Landscape as a Nature Laboratory in Geography Learning in South Malang, Indonesia

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Abstract. The Southern Mountains Zone in East Java is generally a block that is lifted and tilted to the south. Southern Malang is taken place in the Southern Mountains Zone in East Java. It has a landscape appearance that can be used as nature laboratory in landscape-based geography learning and teaching activities. The goals of this study are to reveal the existence of South Malang landscape and the relation to geography learning in class. The method used to achieve the goals is identifying South Malang landscape through fieldwork survey, analysing the previous research results, making landscapes profile, as well as analysing the relation between the landscapes and learning geography aspects in class. The result of the study shows that the research area has karst, fluvial and coastal landscapes. The karst landscape has several surface and subsurface formation such as closed basins, ponor, doline/sinkhole, karst hills, and valley. Meanwhile, the subsurface are in the forms of caves, subterranean rivers, and cave ornaments. Learning geography in relation to karst can be included in the field of karst geomorphology. The coastal landscapes is in far south part, in the form of beaches/gravel and sandy area, sea waves, tides and ebbs, and coastal geomorphology learning context. The fluvial coastal landscape is related to the watershed in Sumbermanjing Wetan district. The studies that can be included are in the scope of hydrology and fluvial geomorphology. Other aspects that can be used as the object of study in learning and teaching geography are related to geography environment, Geographic Information Systems, disasters affair, geography natural resources, soil and water conservation, geography tourism, and geology. Student activities in the implementation of fieldwork can be done by applying equipment in field data collection to find or test hypotheses in fieldwork learning.

Keywords: Landscapes · Learning and Teaching Geography · Nature Laboratory · South Malang

1 Introduction

The Southern Mountains Zone in East Java is generally a block that is lifted and tilted to the south. The north side is marked by a quite complex escarpment (Bemmelen, 1949).

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The physiography of Southern Java Mountains zone stretches from Yogyakarta area in the west to Blambangan area in the Far East area of East Java. The appearance of plateau formation is the result of the uplifted peneplain during the Miocene. As the result of the uplifting process, limestone deposits interspersed with volcanic rocks in the sea are lifted into mountains (Pannekoek, 1949). The Southern Mountains Zone in East Java stretches from Pacitan, Ponorogo, Trenggalek, Tulungagung, Blitar, South Malang and Jember. Pannekoek (1949) divided Malang into 3 zones from north to south based on its physiography and geology. One of those zones is the South Zone. The Southern Zone is approximately in the form of plateau, sloping southward to the Indian Ocean. South Malang is in the southern zone and is southern mountains.

South Malang has rough image of appearance (Fig. 1), which is a limestone area and there are alluvial plains as the part of surface rivers deposits. Besides, South Malang has a coastal area that faces Indian Ocean. The existence of limestone forms karst topography with closed basins, caves, ponor, spring, subterranean rivers, and karst lake (Impala, 2013; Fauzi et al, 2015; Labib, 2016; Suprianto et al, 2017; Salaka, 2018). The coastal appearance has landscapes in the forms of seas, waves, beaches, coast, as the morph dynamics of the coastal area. In the fluvial area, is in the form of a watershed in South Malang.

The existence of these landscapes has an important value in learning geography. Geography that studies the Geosphere phenomenon can certainly make the landscape in South Malang a nature laboratory. Nature laboratories have a central and distinctive role in education to explain concepts and theories discussed in class that can be connected to observations of phenomena that exist in the real world (Hofstein and Lunetta, 2003). In addition, the existence of a nature laboratory can also develop new ideas that connect concepts together which in turn will provide suggestions for new methods, new data interpretations, and new questions about these natural phenomena (Lunetta et al, 2005). Phenomena, objects, and interactions that occur in nature will build knowledge. This knowledge can be generated through the continuous dynamic interaction between scientific theory, research, and experimental data (Lunetta et al, 2005).

The existence of landscapes in the context of learning geography can certainly adapt professional practice and field research (Alomar et al., 2017). The existence of field activities or learning outside the classroom has a positive impact on students (Samsudin et al, 2021), Besides that, learning outside the classroom will certainly provide a learning experience for students (Shammas, 2021). Field activities can be conducted by utilizing the equipment carried out during the survey. The research context can certainly test hypotheses or solve problems by collecting and interpreting data (Onn and Poh, 1978). These natural formations, which of course originate from past processes, can make an effective geography learning media given to students to understand existing features.

Natural laboratories in the context of learning are also carried out in the Mount Galunggung and Kampung Naga areas with the context of volcanic landscapes (As'ari & Mulyanie, 2019; Fadjarajani & As'ari, 2021), and the Lemor Botanical Gardens which are suitable to be used as natural laboratories for learning geography, especially in terms of the object of study of geography and other supporting facilities (Dewi et al, 2021). This is different from South Malang, which is dominated by karst and coastal landscapes.

Landscape-based approaches can certainly have an impact on students' geographic literacy skills, spatial thinking, critical thinking, scientific thinking, research, and mapping (Ikhsan et al., 2020). So the purpose of this study is to reveal the existence of landscapes in South Malang and explain the connection with geography learning in the classroom.

2 Methods

South Malang, which has several landscape appearances, is studied in relation to physical geography and implementation in the field of geography learning. Field data collection was carried out throughout South Malang from Donomulyo District to Sumbermanjing Wetan District. Identification of landscape features in geography learning in South Malang was carried out by field surveys and analysis of previous research results. The field survey was carried out by visiting the landscape. In the coastal area, data is collected on the length and width of the coastline which is also adjusted by using satellite imagery for areas that cannot be reached, in the karst area area plotting is carried out on existing natural features, in the fluvial area identification related to the formation of the watershed in the study location. In addition, a landscape profile was made using topographic data using DEMNAS. The analysis used in this study is the analysis of the landscape profile to see the appearance of the landscape in South Malang. Analysis of the connectedness of geography learning with landscapes to see the relationship between several learning topics that can be used as a natural laboratory for geography learning. Graphical and descriptive analysis provides an overview of the formation of the landscape. To deepen the study of the landscape, it is combined with previous research related to the landscape in the study location.

3 Results and Discussion

3.1 Karst Landscape

The appearance of the karst landscape in South Malang is in several sub-districts, such as Donomulyo District, Pagak District, Bantur District, Kalipare District, Gedangan District, Sumbermanjing Wetan District, Dampit District. Figure 2 shows the cross-sectional profile of Sendang Biru karst block in Sumbermanjing Wetan District and the karst profile in Bantur and Gedangan sub-districts. In Sendang Biru karst block, this cross section is bordered by Kedungbanteng Village and Sitiarjo Village. There are hill cones in the view, dry valleys develop in the north. In the south, there is a sharp difference in elevation with the north. Salaka (2018) explains a) the cross section shows the formation of a karst cone that stretches along Sendang Biru karst area, besides that there is a deep karst valley and a sharp change in elevation in the karst morphology. b) It is a profile of the existing landforms around Sendang Biru karst area, it can be seen that there is a lifting process that causes elevation changes in the karst area. The cross section in Gedangan and Bantur sub-districts also shows the same thing with the presence of karst valleys and karst hill formations. The karst formations in South Malang are exposed to the surface and below the surface. Figure 3 shows the formations on the karst surface.

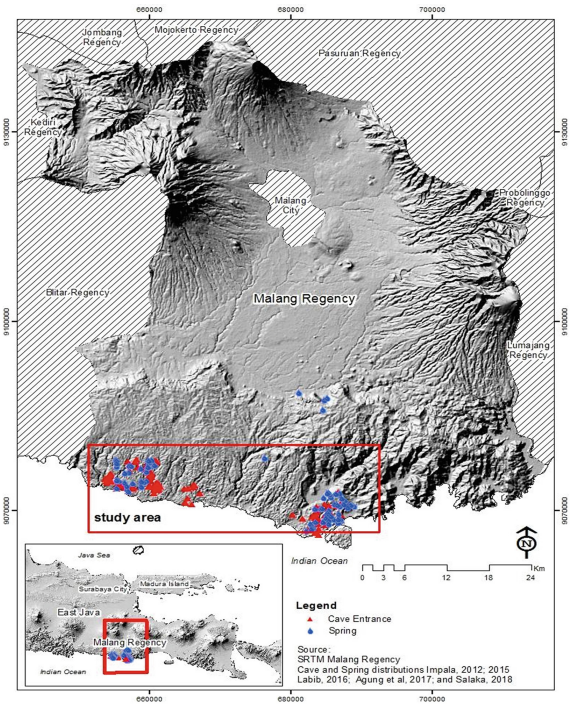

Fig. 1. Study Location

The subsurface landscape appearance is found in the cave passage. Cave is a natural formed passage of past time process which continues to develop. Several caves in South Malang have been identified but there are still very few caves surveyed, considering the existence of caves that are difficult to find. Besides that, the caves that are mapped are also still few, this is certainly because of the difficult terrain in the cave and expertise requirement in cave mapping. The existence of a cave in South Malang has a cave ornament formation and an active subterranean river. The existence of the cave ornament can certainly be used as information in the cave regarding the appearance of the tunnel in the cave, besides the existence of cave ornaments can be used as a cave tour seen in the Coban Perawan Cave and Harta Cave which have the potential for cave tourism (Sahrina et al, 2022). The existence of subterranean river can be used by the community as a source of water. Table 1 shows some of the information in the South Malang karst.

3.2 Fluvial Landscape

The plains in Sumbermanjing Wetan District looks like a basin. The cross section shows the condition of the basin in each watershed area (DAS) in Sumbernjing Wetan district (Fig. 4). The area is located in three villages namely Sitiarjo, Sidoasri, and Tambakrejo Village. The appearance of the landscape that forms the basin allows for flash floods such as what happened in the Penguluran watershed, a village that is often flooded, namely Sitiarjo Village, considering that this village is located in the basin area. In addition, those

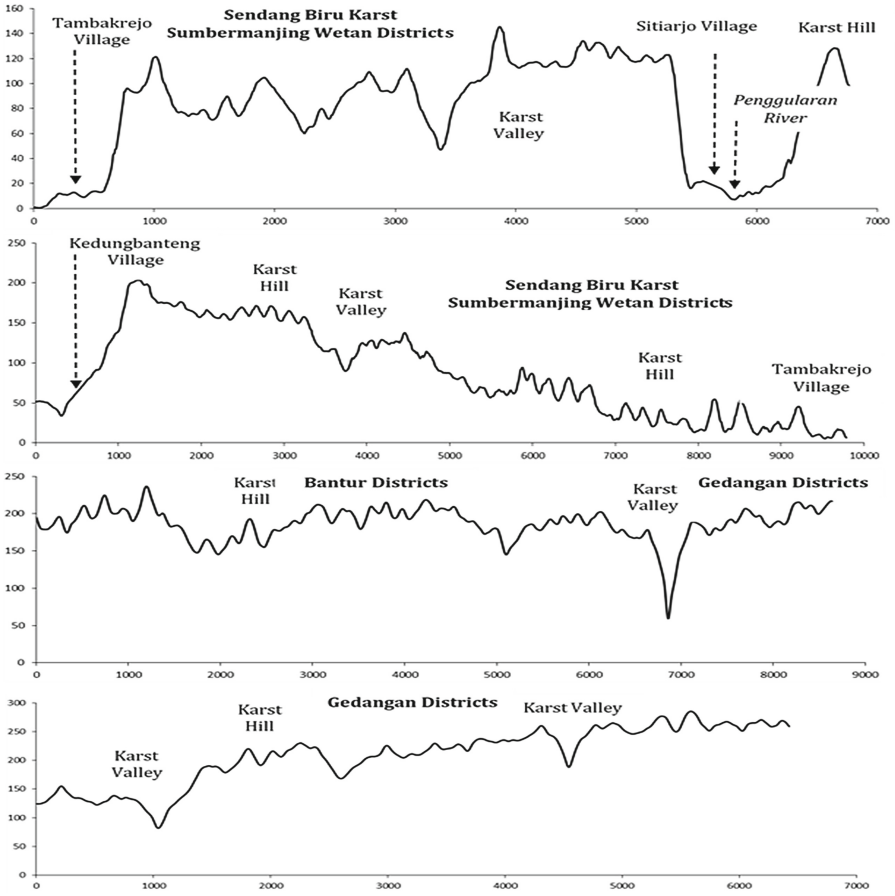

Fig. 2. Cross Section Karst in South Malang

flood prone areas are also found in Sidoasri Village and Tambakrejo Village considering the topography is almost the same as in Sitiarjo Village, but the two watersheds have a small watershed area compared to the Penguluran watershed.

In the upper part of the watershed, surface rivers flow from upstream. In addition, there are reservoirs of water sourced from springs which are channeled to plantations and settlements. Residential settlements are in the upper areas with the dominance of coffee, sugar cane, and sengon plantations. The downstream area is used for rice farming, this can be seen in Sitiarjo Village and Tambakrejo Village. The land use in the Kemudinan and Tamban watersheds has almost the same appearance in terms of land use in the two watersheds. In the upstream part of the land area is still natural with a lot of vegetation covering the land. Upstream agricultural land is generally used for rice cultivation. Figure 5 shows the landscape appearance of the watershed in South Malang.

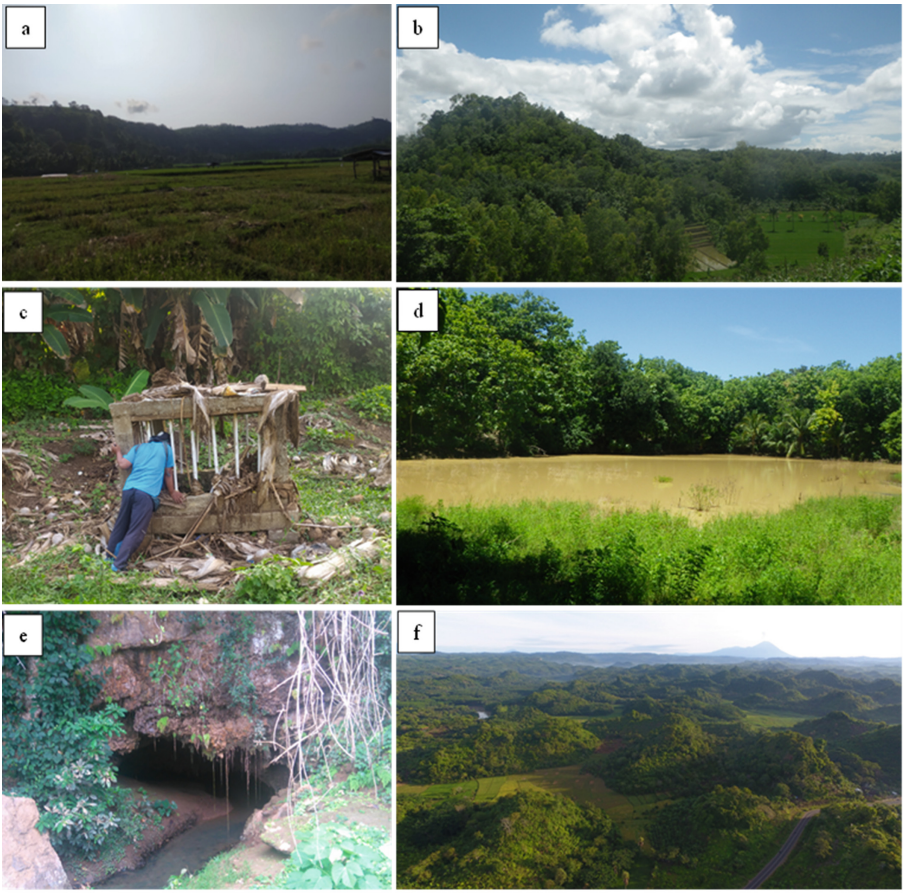

Fig. 3. The appearance of Karst Landscape Surface in Southern Malang (a) The appearance of uplifted limestone (b) The existence of karst hills associated with karst basins (c) The existence of ponor associated with dolines (d) closed basin filled with water forming a doline lake (e) Cave Mas, which is a subterranean river resurgence (f) shows the landscape of the karst hills in South Malang

3.3 Coastal Landscape

The appearance of the South Malang landscape also forms a coastal area. This landscape extends along the coast of South Malang. The appearance of beaches, cliffs, stacks, waves, and the sea are ideal features for the development of coastal landscapes. Studies related to typology on Sempu Island show that there is a typology consisting of the coastal typology of Sempu Island including wave erosion coast, land erosion coast, structurally shaped coast, and sub-aerial depositional coast (Prabawa et al, 2013). The coastal area in South Malang is used as a tourist attraction, residential area, agricultural area that supports the community's economy. In addition, various kinds of social interactions and local wisdom that occur in coastal areas have their own characteristics that are different from other regions. This phenomenon can be used as information and study material

Table 1. South Malang Caves Characterizations

Information	South Malang Karst	
	Sendang Biru Block	**Donomulyo and surroundings Block**
Number of Caves	41 Caves	77 Caves
Mapped Caves	22 Caves	26 Caves
Longest Caves	Lowo Cave (1029.51 m), Harta Cave (603.52 m), Kedung Pitu Cave (457.6 m)	Sengik Cave (1505.1 m), Bagus-Jebrot Cave(1330.35 m), Lowo Cave (858.29 m)
Subterranean Rivers	Lowo Cave, Mbah Wajib Cave, Cave Mas, Kedung Pitu Cave Krompyang Cave	Banyu Cave, Glurug Cave, Gronjong Cave, Kembar Cave, Kerek Cave, Manuk Cave, Rampal Cave, Segawe Cave, Sengik Cave, Sio Cave Lowo Cave, Coban Perawan Cave Bagus-Jebrot Cave.
Storey Passages	Krompyang Cave, Mbah Wajib Cave, Kedung Pitu Cave	Cave Buntet, Cave Peteng, Cave Sumur, Cave Tumang,
Vertical Passages	Ledrek Cave, Watu Jaran Cave, Sumur Windhu Cave	Cave Glurug, Cave Hulu Hua, Cave Sumuran
Ornament Potency	Harta Cave	Cave Lowo
Resurgence Cave	Mas Cave	Cave Jebrot, Cave Banyu, Cave Gronjong
Caves Systems	Tembus Cave Systems	Bagus-Jebrot Caves Systems
Tourism	-	Coban Perawan Cave
Cave Water	-	Sengik Cave

Data source: Impala, 2013; Fauzi et al, 2015, Labib, 2016; Agung et al., 2017; and Salaka, 2018

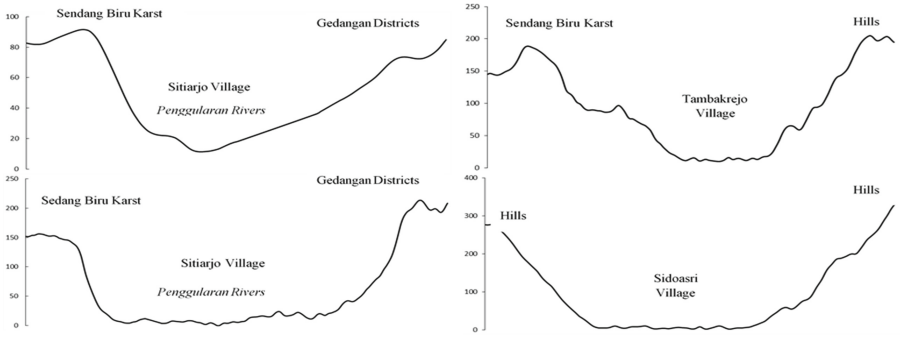

Fig. 4. Cross Section Penguluran watershed (a dan b), Tamban watershed (b), Kemudinan watershed

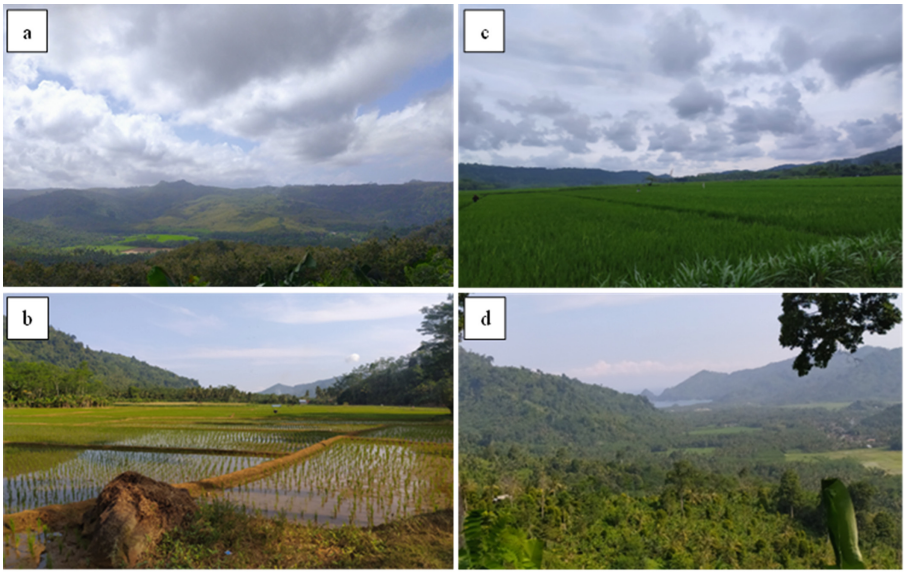

Fig. 5. The landscape of the Tamban watershed (a) where the plains are used as agricultural land (b) such as the landscape in the Penguluran watershed (c) and the Kemudinan watershed landscape (d)

in conducting fieldwork-based geography learning. Figure 6 shows some of the coastal area in the South Malang.

The characteristics of coastal area in South Malang have an important role in the utilization and management of coastal resources. In coastal areas that have a long coastline, it is generally used for tourism. The depth of the beach also shows the appearance of the same thing for tourism activities, where the coast which has a deep beach will give an attractive impression to tourists. Several lengths and widths of the coastline are presented in Fig. 7. The presence of sedimentation originating from the surface also gives an interesting appearance to the coastal area. River estuaries have a lot of sediment deposits which are suitable places for the growth of mangroves. It is proven by the existence of several areas in South Malang which are used as mangrove conservation areas.

3.4 Learning Geography in the Context of Landscapes

Landscapes in South Malang can be in the context of learning geography, related to learning in the classroom. Some learning materials can be included in field studies in South Malang. Landscape itself is a geomorphological study related to the landforms that make up the topography of the landscape. The context of the rocks that make up the landscape can be related to geological studies. The existence of underground rivers, surface rivers, springs, can be related to hydrology studies (various studies of learning can be seen in Table 2). The landscape appearance is a natural medium that can be used as a laboratory in geography fieldwork-based learning activities. Learning in a closed

Fig. 6. Coastal Landscape Appearances in South Malang (a) Ngliyep Beach (b) Perawan Sidoasri Beach (c) Ngudel Beach (d) Sendiki Beach

room carried out by students can be followed by fieldwork learning based by applying the knowledge that has been obtained in class with the natural conditions that exist in South Malang.

3.5 Discussion

The South Malang landscape is certainly a landscape that has various fields of scientific study that can be done in geography learning. Scientific studies have been carried out by several researchers related to the existence of this landscape, such as investigations into karst landscapes (Impala, 2013; Fauzi et al, 2015, Labib, 2016; Agung et al., 2017; and Salaka, 2018). Coastal landscapes with the identification of coastal typologies (Prabawa et al, 2013). The fluvial landscape is nestled between hills, the area is floodplain, with young alluvium fan deposits originating from rivers. The volcanic landscape consists of irregular mountain ridges stretching from the north and south of the study area. The natural landscape in the watershed area is an area that is prone to floods, landslides, and tsunamis (Maulana and Wulan, 2015) and drought (Sahrina et al., 2020). Coastal ecosystems have low vulnerability values seen from the physical aspect, but high vulnerability in coastal areas due to human activities (Handartoputra et al., 2015).

The existence of these landscapes can be used as learning object the same as landscape learning by visiting several study locations (Melnyk et al, 2018; Munandar et al, 2019) and also using the landscape as a nature laboratory for learning geography (Sugiharyanto, 2007; Citra & Sarmita, 2016; As'ari & Mulyanie, 2019). Seeing the nature

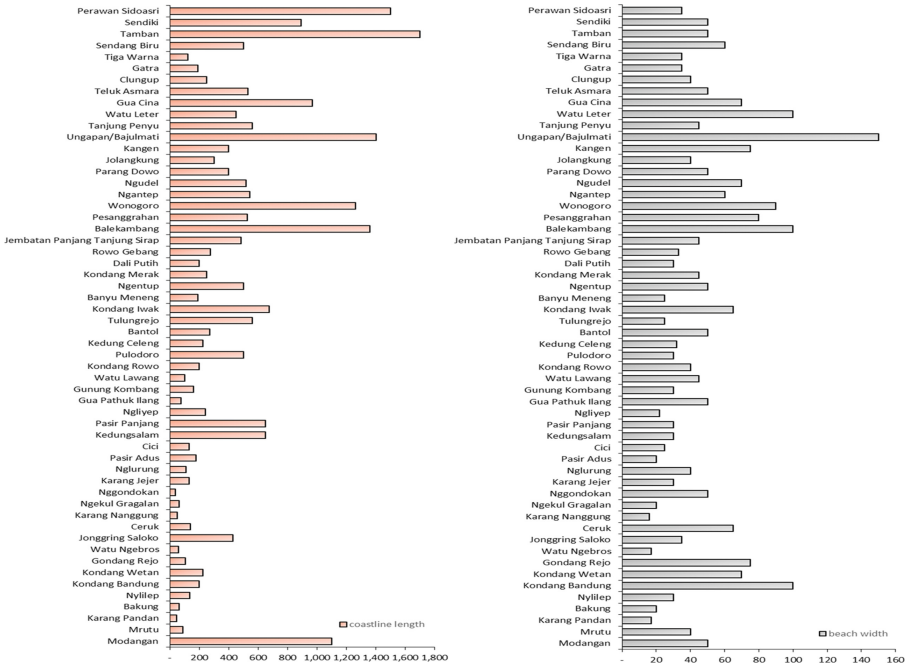

Fig. 7. Length and Width of Beaches in South Malang

phenomena that exist in South Malang, certainly, the existence of these landscapes can be used as a nature laboratory and of course can be done outside the classroom, by field visiting, field investigations, fieldwork, problem solving, research, or other learning schemes, and absolutely, by bringing students to the landscape as the object of learning. One of the areas in South Malang that has a complex landscape is located in Sumbermanjing Wetan district, where learning can be done by doing fieldwork-based learning (Sahrina & Deffinika, 2021).

Learning in a nature laboratory can certainly increase students' understanding of scientific concepts and the use of their applications, scientific practical skills and problem solving abilities, scientific thinking habits, understanding of the steps of scientific data collection, interests and motivation (Hofstein & Mamlok-Naaman, 2007). Fieldwork based geography learning will certainly strengthen the spatial and environmental abilities of students, these abilities are used to solve problems that exist in the study location by taking scientific data according to data collection techniques so that existing data can be further analyzed. Landscapes as part of learning in the field certainly have the appearance and environmental problems that can be solved in learning geography.

Utilization of spatial technology can certainly provide more value in the identification of landscape features in the field. This spatial technology provides more value in learning geography. Technological developments are getting faster, of course the use of printed maps, protractors, compasses is now almost replaced by the use of GIS and the availability of satellites such as GPS on smartphones/smartphones (Day & Smith, 2017). Utilizing GPS determines the location and drones to display the appearance of

Table 2. Geography Study in Context of Landscapes in South Malang

Study Aspects	Landscapes		
	Karst	**Coast**	**Fluvial**
Basic Geomorphology	Learn about karst geomorphology related to form, process, genesis, and the recent updated usage	Learn about coastal geomorphology related to the form, process, genesis, and the recent updated usage	Learn about fluvial geomorphology related to the form, process, genesis, and the recent updated usage
Soil and water Conservation	Learn about land suitability and conservation of water resources in karst area	Learn about land suitability and conservation of water resources in coastal area	Learn about land suitability in fluvial areas and conservation of water resources in watershed areas
Geology	Learn about the constituent rocks of the karst landscapes	Learn about the constituent rocks of the coastal landscapes	Learn about the constituent rocks of the fluvial landscapes
Natural resources	Learn about natural resources diversity in karst landscape	Learn about natural resources diversity in coastal landscape	Learn about natural resources diversity in fluvial landscape
Hydrology	Learn about karst hydrology in the form of springs, rivers, and subterranean rivers	The existence of river estuaries can be used as a hydrology lesson. In addition, aquifers in coastal areas have different conditions from plains.	In a scope study of watersheds, identifying rivers quantity and quality
Geographic Information System	Remote sensing features in the identification and use of GIS for mapping karst landscapes	Remote sensing features in the identification and use of GIS for mapping coastal landscapes	Remote sensing features in the identification and use of GIS for mapping fluvial landscapes
Geography Environment	Ecosystem conditions and environmental services in karst landscapes	Ecosystem conditions and environmental services in coastal landscapes	Ecosystem conditions and environmental services in watersheds landscapes
Disaster affair	Potential and distribution of disasters and disaster mitigation of karst landscapes	Potential and distribution of disasters and disaster mitigation of coastal landscapes	Potential and distribution of disasters and disaster mitigation of fluvial landscapes

Source: Data analysis, 2022

Table. 3. Student activities during the implementation of learning in the landscape

Topics	Elements of Learning	Purpose	Activity	
			Educator	Students
Fieldwork on landscapes in Southern Malang	Preparation	Briefing	Determine the topic, location, and provide material related to the landscape in Southern Malang. In addition, it reveals several hypotheses that need proof in the implementation of fieldwork	Students are given directions regarding the location that will be used as a fieldwork location. And given the studies that have been done by previous researchers
		Inventory of tools and materials	Provide information regarding the need for tools and materials to be used in fieldwork. For data collection and field observations in explaining hypotheses related to the landscape	Prepare equipment and materials to be used in the implementation of fieldwork in Southern Malang such as clinometer, compass, water quality and quantity tools, drones, GPS, laser disto, anemometer, soil drill, soil measuring instrument, etc. Survey materials such as topographic maps, aerial photographs, satellite images, and data collection instruments etc.

(*continued*)

Table. 3. (*continued*)

Topics	Elements of Learning	Purpose	Activity	
			Educator	Students
	Implementation of fieldwork	The various steps in the implementation of fieldwork are as follows Phase I: collect data through observation and measurement Phase 2: adding various data in the field to obtain valid data Phase 3: Interpretation or explanation of the data that has been obtained Phase 4: Presentation of results	Controlling the implementation of fieldwork in South Malang. In addition, it can provide information to students in the form of techniques in data collection and regional conditions that can be used in the implementation of fieldwork.	Carry out activities in the implementation of fieldwork: Phase I. Taking measurements on various types of landscapes, such as water quality in various springs, making landscape profiles, determining the geographical position of the landscape. Phase 2. Students can take measurements and observations at several points, to obtain appropriate information, so that conclusions can be drawn on these natural phenomena Phase 3. Students can provide an overview of the data that has been taken. Examples such as high lime content in karst springs cannot be consumed directly, they need to be processed first. Phase 4. Presenting the results that have been carried out during data collection in the field both verbally and graphically
	Reflection	Meaningful learning about fieldwork	Provide feedback on the results and achievements of students in fieldwork	Provide notes on responses given by educators or other students to improve data and information that has been made. Subsequently, the new fieldwork report was revised

the landscape in South Malang. The use of GPS and GIS allows for greater specification and accuracy of measurements, data processing, and presentation of mapped information (Stoltman & Fraser, 2000). In addition, the use of smartphones also helps in fieldwork-based geography learning. The existence of applications on smartphones eases the students to study landscapes, especially in South Malang.

The landscape in South Malang can certainly be used as a geography lesson. Through landscapes, students can carry out various kinds of applications outside the classroom. Learners can develop their abilities independently and in groups in analyzing and viewing geographical phenomena (Ikshan et al., 2019). The learning steps in the context of the landscape in Southern Malang can be seen in Table 3. Student activities are more emphasized to be able to perform skills in the use of tools and interpretation of field data, so that learning outside the classroom can be meaningful and provide experiences for students. In addition, in carrying out fieldwork, educators must pay attention to the safety of students during fieldwork. Another thing is to ensure that students do not experience financial difficulties with the costs that may be incurred when participating in fieldwork. This can also be a problem where costs, safety in the field, and access to the field are problems that arise when implementing fieldwork-based learning (Arı, 2019). Other problems that arise are related to health and damage to the surrounding area used for fieldwork due to excessive sampling (Day & Smith, 2017).

4 Conclusion

South Malang has a landscape that can be used in geography learning. Karst, coastal and watershed landscapes form complex morphological features in South Malang. The landscape appearance is a natural medium that has different characteristics in each landscape. With these landscape characteristics, it can be included in several courses/lessons so that it can be applied by students. The landscape approach in geography learning can be done to improve the knowledge and skills of students.

5 Suggestion for Future Research

This research only focuses on the study area which is located in for sub-districts in South Malang, it can be continued as a whole. In addition, the study of the landscape as a natural laboratory can be used as a learning module, so that the appearance of the landscape can be presented during class learning. An in-depth study of each landscape is needed, so that the knowledge received by students can be updated about the condition of the landscape.

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Author Contribution. Author 1 conducted a previous study at the research site and interpreted the results. Author 2 prepared a work map. Author 3 prepared a topographic profile and data analysis. Author 4 and author 5 conducted a study on research methodology work. Author 6 performs data entry and field data collection. All authors discussed the results and contributed to the final manuscript.

References

Alomar-Garau, G., Gómez-Zotano, J., & Arias-García, J. (2017). Teaching landscape in Spanish universities: looking for new approaches in Geography. *Journal of GeoGraphy in higher education*, 41(2), 264-282.

Arı, Y. l. (2019). Fieldwork in geography undergraduate degree programmes of Turkish Universities: status, challenges and prospects. *Journal of Geography in Higher Education.*

As'ari, R., & Mulyanie, E. (2019). The use of local landscape as a field laboratory for geography of education. *SPATIAL: Wahana Komunikasi dan Informasi Geografi*, 19(2), 1–7.

Bemmelen, R.W. 1949. *The Geology of Indonesia (2 vols).* The Hague: Gtv Print Office

Citra, I. P. A., & Sarmita, I. M. (2016). Identifikasi Potensi Wilayah Desa Sangsit Sebagai Laboratorium Lapangan Geografi Untuk Menunjang Mata Kuliah Kerja Lapangan. Media Komunikasi Geografi, 17(2).

Day, T and Smith, S R. (2017). Geography education: fieldwork and con-temporary pedagogy. In Douglas Richardson, Noel Castree, Michael F. Goodchild, Audrey Kobayashi, Weidong Liu, and Richard A. Marston. *The International Encyclopedia of Geography*. by John Wiley & Sons, Ltd

Dewi, S., Nurhasanah, N., Hadi, H., & Agustina, S. (2021). Studi Kelayakan Kebun Raya Lemor Sebagai Laboratorium Alam untuk Pembelajaran Geografi. *Geodika: Jurnal Kajian Ilmu dan Pendidikan Geografi*, 5(2), 291–302.

Fadjarajani, S., & As'ari, R. (2021). Utilization of Local Landscape for Educational Field Laboratory Geography. *Review of International Geographical Education* Online, 11(3), 1014–1020.

Fauzi, I., Baihaqi, M. R., Dewi Mar'a, K. T., & Eko, A. (2015). Laporan Pendataan Gua, Mata Air dan Telaga di Karst Malang Selatan Desa Bandung Rejo dan Desa Sumber Bening Kecamatan Bantur Kabupaten Malang. *Laporan Akhir*. Malang.

Handartoputra, Aly. Purwanti, Frida. dan Hendrarto, Boedi. 2015. Penilaian Kerentanan Pantai di Sendang Biru Kabupaten Malang Terhadap Variabel Oceanografi Berdasarkan Metode CVI (Coastal Vulnerability Index). Diponorogo Journal of Maquares. Volume 4, Nomor 1, Halaman 91–97

Hofstein, Avi and Lunetta, N Vincent. 2003. The Laboratory in Science Education: Foun-dations for the Twenty-First Century. *Wiley Periodicals*, Inc

Hofstein, A., & Mamlok-Naaman, R. (2007). The laboratory in science education: the state of the art. Chemistry education research and practice, 8(2), 105-107.

Ikhsan, F. A., Kurnianto, F. A., Apriyanto, B., Kurniasih, F., & Puspitaningrum, D. A. (2020). The practice and indicators research based learning for introduction of geographic landscape (a case study in Department of Geography Education). In *IOP Conference Series: Earth and Environmental Science* (Vol. 485, No. 1, p. 012022). IOP Publishing.

Impala UB. 2013. Studi Potensi Kawasan Karst Inventarisasi dan Pendataan Ponor, Mata Air, dan Telaga/Danau Karst Serta Pemetaan Fauna Gua Dan Studi Masyarakat Di Desa Kedungsalam, Kecamatan Donomulyo, Kabupaten Malang. *Laporan Akhir*. Malang: Universitas Brawijaya

Labib M, A. 2016. Speleogeomorfologi Karst di Kecamatan Donomulyo Kabupaten Malang. *Thesis tidak diterbitkan.* Yogyakarta: Program Pascasarjana Fakultas Geografi Universitas Gadjah Mada

Lunetta, N Vincent; Hofstein, Avi and Clough, P Michael. 2005. Learning and Teaching in the School Science Laboratory: An analysis of research, theory, and practice. *Handbook of Research on Science Education*

Maulana, Edwin dan Wulan, Theresia Retno. 2015. Pemetaan Multi-Rawan Kabupten mlang Bagian Selatan dengan Menggunakan Pendekatan Bentangalam. *Simposium Nasional Sains Geoinformasi* IV

Melnyk, A., Lavruk, M., & Burianyk, O. (2018). Landscape research and education about nature based on the example of the National Park Skole Beskids (Ukraine). *Geography and tourism*, 6(2), 59-70.

Munandar, A., Maryani, E., Rohmat, D., & Ruhimat, M. (2019). Fieldstudy Dalam Pembentukan Kompetensi Sosial Calon Guru Geografi. In *Prosiding Seminar Nasional Pendidikan FKIP* (Vol. 2, No. 1, pp. 784–789).

Onn, Sze Yee and Poh, Poh Wong. 1978. Fieldwork in Geography: importance, objectives and scope. *Singapore Journal of Education*, 1:1, 24-27, DOI: https://doi.org/10.1080/02188797808548515

Pannekoek, A.J. 1949. Garis-garis Besar Geomorfologi Pulau Jawa. Jakarta*: Terjemahan Budio Basri*

Prabawa, B. A., Cahyadi, A., Adrian, V. T., & Anggraini, D. F. (2013). Kajian genesis dan dinamika wilayah pesisir kawasan karst Pulau Sempu Kabupaten Malang Provinsi Jawa Timur. *Ekologi Lingkungan Kawasan Karst Indonesia: Menjaga Asa Kelestarian Kawasan Karst Indonesia.* Deepublish.

Sahrina, A., & Deffinika, I. (2021). Potensi Laboratorium Alam Sumbermanjing Wetan dalam pembelajaran Geografi berbasis kerja lapangan (fieldwork). *Jurnal Pendidikan Geografi: Kajian, Teori, dan Praktek dalam Bidang Pendidikan dan Ilmu Geografi*, 26(2), 61-72.

Sahrina, A., Fadlan, M. S., Withuda, F. A., Labib, M. A., Fitriani, D., & Ma'asika, N. M. (2022). Elaborative Analysis Of Caves As Specified Tourism Destination In Malang Regency-Indonesia. *Geo Journal of Tourism and Geosites*, 41(2), 368-375.

Sahrina, A Fitrianti, D Suprianto A, Labib, M A. 2020. Potential and Challenges of Karst Water Resources in Sumbermanjing Wetan District of Malang Regency. *IOP Conf. Series: Earth and Environmental Science* 412

Salaka, MPA J. 2018. *Eksplorasi Kawasan Karst Sendang Biru Kabupaten Malang*. Malang: CV Komojoyo Press

Samsudin, S., Kamalden, T. F. T., Aziz, A., Ismail, M. H., Yaakob, S. S. N., & Farizan, N. H. (2021). The Impact of Outdoor Education Camp Program in Building Resilience among University Students. *Asian Journal of University Education,* 17(4), 71-83.

Shammas, N. (2021). Experiential Learning Through the Eyes of Emirati Students. *Asian Journal of University Education*, 17(4), 302-311.

Sugiharyanto, S. (2007). Kelayakan Wilayah Perbukitan Jiwo Sebagai Laboratorium Alam Untuk Praktik Kerja Lapangan Geografi Fisik Mahasiswa Jurusan Pendidikan Geografi. *Geo Media: Majalah Ilmiah dan Informasi Kegeografian*, 5(1).

Suprianto A, Prasetyono D, Hardianto A S, Labib M A, Efendi S, Hidayat K, Triyono J A, Ahmad A A. Identifikasi Hubungan Kelurusan dan Pola Lorong Gua Karst di Kecamatan Sumbermanjing Wetan Kabupaten Malang. *Prosiding Seminar Nasional Geotik* 2017. ISSN:2580–8796

Stoltman, J. P. & Fraser R. 2000. Geography Fieldwork: Tradition and Technology Meet. In Gerber R and Chuan G K. Fieldwork in *Geography: Reflections, Perspectives and Actions.* Spreinger Science + Business Media, B.V