The Prospect of Geotourism in the Cycloop Mountains Conservation Area Papua

P Setiadji¹ B Sulistyantara² B Pramudya³ and Suwardi⁴

¹ Student of Natural Resources and Environmental Study Program, Graduate School of IPB
² Lecturer of Department of Landscape Architecture, Faculty of Agriculture, IPB
³ Lecturer of Department of Mechanical and Biosystem Engineering, Fateta IPB
⁴ Lecturer of Department of Soil Science and Land Resources, Faculty of Agriculture, IPB

Email: prihananto_jpr@yahoo.com

Abstract. The Cycloop mountains in Papua are a nature reserve conservation area that has diverse geology, biology and culture. This paper discusses the prospects of geotourism in Cycloop mountains based on a method of analyzing the community acceptability and tourists preferences, likewise the geosite attraction and geotourism sustainability. The results of analysis indicates that a) village communities in surrounding conservation area accept and wish to get involved in natural activities; b) local tourists are very dominant and motivated on outdoor recreation in groups; c) identified geosites has classified as from Quite Interesting to Interesting based on the index of attractiveness; and d) geotourism activity in the mountains Cycloop is categorized Quite Sustainable reviewed from the environment, society, economy and governance dimension. The exploration and the geological conservation to be the reliable activities in organizing the geotourism. Geotourism is likely to be applied to the conservation area as a form of implementation of the sustainable tourism concept.

1. Introduction

Papua as the largest island of the Indonesian archipelago is located in Eastern region of Indonesia. The geological process of Papua island is influenced by tectonic order involving two giant plates: Pacific plate and Australian plate. The interaction of the two plates to produce geodiversity which has scientific, aesthetic and touristic meaning. Geodiversity describes the characters of landscape, realm of rock, internal and external processes, and tectonics. The composite of authentic and natural geodiversity makes Papua island known as exotic.

One of regions in Papua that has a high geodiversity is Cycloop mountains which is located on the Northern shore. These mountains have a geodiversity characteristic that is specialized in form of the mountainous structural landscape and ophiolite rocks characterize complex tectonic processes over a very long period. The mountain range is a single unit of typical landscape, because it has complete morphology of coastal plain to structural mountains which is characterized by rocks of ocean floor, rocks arc of volcanic islands and deposition of shallow sea, biodiversity of endemic as well as occupied by variety of tribes, both in native tribes such as the Sentani, Moi, Tepera, Ormu and Imbi-Numbay along with tribal migrants [1]. The presence of complex ophiolite in the form of mafic-ultramafic rocks collection is raised from bottom of ocean to surface of worth leading according to the rating of geodiversity. Therefore, the existence of ophiolite in Indonesia is rare and only to be found in Ciletuh West Java, Meratus mountains in South Kalimantan, Bombana in Southeast Sulawesi and Cycloop mountains in Papua [2][3].
The Cycloop mountains have been designated as a conservation area with status of a Conservation Area, which serves as the heart of forest for conservation, protection and education. Although these mountains are protected by law it does not guarantee conservation areas to be sustainable. Threat of deforestation and land degradation occurs due to growth of population of migrants, forest encroachment, hunting of wild flora and fauna endemic, as well as quarrying and mining of wild. Existence of a conservation area only protects the ecological aspect, not yet to give economic impact for local indigenous people as the owners of customary land. Welfare problems and injustice have become strategic issues of the natural resources management in Cycloop mountains. Geology as a part of the natural resources are challenged to be useful and contributing in management of the area so that it will become sustainable. The characteristics of specialized geodiversity consist of ophiolite rocks and mountainous landscape structures which characterize complex tectonic processes over a very long period. This geological phenomenon is vital scientifically, aesthetically and touristically exciting.

Management of geological resources in a sustainable manner can be practiced through geotourism. Geotourism is defined as activity of natural attractions of special interest-based geological aspects [4][5] and landscape aspects [6][7]. The Geological Agency of Indonesia in national seminar of 2003 defines geotourism as a tourism activity that utilizes all aspects of geology. Including landforms, rocks, fossils, minerals, water and geological processes.

This research was developed from the result of study on natural resource extraction and community livelihood system around the Cycloops Mountains [8], and modifying the study of the attractiveness of geosites for geotourism in Razavi Khorasan Province of Iran [9]. The study aims to determine the prospects of geotourism in Cycloop Mountains, which is a largely conservation area. The approach underlying research geotourism are 1) acceptability of the community and preferences of visitors, as well as 2) attractiveness and sustainability of geotourism.

The advantages obtained from this research are availability if information regarding geodiversity for community and visitor along with development of geotourism-based attraction and sustainable management efforts. Geotourism is expected to be a solution to reduce threats to conservation areas, addressing social and economic inequalities, as well as preserving the environment.

2. Methodology

Study site is located in Cycloop mountains in Papua Province. Geographical boundaries, to North by the Pacific Ocean, East by the Humbold Gulf, South by the Sentani Lake and West by Tanamerah Gulf. (Figure 1). Meanwhile the tool used in this study consists of 2 categories: a) survey and interview equipment, and b) computer along with an application program for analysis. This study is designed in 3 phases: a) data collection, b) analysis and discussion, as well as c) conclusion (Figure 2).
Figure 2. Stages of study

Primary data collection is conducted by survey, interview and questionnaires to community, visitors and experts. The secondary data obtained from literature studies, reports or the planning documents of government. Questionnaires and interdimension used in study of acceptability, and preference. A questionnaire and a discussion of attractiveness and sustainability aimed at expert based on educational qualifications, skills or experience and work that represents the institutions of local government, universities, professional associations and tourism community.

Samples of villages are determined using Simple Random Sampling method. The respondent society is determined by Stratified Random Sampling method and divided into groups of village authorities, indigenous peoples, youth, women, and migrant population. The number of samples is determined by Slovin formula as follows:

\[ n = \frac{N}{1 + Ne^2} \]  ... (1)

Where n is minimal sample size, N is population size, and e is tolerance of inaccuracy (1%, 5%, 10% etc.)

Respondents visitors determined by the Purposive Sampling method intentionally during visit to city. The sample size is calculated by Estimation of Proportion Parameter Formula as follows:

\[ n \geq \frac{pq(Z(\frac{1-\alpha}{2}))^2}{b^2} \]  ... (2)

Where n is minimal sample size, p is proportion of population or percentage of first group (decimal), q is proportion of rest of population, is calculated by \((1 - p)\), \(Z(1 - \alpha)/2\) is level of real (obtained from table Z normal curve), \(\alpha\) is level of confidence (90%, 95% or 99%), and b is estimation of inaccuracy possibility in determining the sample percentage.

The acceptability analysis is defined as an assessment of perception and reception of community on upcoming activity or program. Assessment using a directed questionnaire by providing answers on agree, disagree, disagree, or no idea. After the assessment, total rating of variable and acceptability rate are determined. Acceptability rate variable of community refers to Table 1.

| Variable                                | Ranking                  |
|-----------------------------------------|--------------------------|
| 1 Development of area as a tourist destination | Agree Less agree Not agree No Idea |
| 2 Management of tourist area by community | Agree Less agree Not agree No Idea |
| 3 Community active roles in tourism      | Yes Less No No Idea      |
| 4 Advantages of tourism activities       | Yes Less No No Idea      |
| 5 Existence of tourist                   | Willing Less willing Not willing No Idea |

Source: [7]
Assessment of community acceptability in every village is calculated by formula as below [8]:

\[ F_p = (4-n) + (3-n) + (2-n) + (1-n) \] (3)

Where \( F_p \) is total score of the variables in the village, and \( n \) is the number of voter.

Assessment of total community acceptability in every villages is calculated by the formula as below:

\[ AM = \Sigma Pvar_1 + \Sigma Pvar_2 + \ldots + \Sigma Pvar_n \] (4)

Where \( AM \) is total of community acceptability, \( Pvar_1 \) is variable of assessment 1, \( Pvar_n \) is variable of assessment-\( n \), and \( \Sigma \) is total amount of the value of people’s preferences towards a particular variable.

Acceptability rates in each villages are summed, then categorized into 4 classes as follows: a) Disagree (85-169), b) Less Agree (170-254), c) Agree (255-339) and Strongly Agree (340 to 425).

Preference is an ideal view of visitors in determining choice of tourism, which demands, priorities, perspectives and motivations of visitors to touring desires. Preference analysis aims to determine the characteristics, reasons for touring, ways to tour and the desirable tourist destination. The characteristics of tourists are determined based on age, gender, education, occupation and the origin of visitors. The analysis of preferences is processed using the operation of descriptive statistics.

Analysis of attractiveness of using an index based on 9 criteria [9], i.e. distance between geosite (10%), accessibility (10%), climate condition (5%), rock formation type (5%), history of geology (5%), topography and slope (5%), geology and geomorphology (25%), security (10%), and tourism infrastructure (25%). The score is determined by an expert and index is calculated by the formula (5), while criteria of attractiveness of each geosite according to Table 2.

\[ I_{DT} = (S \times B)/S_{max} \] (5)

Where \( I_{DT} \) is attractiveness index, \( S \) is score (1 – 5, 1 for lowest rate and 5 for highest rate), \( B \) is quality of each criteria, and \( S_{max} \) is maximum score that has been set on each of the criteria.

| Table 2 Criteria of geosite attractiveness |
|------------------------------------------|
| Category          | Index   |
|-------------------|---------|
| Less Attractive (LA) | < 3,0   |
| Quite Attractive (QA) | 3,1 - 5,5 |
| Attractive (A)     | 5,6 - 8,5 |
| Very Attractive (VA)| > 8,5   |

Source:[10]

Sustainability analysis aims to measure the sustainability and status of geotourism, as well as to identify variables or sensitive attribute effects on each dimension of sustainability through analysis using the Multidimensional Scaling (MDS) method are processed with RAP-Geotourism (Modification of the RAPFish) software. The sustainability status is following Table 3.

| Table 3 Index rate and sustainability status |
|---------------------------------------------|
| Index rate | Category | Sustainability Status |
|------------|----------|-----------------------|
| 0 - 25     | Bad      | Not sustainable (NS)  |
| 25 - 50    | Less     | Less sustainable (LS) |
| 50 - 75    | Enough   | Quite sustainable (QS) |
| 75 - 100   | Good     | Very sustainable (VS)  |

Source: [11]

3. Results and Discussion
The Cycloops Mountains are landscape on the Northern coast of Papua, located across Jayapura Regency and Jayapura City. There are 31 villages inhabited by 185,735 inhabitants around the mountains. According to Slovin formula (1) with inaccuracy level \( e=5\% \) and 10%. The number of respondents visitors are set to 151 people. According to formula (2), where visitors number assumption
in a year is 90,000 people and approximate visitors remain 10,000 people, level of inaccuracy b=5% and tangible level of $Z_{1/2}=95\%$. Natural tourism with geosite set as many as 24 locations based on result of survey and tourism planning documents of the regional government.

3.1. Acceptability
The activities of natural attractions surrounding Cycloop mountains are not widely held either by the public or institutions of regional governments. Nevertheless, the community desires to be highly involved (71.32%) and make their village a tourist destination is elevated (72.31%). Community stated, the city should be managed by the community itself and the profits arranged by family name groups or Indigenous Peoples Agency. Specifically for the Sentani tribe, known as Keondoafian. Whereas, responses of the community refuse visitors or other visiting parties in number is very small (8.58%).

The results of community acceptability The analysis of tourism indicates nature tourism in villages as high (more than 260). The community argued that implementation of natural tourism can be the additional income for families. The community also received a proposal or coaching by government or other parties to engage with the natural tourism organizer.

![Community Acceptability](image)

**Figure 3.** Acceptability rate per village graphs

The communities in Jayapura Regency and Jayapura City have perceived the substance of tourism and realize the benefits received from tourism activities. Most people have recognized natural and cultural tourism, but only some that know about its geotourism (Table 4). This becomes a challenge for the various competent authorities on geotourism activities to intensively introduce the products of geotourism activities to the community.

| Community Perception (%) | Tourism advantages | Natural tourism | Cultural tourism | Geology tourism |
|--------------------------|--------------------|-----------------|-----------------|----------------|
| Jayapura Regency         | 89.27              | 84.43           | 79.93           | 27.34          |
| Jayapura City            | 89.08              | 81.51           | 78.99           | 23.53          |
| Average                  | 89.17              | 82.97           | 79.46           | 25.43          |

3.2. Preferences
Out of the 24 geosite destination categories in the survey, only 17 cities existed and were visited by tourists on holiday or weekend. According to the characteristics of visitors based on age, that is dominated by juveniles between 20-41 years old who work as the civil servants and students with income ranging from 3-5 million IDR monthly along with the bachelor's degree dominant (Figure 4). The visitors are dominated by local tourists living around Jayapura and only some coming from outside the city.
Figure 4. Characteristics of visitors

Visitors who come are motivated to just visit the places by their own will and have the planning in advance. Visitors spend about 3 hours on enjoying one destination (Figure 5). Most visitors desire a destination nearby the city within 5-10 km in destination or less than 1 hour travel time and affordable and massive recreation, preffered less than 500,000 IDR in cost. Motivations of visitors are to get a relaxing circumstance and different from regular activities that are performed simply and collectively.

Figure 5. Motivation of visitors

Favourite tourism destinations are cultural and natural attractions. Natural attractions related to flora and fauna, and culture are associated with dance or object that are associated with tradition (Figure 6). The desirable geotourism is landscape attraction in various charming forms such as natural scenery, such as beach, sea, mountain and river. In general, visitors who come to the current existing destination are Quite Satisfied. Level of satisfaction of service is related to cost of travel, location of tourism sites and nature attraction which is still original.
3.3. Geosite attractiveness
Assessment of tourist attraction is determined based on the tourist destination that contains objects of authentic (geosites) and unique geological objects. Geosite being the study of region unit attractiveness analysis. Attractiveness assessment is made by experts towards 24 destinations and results of assessment are presented in Table 5. Category based on index rate shows Quite Attractive to Attractive. The index rate is relatively relevant which illustrates advantages of geosite, because it meets the concept of tourism such as, attractions, accessibility and amenity and is calculated by considering quality and size of each criteria. Geosite potential based on attractiveness index is Pasir VI Beach, Kloofkamp Biru River, Bhayangkara Hill, Kodam Hill, Skyline Hill, Kapur Entrop Hill, Uncen Waena Hill, Buper Waena Lake, and Harapan Village River. The distance between the geosite, accessibility, geology and geomorphology information, security and infrastructure becomes a key factor of geosite attractiveness in Cycloop Mountains.

### Table 5 Geosites attractiveness index

| Geosites | Bukit Angkasa | Pantai Pasir VI | Kali Biru | Kloofkamp | Bhayangkara Hill | Kodam Hill | Skylane Hill | Kapur Entrop Hill | Uncen Waena Hill | Buper Waena Lake | Harapan Village River |
|----------|---------------|----------------|----------|-----------|------------------|------------|--------------|-------------------|-------------------|-------------------|----------------------|
| Indexes  | 5.2           | 5.8            | 6        | 5.8       | 6.6              | 7          | 6.8          | 6.8               | 5.4               | 5.8               | 6                    |
| Categories| QA            | A              | A        | A         | A                | A          | A            | A                 | QA                | QA                | QA                   |

3.4. Geotourism sustainability
The Cycloop mountains have a worthy developed geosite for the nature tourism activities. Geotourism sustainability aspect is a geosite development and management that gives attention to the necessity of the current generation that will be coming for preserving geological resources.

Based on the discussions by experts and literature study, analysis of geotourism sustainability in Cycloop Mountains Papua is based on 4 dimensional and 26 attributes as follows:

I. The environment dimensions (Attribute: Conservation, Disaster, Supporting Capability, pollution, Natural Resources, and Geology conservation area)

II. The community dimensions (Attribute: local Wisdom, culture Preservation, Community Acceptability, the Indigenous Community Development, Population Growth, Conflict Efforts, and Visitors Motivation)

III. The Economic dimension (Attribute: livelihoods, regional Income, community income, feasibility effort, assets and attraction)

IV. The governance dimensions (Attribute: Regional policy, Institutional, Tourism management, Destination, Infrastructure development, Security and convenience, role of parties, and technology information system)

3.4.1. The Environment Dimensions.
The analysis of MDS results indicate sustainability of environmental dimension to geotourism is 54.15 means that it is Quite Sustainable. Sensitive attribute leverage is conservation and damage/environmental pollution. Geotourism implementation which the appropriate aspects of the environment is highly paid attention to the function of conservation and prevention of pollution. Geological conservation carried out a protection against uncontrolled excavation of geology objects, consist of natural resources and renewable mining commodities.
3.4.2. The Society Dimensions.
The analysis of MDS results show society sustainability dimensions for geotourism is 55.09 or Quite Sustainable. This status is affected by 3 attributes as levers sensitive attribute, i.e. acceptability, community, visitors motivation and local wisdom of community. The community acceptability to be a vital factor for geotourism implementation. The community awareness as a local wisdom can support geotourism sustainability through naming, utilization and preservation of geology objects, such as stone axes (tomago), beads and bracelets on objects of Moi, Tepera and Ormu tribals.

3.4.3. The Economic Dimensions.
The analysis of MDS result to economic dimension describes status of geotourism sustainability indexed 74.31 or Quite Sustainable (QS). It is the highest compared to three other dimension. The economic dimension is seen as a key to geotourism sustainability. The results of levers analysis stated that the business feasibility and an increase in assets to attribute sensitive affect economic dimension. The community business feasibility in the tourism sector is relatively a family business or individually managed. Business tourism sector to be a source of livelihood and income for local communities is obtained through the rental of tourist facilities that are provided. The activity of geotourism by the community requires none of business feasibility and assets of the lot. However, consistency of business and asset maintenance becomes vital for the community's economic improvement.
3.4.4. The Governance Dimensions.

The analysis of MDS results indicate geotourism sustainability of governance dimension is less sustainable, i.e. 34.66. The leverage analysis results show 3 sensitive attributes; infrastructure, tourism management and conveniency. Infrastructure can drive the growth of tourism activity, specific to the nature of geology. However, it also disrupt the balance of the ecosystem. Planning, operating, supervising tourism promotion should be arranged and applied on a consistent basis. Aspects of security/convenience in geosite ensure arrival of visitors and absolute discretion provided by the local community supported by government officials.

![Figure 10. Sustainability status and leverage governance dimensions analysis](image)

The index rate that describes geotourism sustainability obtained from recapitulation of entire rates of attribute levers all dimensions, amounting 57.99 means sustainability category status is Quite Sustainable (QS). Under the sustainability status which is classified as medium, chances of sustainability can be improved through synergy of each sensitive dimension attributes of environment, society, economy and governance.

| Status          | Dimensions     | Index  | Levers Attribute        | Rate |
|-----------------|----------------|--------|-------------------------|------|
| Environment     | 54.15          | Land & Water Conservation, Environmental Damage | 5.83 |
| Community       | 55.09          | Community Acceptability, Motivation of the Visitors | 5.54 |
| "Geotourism in The Cycloop Mountains" Rate = 57.99 (QS) | Community Acceptability | 5.54 |
| Economy         | 74.31          | Feasibility, Assets                              | 11.4 |
| Governance      | 34.66          | Infrastructure, Tourism management                | 5.18 |

3.5. The geotourism prospects

Geodiversity of Cycloop mountains is categorized high and distinctive. Therefore it becomes a geotourism attraction that can be cultivated by society in the form of geology exploration and geological conservation. Geo-explorer that explores village and geosite through activity of tracking, hiking, biking, river tubing and photography. The community, geologists association and academic can develop a geo-conservation through the geosites featured protection and leading as the nature reserve of geology, laboratory of natural geology, research and development of geological information as well as documentation of geological heritage. Geotourism activities and facilities can be optimized with cooperation between the community and with community groups, professional associations and practitioners of local tourism, as well as coaching and mentoring of local government. Cooperation and
development management of the environment becomes a key factor in improving the status of the geotourism sustainability based on the governance dimensions.

The Prospect of geotourism in the Cycloops Mountain has the opportunity to be developed by indigenous people, who hold the authority to utilize natural resources. Aspects that support the Development of geotourism are the acceptance to geotourism by community (acceptability), visitor motivation (preference), superioritas geological objects (attraction) and sustainability. Geotourism becomes interesting because of its unique and diverse activities. Geotourism Development involves the community, government, academics, business and mass media (Pentahelix).

4. Conclusion and Suggestions

4.1. Conclusion

Indigenous peoples around the Cycloop Mountains agree to accept geotourism activity and they are willing to be involved. Geotourism is represented on scattered geosites. Attractiveness geosite containing geological objects are categorized as “Quite Attractive” to “Attractive” based on geosite distance, accessibility, geological and geomorphological information, security and available infrastructure. Geotourism development in Cycloop Mountains is considered as “Quite Sustainable” according to the dimension of the environment, society, economy and governance which are influenced by attributes of levers; conservation, damage/pollution, acceptability, community, motivation visitors, local wisdom, and feasibility of trying, assets, infrastructure, tourism management, and convenience.

4.2. Suggestions

Geotourism is natural tourism that has opportunity to be developed around the Cycloop Mountain Conservation area The pentahelix collaboration is vital for the development of geotourism, with the key factor being indigenous peoples. Geotourism development is prioritized on the geosite superiority and based on the business feasibility of the tourism community. Therefore, training, assistance and guidance from various parties is needed, including information and interpretation of geotourism.

References

[1] Maintindom Y Indrawan A and Kartodiharjo H 2006 J. Manajemen Hutan Tropika 12 0358
[2] Ishlah T 2012 Bul. Sumber Daya Geologi 7 0123
[3] Sendjaja YA and Sunarie CY 2015 Bul. Scien. Contribution 13 03231
[4] Hose TA 2012 Geoheritage 4 pp 1-5
[5] Komoo I 2004 Geological Heritage of Malaysia pp 221-230
[6] Dowling RK 2010 Geoheritage 3 pp 1-13
[7] Farsani NB Coelho C and Costa C 2011 Int. J. Tourism Res. 13 pp 68-81
[8] Risky NN Eka IKP Arya HD and Dudung D 2017 J. Sosiologi Pedesaan pp 36-42
[9] Hassan SS Andrzejk K and Einafschar A 2012 J. Hospitality Management and Tourism 3 0582
[10] Andriany SS Fatimah MR and Hardiyono A 2016 Bul. Scien. Contribution 14 0175
[11] Thamrin SHS Herison C and Biham S 2007 J. Agro Ekonomi 25 02103