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GEOSITE ASSESMENT OF THE TRACE OF MESOZOIC SUBDUCTION IN LUBAR VILLAGE, MUARA DUA DISTRIC, SOUTH SUMATERA PROVINCE, INDONESIA

Ugi Kurnia Gusti[1,2], Nanda Eka Nugraha[1]*
[1,*]Geological Engineering Study Program, Faculty of Engineering, University of Sriwijaya
[2]Structural Geology and Tectonics Research Group, University of Sriwijaya
[*]*Korespondensi e-mail: ugikurnia@unsri.ac.id*

ABSTRACT
Lubar Village, in Muara Dua District, South Sumatera Province, Indonesia, has high geotourism potential due to its geological characteristics related with Mesozoic subduction events. This project will evaluate the geotourism value of two significant sites—Situlanglang Hill and the Insu River Waterfall—using scientific, educational, economic, and environmental criteria. Field studies, petrographic and paleontological examinations, and site appraisals were carried out to assess each site's potential and difficulties. The results suggest that the scientific value is considerable (75-88%), notably at Situlanglang Hill, whereas the educational and economic values are low (50% and 33%, respectively) due to poor infrastructure, access, and public awareness. Conservation ratings range from 50% to 63%, indicating a lack of institutional protection despite existing environmental challenges. However, both places have additional value due to their cultural, ecological, and aesthetic significance. This study emphasizes the importance of integrated management, educational outreach, and community engagement in promoting sustainable geotourism development in Lubar Village.

***Keywords**: Lubar Village, geotourism, geosite assessment, Mesozoic subduction, Garba Formation.*

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teknikgeologi@ft.unsri.ac.id

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INTRODUCTION

Geotourism, an emerging branch of sustainable tourism, emphasizes the appreciation of a region's geological features, landscapes, and processes as part of its natural heritage. Coined by British geologist Tom Hose in 1996, the term highlights the integration of geological understanding with tourism experiences, aiming to promote both education and conservation (Brahmantyo, 2008). In Indonesia, where diverse tectonic and volcanic histories have shaped the archipelago, geotourism has gained traction as a tool for raising public awareness of Earth sciences and supporting local economies.

Geotourism's growing relevance in Indonesia is particularly evident in regions with unique geological histories, such as Lubar Village in the Muara Dua District, where ancient tectonic processes have shaped a landscape rich in scientific and educational value. Lubar Village, Muara Dua Distric is a part of Ogan Komering Ulu regency, it is known due to the shapely lanscape and the geological resources. In the South Sumatera Basin, Garba Formation which dominated by Basalt, andesite, chert and occasionaly serpentine (S.Gafoer et al. 1993) has many variation of landforms those reactive to the water flowing due to the different value of rock resistance. There are two geotourism objects in Lubar Village, Muara Dua Sub-district, Ogan Komering Ulu (OKU), South Sumatera Province, Indonesia which include to Garba Formation, those are Situlanglang Hill and Insu River in the Lubar Village.

This study focuses on the assessment of key geosites in Lubar Village, specifically Situlanglang Hill and the Insu River. Both sites are part of the Garba Formation and exhibit features that reflect the geological evolution associated with ancient subduction processes. The aim of this assessment is to support the preservation of these geosites while enhancing geological awareness, fostering educational opportunities, and exploring their potential for geotourism development.

REGIONAL GEOLOGY

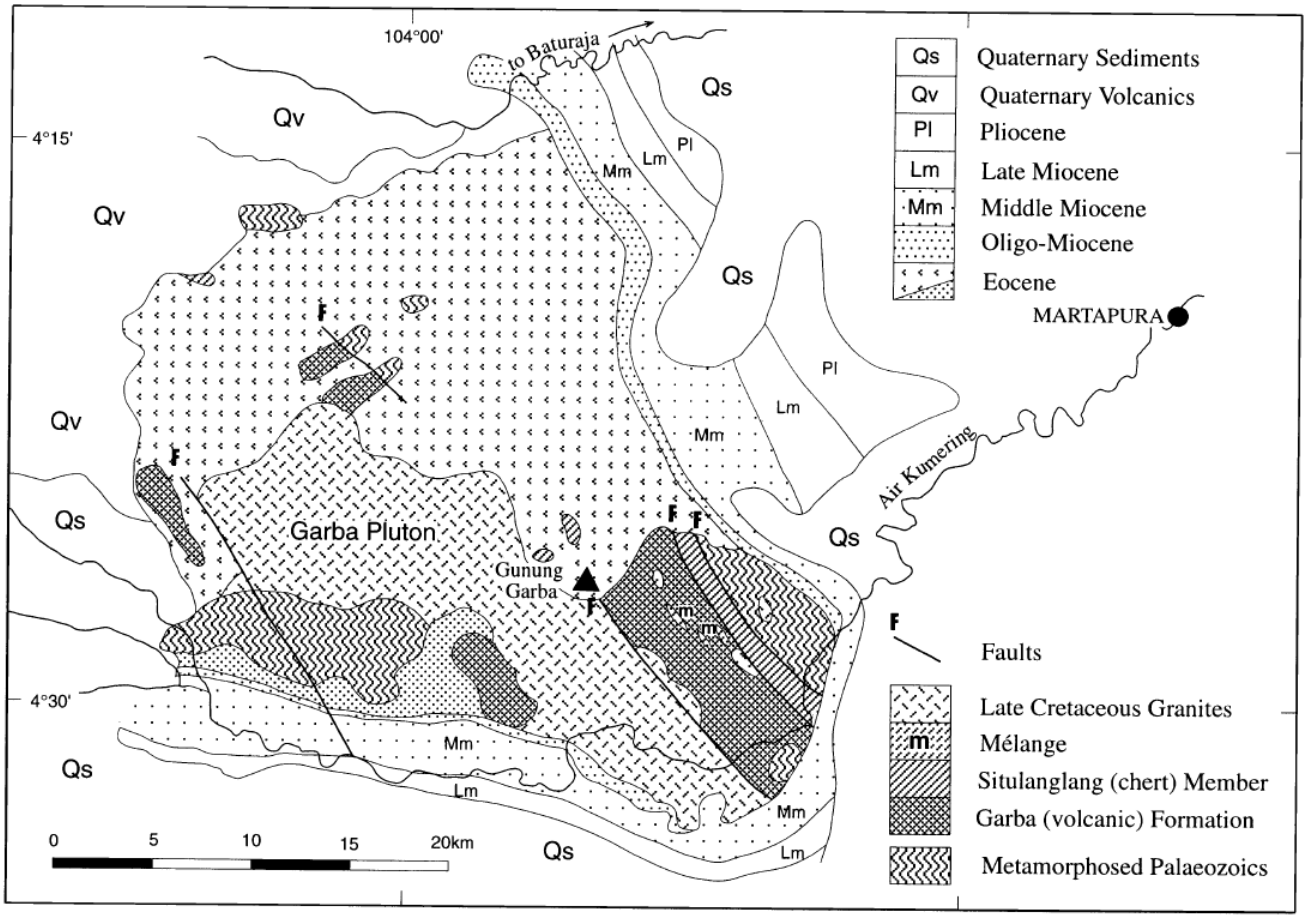
Garba Mountains is an inlier of pre-Tertiary rocks, same as Gumai Mountains is declared to be the basment rock of South Sumatera Basin consist of amalgamation of porhiritic and andesitic lavas (Barber, 1999). Situlanglang hill and Insu river are part of Garba Formation which deposited inharmoniously bellow the Kikim Formation (S.Gafoer et al., 1993) (Figure 1). Based on Gafoer et al (1993) association of rock in Garba area can be divided to association of rock from continental plate and oceanic plate. Rocks such as phillite, schist and quartzite is assumed come continental plate. Whereas chert and basalt are from oceanic plate.

Garba Formation which is proposed by Gafoer et al. (1993) is arranged by Basalt, andesite, chert and occasionaly serpentinite which is interpreted aged Late Jura and Early Cretaceous. Further, Melange Complex is arranged by boulders of limestone, chert, andesitic rocks, siltstone, claystone, and schist in a matrix of scaly clay (Idarwati et al. 2025). Garba Formation is divided into two members: Silungkang Member, Insu Member and Melange Complex. Silungkang Member outcropped in Silungkang hill, is arranged by dominantly red brown chert, yellow, hard, and weathered, contains radiolarian. Insu Member is comprised by basalt, andesite and chert lens, or intercalation with chert which outcropped in Insu river. Melange Complex based on geological map of Baturaja (Gafoer et al., 1993) is stated made up by limestone, chert, andesitic rock, siltstone, claystone, and schist in a matrix od scaly clay. Pulunggono et al (1990) stated that Garba Formation is 79.9 ± 1,3 my and 89,3 ± 1,7 my using K-Ar methods and Gafoer and Amin (1993) assumed 115 ± 4 myr.

METHODS

The investigation is conducted by field observation to gain primary data in Lubar Village, Muara Dua sub-district, Ogan Komering Ulu (OKU), South Sumatera, Indonesia consisting of rock description and taking photos toward the object which support the study. In order to support the primary data analysis, former literatures and research papers are also collected studied. The laboratory analysis such petrography was done to determine the rocks name under microscope and fossil included. Further, the researchers was also done the tour simulation to predict the time travel estimation and site reachable.

Field investigation was done by the reseachers at several site such as Situlanglalang hill, Lematang river, Insu river, and isolated limestone hill nearby the Lematang river. Quantitative assement of geosite assessment methods, according to Assessment of Geotourism potentials Kubaliková, (2013) is a methodology to rank the ites, to assess the site numerically and to detedct the potential of this site. The result of the field investigation, quantitave assesment, literature review and laboratory analysis are summarized to be a geological tour guide in Lubar Village, South Sumatera, Indonesia and also to empowering local people to be aware of their rich geological resources.



Gambar 1. The distribution of the Garba and Situlanglang Formation, correlatives of the Woyla Group, in the Garba Mountains, South Sumatera (after GRDC geological map of Baturaja, Gafoer et al., 1994 in Pulunggono, 1999).

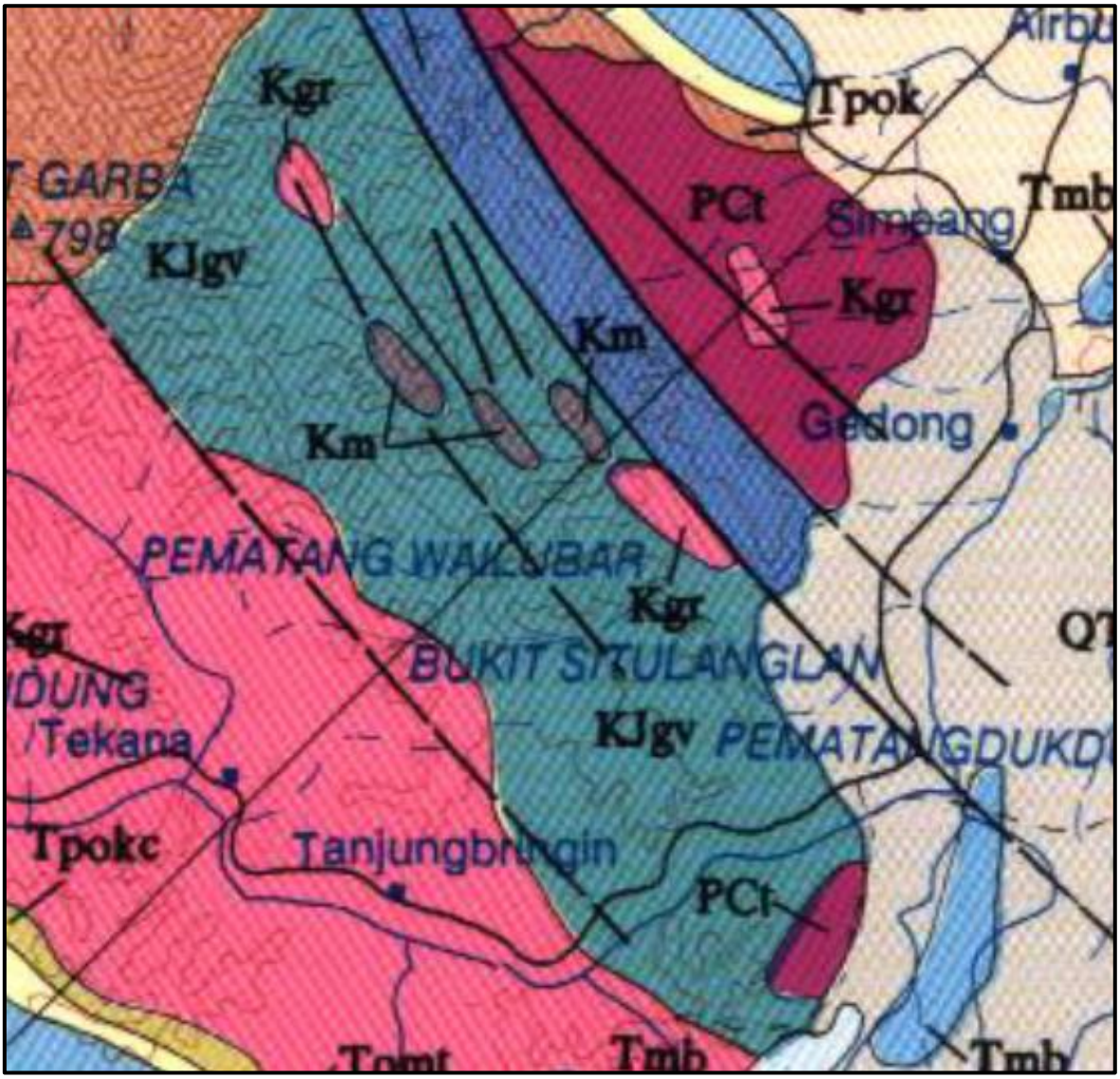


Figure 1. Geologic Map of Lubar Village simplified from S. Gafoer et al., (1993).

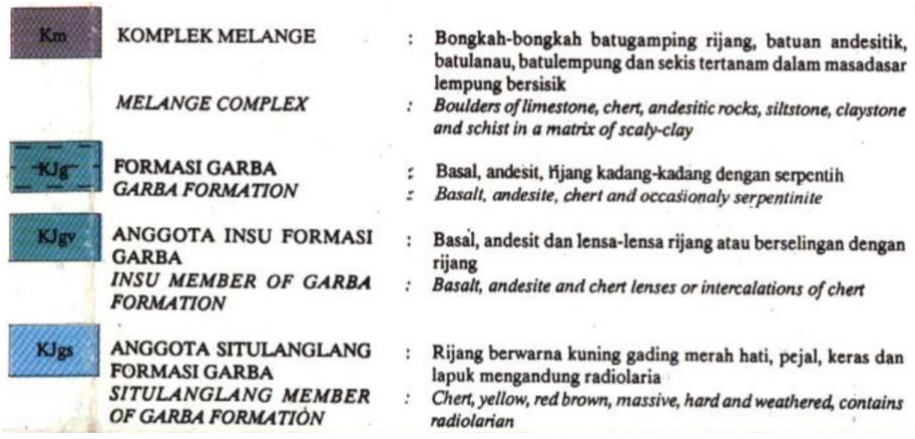


Figure 2. Stratigraphy of research area simplified from S. Gafoer et al., (1993).

Table 1. Assesments of Potential Geotourism Spots in Lubar Village area

Parameter		Insu River Waterfall	Situlanglang Hill
Scientific and Intrisic Values	Integrity	0,5	1
	Rarity (number of similar sites)	1	1
	Diversity	0,5	0,5
	Scientific Knowledge	1	1
%		**75%**	**88%**
Educational Values	Representativeness and Visibility/ Clarity of the Features / Processes	1	1
	Exemplarity, Pedagogical use	1	1
	Existing Educational Products	0	0
	Actual Use of a Site for Educational Purpose	0	0
%		**50%**	**50%**
Economical Values	Accessibility	0	0
	Presence of Tourist infrastructure	1	1
	Local Products	0	0
%		**33%**	**33%**
Conservational Values	Actual threat and Risk	0,5	1
	Potential Threat and Risks	0,5	0,5
	Current Status of a Site	0,5	1
	Legislative Protection	0,5	0
%		**50%**	**63%**
Added Values	Presence of Cultural Value	0,5	0,5
	Ecological Value	0,5	0,5
	Aesthetical Value	0,25	0
%		42%	33%
Mean		**50%**	**53%**

RESULTS AND DISCUSSION

Geologically, Lubar Village counted to Geologic Map of Baturaja (S. Gafoer et al., 1993). Whereas geographically located at Muara Dua sub-distric, Ogan Komering Ulu (OKU), South Sumatra Province, Indonesia. The area is choosen due to several reasons,

one of them is in order to empower South Sumatra to be favourite tourism destination outside Java Island, besides that South Sumatra has its own unique geological aspect, due to the oblique position towards the subduction line in the south west boarder of this island.

According to Pullungono and Cmeron (1984), Sumatra Island is a collision product of microcontinent in Late Pre-Tertiary. Another reason is, widely, Sumatera Island especially South Sumatra has been known as a national energy barn, the location of coal, oil, gas, and geothermal which are mined economically. The research area based on Geologic Map of Baturaja (S. Gafoer et al., 1993) is determined as Garba Formation (Figure 1 & 2). Garba Formation formed from Jurassic to Cretaceous where there is a mixture of oceanic and continental rocks.

Area Accessibility

Lubar Village can be reached by land and air travel. Air travel is used if the visitors are not from South Sumatra, they have to travel from the origin area by airplane to Palembang, the time travel depends to the origin area, for instance from Jakarta to Palembang takes only 55 minutes. Land travel can be traveled by two or four wheel vehicle through travel route: Palembang – Prabumulih – Baturaja – Muara Dua – Lubar Village with the distance approximately ± 300 km. The road condition from Palembang to Baturaja is good and can be passed by vehicle from motorcycle to truck. Further, from Baturaja to Lubar Village the road is smaller than the road from Palembang to Baturaja, but truch still can be passed. Travel time from Palembang to Lubar Village is calculated 5 to 6 hours depends on the traffic condition.

Geosite Object in Lubar Village

Field observations

Situlanglang hill (Figure 3) located at Lubar Village, to be certain in eastern side of Insu river (Figure 4 and 5). The hill is a maskot of this village, because of its morphology resemble komodo's back. The villagers named the hill Silanglang hill. The elevation of the hill is 330 metres above sea level (mdpl) based on SRTM data. In western side of Situlanglang hill flows Insu river.

Morphology of Situlanglang hill that is seemed as Komodo's back has a several assumption of how the hill was formed. The hillshape is formed from a homogenous rock, oceanic rock chert (Figure 4). Based on former research done by Munasri (2016), the chert contains radiolarian fossils that dated Middle to Late Triassic. Chert is formed from quartz mineral which rich of silica (SiO2). The quartz itself which made the Situlanglang Chert hill is more resistant that the surrounding rocks. The chert in Situlanglang hills is yellow to red brown coloured and massive.

Morphology of Situlanglang hill that is seemed as Komodo's back making Situnglanglang hill to be the scarying place for local people. Based on local folklore, ancient people of this village were using this hill to do several ritual to gain power or wealth. And there is at least three cementary which was made by stacked rocks. But the tradition is no longer practice in recent years.

The geosite object can be observed by the brigde nearby the village. From the bridge, it seems like Komodo's back and its tail. The hill is very steep and in hill foot there are several water source. The form which look liked Komodo's back it is a sign that the chert hill is resistant to the denudational process (weathering and erotion). This hill is not a proper place for camping due to the steep slope but it is good for looking sunser or sunrise.

Waterfall at Insu River

Waterfall or local people call it "curup" from the geological perspective is a sign of geological phenomenone was happened in that particular location. The waterfall (Figure 4 and 5) located in Insu river at Lubar Village,

which can be reached by tracking approximately 15-20 minutes along 2 -3 kilometres. Throughout tracking to the waterfall, it outcropped chert, basalt, and deposited multiple float (rock fragment). The chert is yellow and red brown coloured, in several places there is a lense of limestone.

The waterfall consist of vulcanic rock basalt. Basalt is characterized as oceanic plate rocks. This rock lies bellow the chert, it interpreted based on the outcrop condition that basalt is in the river bed and chert is outcropped as a hill. According to former research done by S Gafoer (1993) basal has the same age as chert, both are formed in Triassic and Early Cretaceous. The villagers said that there were many traditional gold mining in this area, but recently there is none, due to the local goverment was just a strict with the miners. Because of the tectonic activity that moved the oceanic rock to be outcropped in the land, this rock exhibit fractures. Fractures or joint has several pattern.

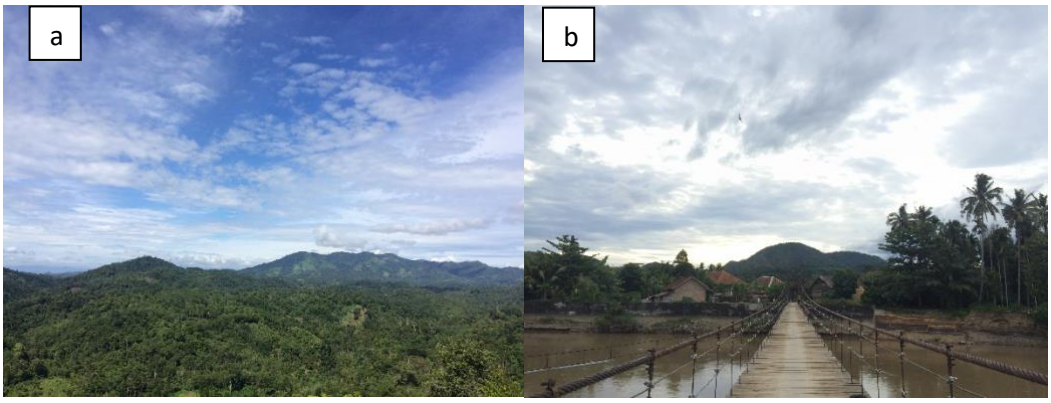


Figure 3. (a) view from the top of Situlanglang hill facing southwest, (b) Situlanglang hill from bridge facing noth.

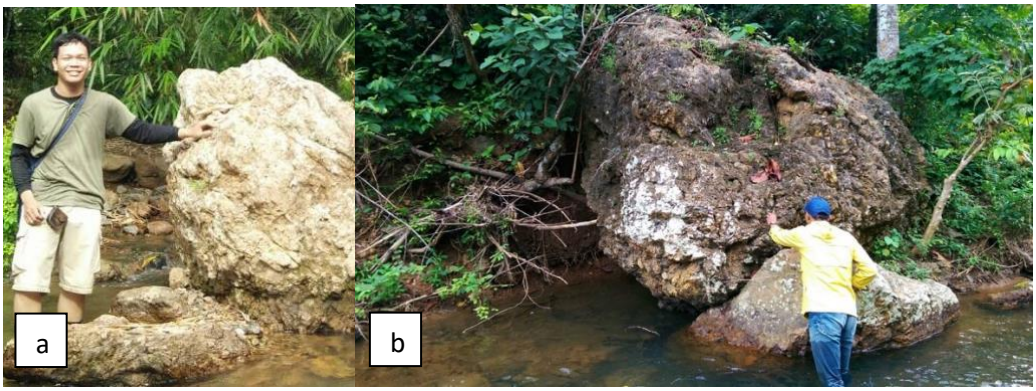


Figure 4. (a) yellow chert, (b) red brownish chert.

Quantitative Analysis

Quantitatie analysis is done by scoring the goutourism site based on several parameter 0 – 1. By doing the quantitative analysis, it can be seen that each of geosites have different scores that showing the aspect that need to be developed and improved in order to present a suitable geotourism activity (Figure 6 and Table 1).

A quantitative study shows that various aspects need to be considered and further action need to be taken in order to optimeze geotourism itinerary in Lubar Village. The scientific value ratings ranging from 75% to 88%, indicating a high value of geological relevance. Situlanglang Hill received the highest score, while the Insu River Waterfall received the lowest. The waterfall site's lower ranking is mostly because of the environmental deterioration, including from small-scale traditional mining operations that reduce the site's integrity.

Both sites received 50%, indicating a modest level of educational value. Given that these areas are still primarily undeveloped and forested, the lack of infrastructure and educational resources is the reason for this comparatively low score. It is advised to implement instructional signage, pamphlets, brochures, websites, and community-based training programs to prepare locals to serve as geotourism guides in order to increase educational value. Both sites received only a 33% economic score. This is mostly because local geotourism-related items are scarce and accessibility is restricted. Regular visits are discouraged by the area's remoteness and lack of adequate roads, and the local population has not yet fully acknowledged or capitalized on geotourism's economic potential.

Figure 5. (a & b) river flows create a waterfall above basaltic rock, (c & d) basaltic rock outcropped in the river wall.

Conservation value scores fall within the medium range, between 50% and 63%. These moderate scores reflect the absence of formal legal protection from local authorities, despite existing environmental threats. On a positive note, both sites exhibit added value through shared cultural, ecological, and aesthetic characteristics. These values highlight the strong connection between abiotic and biotic elements in the area. To enhance the geotourism appeal, active promotion of these additional values is essential.

Based on the radar chart (Figure 7), Situlanglang Hill and the Insu River Waterfall have different geotourism potential profiles. Situlanglang Hill has a little greater and more balanced potential, with its most notable strengths being Scientific and Intrinsic Values. In comparison, the Insu River Waterfall has a less rounded character, with a higher score in scientific value, but to a smaller extent. Both sites have a major deficit in Economic Values, as seen by a distinct fall in the charts for both profiles. Their ratings for Educational Values are similar, showing a common need for improvement in this area. Overall, the graphic clearly shows that Situlanglang Hill has a greater, more well-rounded potential, but the Insu River Waterfall has a few key areas that require more effort to improve its viability as a geotourism destination.

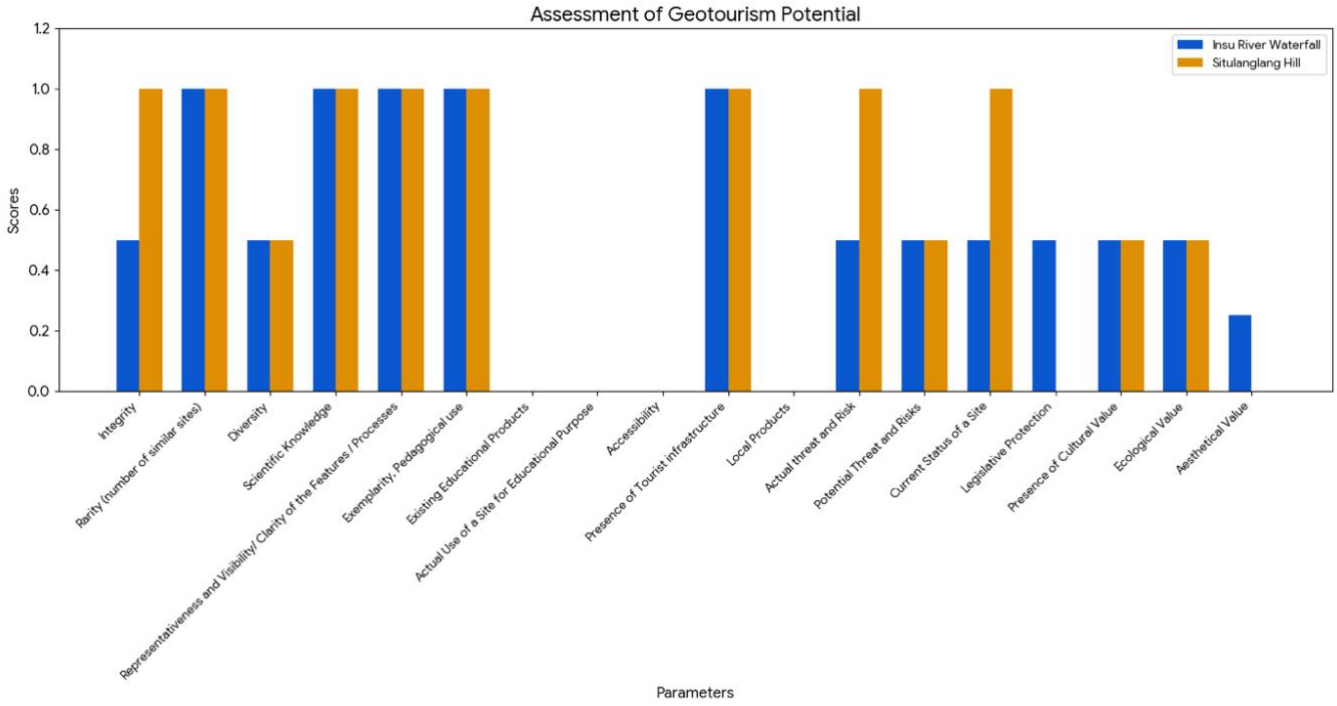


Figure 6. Comparation of the geotourism potential of two sites, Insu River Waterfall and Situlanglang Hill, across various parameters.

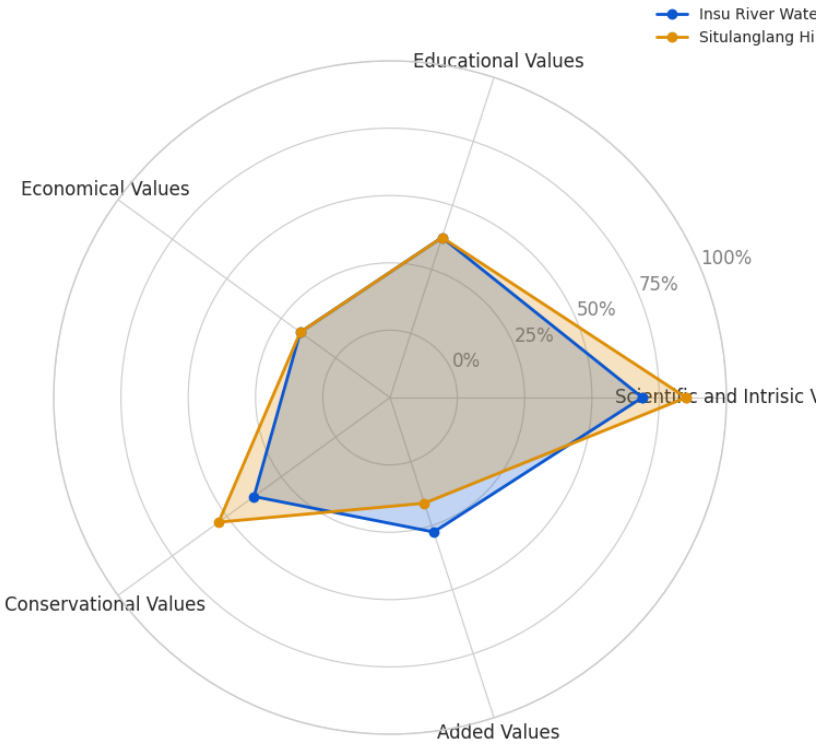


Figure 7. Radar chart of comparative overview of the two sites.

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