of socio-culture were name, profession, age, gender, education, and position in social structure, while traditional ecological knowledge was the utilization of flora, fauna, and the forest. We also asked how they traditionally managed the area as a tourist destination when they prepared accommodation, local guide, souvenir, and their awareness of the sustainability of nature. Besides, we gathered the information of those who have already assisted during tourism development in this area such as non-governmental organizations (NGOs) and local government. Moreover, the process of assistance was also figured out to gain information. We collected the information using written questions and we also requested them to show the tourist places.

Data analysis

The data were analyzed by examining them directly in the field, setting conclusions and assumptions, and recording with ethnozoological and ethnobotanical descriptions. The explanations were also illustrated by means of images that were taken during the site visit. The result of the interview would be matched with those images to find out the traditional ecological knowledge during tourism management. The images during data collection comprise the story of local people's activities and can be used to visually validate the information (Castleden et al. 2008, Peterson et al. 2019).

RESULTS AND DISCUSSION

Results

The local concept for natural resource management

Residents living in Kwau and Syou villages are native to Arfak from the *Hatam-Moile* sub-tribe. They live on the move, participating in gathering and hunting activities in their clan's customary regions. They formed the first settlement in *Mokwam* village from their home village in

Minyambouw. Kwau village was formed because when the access to the highway was not opened, Kwau village was the closest exit for people from Warmare to Manokwari City. The communal formed another new settlement in Syoubri hamlet which was closer to the main road. The formation of these new villages is thought to be closely related to their communal customary land tenure system based on the clan. So, each village tends to be occupied only by several clans whose customary lands are located side by side. Settlement patterns of village formation are so closely related to the land distribution system with the concept of *Igya Ser Hanyob* which means "let's stand guard the boundaries".

The tourist attraction in the village are unique landscape, and unique flora and fauna, and culture. Therefore, the introduction of orchid cultivation and other types of ornamental plants are considered. Thus, the conservation consists of ex-situ and in-situ conservation of endemic orchids. This species of orchid is unique, so the floriculture will impact on the endemic orchid by the presence of introduced species of orchids and other ornamental plants.

The most famous tourist attraction in this village is the smart bird's nest (*Namdur*) constructed from twigs, flowers, and other colorful materials and a

variety of birds of paradise. Based on the guest book in the guest house (homestay), bird researchers from various parts of the world have come to Kwau villages, such as bird researchers from America, England, Germany, Sweden, Netherlands, Africa, Australia, China, Italy, Singapore, France, and others. Lodging rates for foreign tourists are IDR. 250,000 per day/person, domestic IDR. 200,000, and service guests IDR. 100,000. In addition to lodging rates, rates for tourist guides are also set at IDR. 250,000 / day. In addition to the homestay, the local community has also built an observation lodge for smart birds and birds of paradise with a rate of IDR. 100,000 per observation. The rates of homestay and observation cottage are determined by the local community based on the birds' musicality. Income from sales of homestay services and observation huts is managed for the village treasury, church cash, donations for the education of school children, and the manager of homestays and observation huts. Several key figures of the Kwau village community say that the community has realized that smart bird and Cenderawasih tours can bring the village's income from the bird-watching homestays and huts, as well as tourist guide services.



c. Homestay in Kwau hamlet 1 (IDR 50,000/day)



d. Homestay in Kwau hamlet 2 (IDR 200,000/day)



c. Homestay in Syoubri hamlet 1 (IDR 100,000/day)



d. Homestay in Syoubri hamlet 2 (IDR 100,000/day)

Figure 2. Lodging facilities for domestic and foreign tourists

Traditional ecological knowledge

The Arfak and *Hatam-Moile* communities in particular are familiar with the distribution of forest areas based on natural biophysical characteristics such as elevation, topography, and climate and the rules for their use. The division of this forest area includes the concept of *Igya Ser Hanjob*, from the *Hatam* language which means "we stand guarding the limits". This concept is a rule and warning for the large tribal people of Arfak which consists of the sub-tribes *Hatam*, *Meyakh*, *Moile*, and *Sougb*. For the people of the Arfak tribe, "guard and do not cross the boundaries that are determined when utilizing forest products". Finally, the concept of *Igya Ser Hanjob* is interpreted broadly by the community as the slogan "let's keep the forest for the common good".

The *Igya Ser Hanjob* system is divided by categories of zoning, viz. *Tumti*, *Babanti*, *Nimahanti*, and *Situmti*. *Igya Ser Hanjob* zoning is a traditional conservation technique that has been applied by the Arfak community for generations. The area is divided into 4 zones based on the nature and characteristics of the land (Figure 2), namely: (1) *Situmti* is a zone used by people living and gardening; (2) *Nimahanti* is a zone that was previously opened by the community to carry out gardening activities, and after the harvest is over, the land will be abandoned. In this zone, there are many ferns and fast-growing plants. This zone is a secondary forest; (3) *Babanti* Zone is a zone that is overgrown by large trees. This is a zone that can be converted into a new zone because the forest floor is not completely covered with moss. In this zone, there are still primary forests; and (4) *Tumti* zone

(Figure 3). This zone is generally located at the top. Because this is a primary forest and the floor is covered with moss, arresting violators in this zone cannot be done.

The Arfak community generally divides the forest zone (*bigbebei* = forest) into three parts, namely: (1) *Babanti* is a primary forest area whose location is higher than the community settlement. This foggy area has a cold temperature. In this area, it is not allowed to build villages and gardens. This area is the location for taking certain types of timber, pandan leaves, and rattan. The timber taken in this area is used as columns, the bark as wall material, the pandan leaves as roof material, the fruit as a repellent, and the small rattan as binders in the construction of a thousand-foot house, a traditional house with elevated floor supported by many columns; (2) *Nimahanti* is a forest area that is very moist and overgrown by moss both on the ground and in trees. This area has a topography that is difficult to reach from the village, and cold temperatures, so not all plants can thrive, especially food crops; (3) *Susti* is a secondary forest area that was previously used as a garden area that has been abandoned and has grown into a forest again. Ex-plantation areas with cleared land can be categorized into sustenance areas. After having been abandoned for 4 years, the diameter of the tree has reached an average of 40 cm with a total tree height of 8 m. This area is a source of wood for fuel (firewood) and a garden fence. The species of woody plants that dominate this area are *Piper* spp. and *Dodonea viscosa*. *Dodonea* sp. There are two types of plants grown in this area, namely red bark

and black bark. This area is divided into 2 parts, namely: *Susngöisi* (former gardens that have been abandoned for a year, and the plant buds have begun to grow); and *susmahan* (former gardens that have been left for more than five years, and the plants have reached a diameter of > 30 cm). *Arwob* wood (*Dodonea viscosa*) with a small diameter that is used to build a thousand-foot house is also taken from this region.

In addition to using plants, the ethnic group of Kwau and Syoubri village and its surroundings also utilize animals to fulfill their daily needs, such as food and health needs. At present, local, domestic and foreign tourists who are looking for the native habitat of Arfak plain birds and black souvenirs will come to the *Mokwam* plains. This is what causes the community to gradually, with assistance from the government and NGOs, has developed this area into a natural tourist destination. Various species of birds that were once hunted animals are now no longer the target of the game. Currently, in forest areas that used to be hunting areas, with the deliberation of all villagers and determined as village decisions, hunting is not permitted in any form and any type of hunting equipment. Cultural norms and values owned by the community are realized through traditional ceremonies, dances, and handicrafts. Traditional ceremonies are a form of public expression of joy and sadness. The community's joy can be expressed during the reception ceremony and wedding parties, while sadness is expressed when grief occurs. The best-known dance of the *Hatam-*

Moile tribe is the *Tari Tumbu Tanab* (traditional dance). This dance is performed in conjunction with traditional ceremonies such as guest reception, wedding, and death ceremonies. The dance is accompanied by songs whose lyrics are in the form of rhymes selected according to the type of celebration.

This *Tumbu Tanab* dance is very well known in Manokwari and throughout the bird's head region in West Papua Province. This dance is interesting and unique because its movements mimic the movements of snakes above the ground. This dance is also known as snake dance because for them snakes are their symbols of greatness. The movements in the *Tari Tumbu Tanab* resemble snakes following the rhythm of the song sung by the dancers (Figure 4). This *Tari Tumbu Tanab* spreads throughout the bird's head region, Papua, and it is done especially by the large Arfak tribe in Manokwari (*Mnu Kwar*), which consists of several sub-tribes, namely *Hattam*, *Meyakh*, *Sough*, and *Moile*. There are also several tribal clusters including Karon, Saukorem to *Ayamari*, *Aitinyo*, and *Aifat* in Maybrat and South Sorong Regencies. Generally, these tribes know *Tari Tumbu Tanab*, only in different versions and methods according to the character of each tribe in the *Tanab Burung*. The *Hattam* people call *Tari Tumbu Tanab* in the local language *Ibihim*, for the *Meyakh* people, *Muuka* while the *Sough* people *Lenyohora*. For them, this dance is usually held for greeting guests, weddings, the victory of the war, and others.





Figure 3. Forest distribution system based on biophysical characteristics in the Arfak community.



Figure 4. Ceremonial activities: a, b. community activities make traditional ceremonies; c. the *Tari Tumbu Tanah*; d. the group of *Tari Tumbu Tanah*

The most popular crafts made by the people in *Mokvum* village and its surroundings are *noken* that are made mostly by women. *Noken* raw materials come from herbaceous plants (local name: *konica*) which reach 3-4 meters high and fiber from pineapple leaves. *Noken* raw materials derived from herbaceous plants are from old *konica* stems taken for about 1 m in length and then dried to dry and then taken by the skin. Then the skin is separated according to the fiber groove and then twisted in a

circle until it forms a thread and is ready to be used as raw material for making *noken*. The other raw materials are pineapple leaves. The work process begins with choosing pineapple leaves that are of medium age (not too old and not too young). The selected leaves are then slowly scrubbed on the outside, and dried. Then the fibers are separated according to the fiber path and then twisted until they form strands of yarn that are ready to be used as raw materials for *noken*. In addition, the

customary wedding procession starts from the proposal, payment of the dowry, wedding ceremony, and the ceremony take the bride to the male side. The dowry that applies to the people of *Hatam-Moile* are *kain timor*, *toba* cloth, *paseda* (clam bracelets), large hanging beads, shop cloth, sarong fabric, pigs, and large weapons. At present, the types of dowry have been given in the form of money, cattle, wall clocks, radio, and cars. The bride who has just been paid can be delivered to the family of the man.

According to one of the *Wonggor* clan woman, (*Wonggor* clan knows religion, i.e., Christianity), they did not request a dowry to the man who wanted to woo the *Wonggor* clan. Instead, the man who proposed to the *Wonggor* clan was obliged to live in the women's clan. This was pioneered by Mr. Benyamin *Wonggor*, who introduced Christianity to the Arfak tribe, especially on the *Mokwam* plain. People use signs that come from plants as a marker. For example, in a forest area where hunting and other damaging activities are prohibited, the community gives signs: *Riyepa/igyok monga* (snares), meaning that you cannot trap wildlife; *Nimaia*, in the form of bamboo tied with ropes, meaning that they cannot hunt with weapons; Bamboo is split and hung at the top, meaning that the offender will get a life punishment.

Another example, if people give a sign to a building or land using bamboo, especially bamboo with a small size, it means a very strong warning for anyone who deliberately violates the prohibition sign. If the violator of the ban is caught red-handed, then he or she will be processed customarily. The party making the prohibition sign is the party that determines the number of customary fines that must be paid by the violator. The type of fine that the offender must pay, according to *Hatam-Moile* culture is in the form of *kain timor* or pig. Currently, the payment of fines is carried out with the equivalent of money. If the violator accidentally enters the prohibited area, a fine would be the consequence.

Discussion

The Arfak community is very strict in maintaining customary boundaries between one clan and

another. Members of one clan with other members of the clan may not carelessly enter and carry out activities in indigenous territories controlled by other clans, without permission from the clan chief who controls customary territories (Sutarno et al. 2017, Pattisclanno et al. 2019).

Tourist products in the PANR area are three aspects known as triple-A (Attractions, Amenities, Accessibility). Tourist products can be interpreted as anything that can be sold as a tourism commodity (Sutarno et al. 2017, Carson et al. 2018, Peterson et al. 2019). Tourist attractions consist of the potential of flora, fauna, landscapes, and artificial attractions in the form of art and community culture (Figure 3). Based on the criteria for flora diversity in various ecosystems in the PANR, the quality is very good because FAO survey in 2005 identified 2.770 species of orchids. Various species of wing-bird butterflies (*Ornithoptera* spp.) which become the favorites of international butterfly collectors live abundantly in this region. There are 6 species of wing-bird butterflies (*O. Arfakensis* and *O. robchildi*) which attract the most attention of researchers and foreign tourists when visiting the PANR (Figure 5). The species of endemic Pegunungan Arfak avifauna have high economic value in their habitat since foreign researchers began to search for them in the early 1990s (Sutarno et al. 2017). In the PANR, it is estimated that there are 110 species of mammals with 44 species that have been recorded, 320 species of birds, of which five are endemic to Papua that is a huge potential as an ecotourism attraction.

The landscape in the PANR is a combination of various physical components of the ecosystem with the surrounding vegetation, creating a very beautiful panorama as part of the tourist attraction. Landscapes which have an important role in attracting tourists are well-kept in the PANR. One of the attractions in the PANR is the forest that stretches across the region making the PANR a favorite place of tourists because they can get a sensation or a tough natural challenge when tracking from the starting point of the journey to the finish line (Figure 6). In the mountains, tourists can also enjoy the superior natural beauty of the PANR, especially the smart bird sanctuary, the

various species of bird of paradise, and the culture of the community can be used as a support for the development of nature tourism. Cultural tourism attractions that can be sought around the PANR include folk art (*Tari Tumbu Tanab*). The supporting factors of tourism here are the natural conditions of this place including the tradition of local people. Local people in Papua still preserve the traditional knowledge during their life and some of them have adopted the tradition to the environment (Ungirwalu et al. 2014, Ungirwalu et al. 2017, Ungirwalu et al. 2019). Moreover, Papua has the highest floristic richness in the world (Murdjoko et al. 2016, Cámara-Leret et al. 2020, Fatem et al. 2020, Murdjoko et al. 2021b, Murdjoko et al. 2021a, Tawer et al. 2021). The faunal richness has attracted naturalists since centuries ago leading to the promotion of this place as a tourist destination. The local

government has attempted to design the development of tourism programs by providing infrastructure such as roads and socialization to local people to take part. The local government and non-government organizations (NGOs) have performed the development of tourism for a couple of years. However, possible barriers should be anticipated by identifying both external and internal factors. The social and political conditions in Papua are more or less dynamic, so the local government should guide the local people to support the development (Ungirwalu et al. 2021). The cost of living in this area is fairly higher than in other cities in Indonesia. Therefore, governmental intervention should be conducted to support the economic condition, so the living cost particularly in this area would be lower.



Figure 5. Fauna and its use in ecotourism



a. Place of observation

b. Display area of Vogelkop bowerbird



c. Nest of Vogelkop bowerbird

d. Nest area of Vogelkop bowerbird

Figure 6. A place of observation for the ecotourism of birds of paradise.

Tourism as a potential sustainable product of nature

The finding of this research revealed that local people in Pegunungan Arfak (the *Hatam-Moile* sub-tribe) still maintain traditional knowledge for their livelihood support. The biodiversity and social-cultural richness of local people in Pegunungan Arfak should be developed using traditional ecological knowledge in sustainable nature management which provide economic benefit to local people and conserve the nature at the same time. The development of socio-culture in Papua is in agreement with the declaration of West Papua Province programs that have been stated in Manokwari Declaration to conserve nature and culture (Cámara-Leret et al. 2019). Then, the implementation of those programs could promote nature and culture conservation in which the local people could also benefit from such programs. However, the application of tourism activities must be accompanied by Environmental Impact Assessment (EIA) that is controlled by the government. This is very useful to ensure the tourism activity would minimize adverse impact on the environmental conditions particularly socio-culture and nature.

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