

DESIGN OF NATURE TOURISM TRANSPORTATION IN KULON PROGO FROM YOGYAKARTA INTERNATIONAL AIRPORT TO BOROBUDUR

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ABSTRACT

Starting April 29, 2022, New Yogyakarta International Airport (YIA) will open international flights. Public transportation from YIA to natural tourist destinations does not yet exist because of the up and down road conditions, and the road width varies from 2.5 to 7.5 m. This study will design an intelligent medium-sized vehicle using the Internet of Things (IoT) for nature tourism transportation from YIA to Borobudur. The plan is for the current state of the COVID-19 pandemic and its challenges. This study uses observations and interviews to collect data to examine experiential aspects of natural tourism transportation in 2021. The data collected is on nature tourism packages and transportation from YIA to Borobudur. The result is an intelligent medium-sized vehicle design with 18 seats consisting of 16 passenger seats, one driver seat and one tour guide seat. The vehicle is equipped with three CCTVs or video cameras, global positioning system (GPS) sensors on cars to monitor vehicle position and fuel consumption, motion sensors, GPS on mobile phones, RFID sensors and other IoT sensors. The proposed vehicle is feasible with a load factor is 75% and fare IDR 200,000/passenger, then the benefit-cost ratio is 1.3118, the payback period is 2 years and 11 months, and the internal rate return is 0.506491.

Keywords: Borobudur, IoT, nature tourism, public transport, Yogyakarta International Airport.

1 INTRODUCTION

Today's implications tourism is at the social, cultural, environmental and quality of life levels. Tourism is a driving factor for the sustainable use of local tourism resources. Tourism also revives traditions, preserving the environment. Consequently, improve the quality of life and change the local population's lifestyle [1]. Tourism is one of the most significant and fastest-growing economic sectors worldwide. Tourism includes the activities people undertake during their trips and stays in places different from their familiar environment for recreation, business and other purposes [2]. It is an essential driver of socio-economic progress as it stimulates the economy and leads to job creation, income, investment and exports [3]. Tourism is considered the primary sector to realize sustainable development in rural areas. Tourism is a need of every human being. Many countries have developed tourism according to the situation and conditions of their respective countries, for example, nature [4,5], the island [6], Astro [7], agricultural [8], villages [9], urban [10], etc. Research on the economic crisis did not significantly affect the choice of destination, means of transportation and accommodation [11].

One of the main priorities of the Special Region of Yogyakarta is to receive areas from the tourism, education and culture sectors. The trend of foreign and domestic tourist visits increased yearly (before the COVID-19 pandemic). The tourism potential in the Special Region of Yogyakarta is the potential for nature, culture and other supporting tourism potential. This condition provides added value and more substantial competitiveness both nationally and internationally. To that end, tourism is now one of the economy's largest and most significant sectors. It is rapidly growing all over the world. It is an essential driver of socio-economic progress because it stimulates the economy and leads to job creation, income, investment and exports [12].

Key factors affecting tourism marketing include integrated services (including the location of visits can adjust tourists, unique and professional travel planning, security guarantees and handling in case of emergency) and information access services (complete information services, integrated transportation services, travel plan booking platforms, attractive attractions) [13]. Transportation/accessibility is essential to encouraging economic and socio-cultural [14]. Lastly, the dimensions of memorable travel experiences, namely satisfaction with vacation experiences, affect tourists' satisfaction with vacation experiences, especially those whose primary motives are natural beauty and natural scenery [15]. Intelligent vehicles are emerging as a possible solution for multiple concerns in road traffic, such as mobility and safety [16].

Starting April 29, 2022, New Yogyakarta International Airport (YIA) in Kulon Progo Regency opens international flights with the hope that it will increase community economic activities, especially nature tourism. Unfortunately, the local government has not fully paid attention to roads and vehicles to reach tourist attractions. For example, there is no public transportation from YIA to Borobudur Temple via the Mount Menoreh route even though the scenery is outstanding, with many exciting and instagramable natural attractions. The location of the Menoreh mountains is prone to landslides. The road is narrow and up and down, with ravines on the right/left side. The width of the route varies from 2.5 to 7.5 m. In addition, rental vehicles are not always available. So, in this paper, we will design nature tourism transportation in Kulon Progo from YIA to Borobudur. The design combines medium-sized intelligent vehicle transportation elements with the internet of things (IoT). The method can monitor road conditions due to vehicle interaction information and the control centre. The reason is that the vehicle through the route is dangerous and prone to landslides. Also, everyone using a smartphone can monitor the information on vehicle position, safety and passenger comfort [17,18].

The remaining of the paper is set as follows: the next section elaborates on the literature review of the study, section 3 discusses the methodology, section 4 explains and discusses outcomes and findings, and the last offers the discussion and significant policy implications of our results.

2 LITERATURE REVIEW

Road transportation, including railways and highways, is one of the crucial components of transportation systems [19]. The transportation sector has a strategic role in economic development in rural and urban areas. Transportation plays an essential part in developing the tourism industry in any given country [20]. Taff et al. found that stress, density, conflict, freedom, access and natural experiences are essential aspects of the overall transportation experience [21]. Road accessibility is also relevant to airport connections and tourism destinations or other locations between islands [22].

Road quality and driving skills are two main factors affecting vehicular transportation's comfort and safety [23]. On the other hand, there are four categories of quality of vehicle in urban passenger transport time spent on a trip, safety, comfort of the car according to the location of the system of urban passenger transport in time and space and ease of vehicles of urban passenger transport [24]. On the other hand, tourism centres need to implement an intelligent transportation system (ITS) to help provide better information to drivers and travellers (tourists) [25]. Route selection behaviour in the public transport network is essential for supply and demand management. The tourism agency needs route selection input to manage service levels and prioritize relevant investments.

Furthermore, the tourism office finds out how the decision is made with ITS. With this system, tourists can be directed to more optimal choices to generate higher tourist satisfaction [26]. Mobility as a service (MaaS) has been a new alternative for building a sustainable ITS by providing seamless and personalized travel planning [27]. ITS rely on connected environments and cloud systems. Intelligent vehicles perceive the environment through multi-sensors, networks and pervasive systems to obtain helpful information.

On the other hand, many research papers were in ITS and IoT. In their article, Tashtoush et al. surveyed agile approaches for cybersecurity systems, IoT and intelligent transportation. This survey serves as a comprehensive and valuable source for future directions to enhance the cybersecurity integration with agile software development and select the most appropriate agile method for a software development project based on its development environment and characteristics [28]. Hidalgo et al. do research to ensure secure and reliable communication among connected ITS (C-ITS) components (vehicles, infrastructures, etc.) using the SerIoT's system capabilities to detect and mitigate possible network attacks [29] Khalifa et al. propose vehicle detection for vision-based ITS using a convolutional neural network algorithm. The researcher ensures that vehicle detection in ITS is crucial in ensuring road safety. It is necessary to monitor vehicle flow, illegal vehicle type detection, incident detection and vehicle speed estimation [30]. Hu and Hubei have designed and implemented an intelligent vehicle control system based on the IoT and smart transportation [18].

In addition, a network technology known as the internet of vehicles (IoV) is a vehicle with sensors, control units and computing, communication, storage and learning capabilities, which enable the integration of intelligent vehicles with the Internet, transportation infrastructure and other road users through vehicle-to-everything (V2X) communication [31,32] The IoV has been developed to improve road safety and vehicle safety, to serve the digital needs of car drivers and passengers [33].

Furthermore, Hu and Hubei showed that ITS could effectively realize the information interaction between the vehicle and the control centre. With this information, the driver can understand the road conditions and increase the vehicle's driving speed on the road. The data effectively uses resources, reduces economic losses during vehicle operation, and reduces air pollution caused by gasoline emissions [18]. Twahirwa et al. stated that with sensors and mini actuators, the vehicular IoT (V-IoT) would increase the level of the urban transportation system. In addition, the development of V-IoT and its implementation creates a low-cost yet powerful transportation system and raises ITS in urban environments [34].

3 METHODOLOGY

This research focuses on the proposed design of a medium-sized vehicle for nature tourism transportation in Kulon Progo.

Figure 1 shows the research stage in this paper from start to finish. Research is conducted in several phases. The first stage is the literature study and field studies (observations and interviews). In the literature study, researchers collected previous research documents and reports to be used as a reference for this research. The research uses observation and interviews to gather data to study the experiential aspects of nature tourist transportation in 2021. Diagnosis of the situation shows a scenario of massive use of private vehicles and only slight use of public transport with a road width of 2.5–7.5 m. Thus, we wish to evaluate the inter-modal transportation and accessibility of transportation in the area, focusing our study on a specific analysis of the rental vehicle sector on Kulon Progo's nature tourism. Our research is based on data compiled from a survey developed and carried out specifically for this study as

an opportunity to obtain information relevant to the study's goals. We got first-hand information about the guidelines describing the use of this service.

The second stage analyses the new normal during and after COVID-19 for transportation. The third stage is to collect data for medium-sized vehicle design and creation with a road width of 2.5–7.5 m. The fourth stage is designing the medium-sized vehicle. Design made creative and innovative to attract users. The next step is to propose a medium-sized car based on created designs.

Primary data was collected and analysed. The preliminary data were derived from interviews with informants and observation. The informants of this study were eight managers of tourist destinations. The discussion relates to the management of nature tourism with the opening of the YIA and transportation to their goals and the solutions they offer related to the vehicle. Data collection is carried out to observe road conditions to tourist destinations. Observations started from YIA to Borobudur.

4 RESULT AND DISCUSSION

Kulon Progo Regency is a regency located on the westernmost side of the Special Region of Yogyakarta. The northwest part of Kulon Progo Regency is a mountainous area of Menoreh Hill, while the southern part is a sloping lowland to the coast and borders the Indian Ocean. This geographical area surrounded by mountains and beaches makes Kulon Progo Regency have beautiful and beautiful natural conditions. Such natural conditions can uniquely attract the community to support the tourism sector. Sponsored by the existence of YIA, tourism in the Kulon Progo Regency has the potential to be developed. Figure 2 shows the Kulon Progo nature tourism map.

Tourist attraction objects in Kulon Progo Regency are beaches, caves, pilgrimage graves, museums, etc. Based on data from the tourism office, the number of tourist attraction objects in 2019 was 66. The existence of tourist attraction objects in the Kulon Progo Regency can contribute to regional income. In addition, the tourist attraction can move the surrounding community's economy by encouraging the development of other sectors, especially accommodation and food and drink services. Accommodation services provide a place to stay for tourists, while food and drink services provide consumption for tourists. The existing tourist attraction objects can be divided into four types. The four types of tourist attractions are natural tourist attractions, marine tourism attractions, cultural tourist attractions and artificial tourist attractions. In this case, Kulon Progo Regency has four types of tourist attractions.

4.1 Current Condition

The presence of YIA makes the Kulon Progo district an aerotropolis (airport city). This condition causes the community to experience a social change from a traditional agrarian society to an industrial and tourism society. Airport city makes the airport an economic, social and cultural centre for the community, spreading to other areas around the airport. The development of the airport city area has become an investment and business area, one of which is tourism. Several tourist villages have experienced the growth of tourist visits, although, during the COVID-19 pandemic, there was a tremendous blow to tourist destinations there. There are 33 tourism object in Kulon Progo: Sermo Reservoir, Glagah Beach, Trisik Beach, Congot Beach, Kiskendo Cave, Suroloyo, Nglinggo, Tritis, Kalibiru, Kleco Peak, Embung Tonogoro, Dolan Ndeso Boro, Maria Sendangsono Cave, Kedung Pedhut, Kembangsoka Waterfall, Mudal River Ecotourism, Tubing Pringtali River, Bolong Stone,

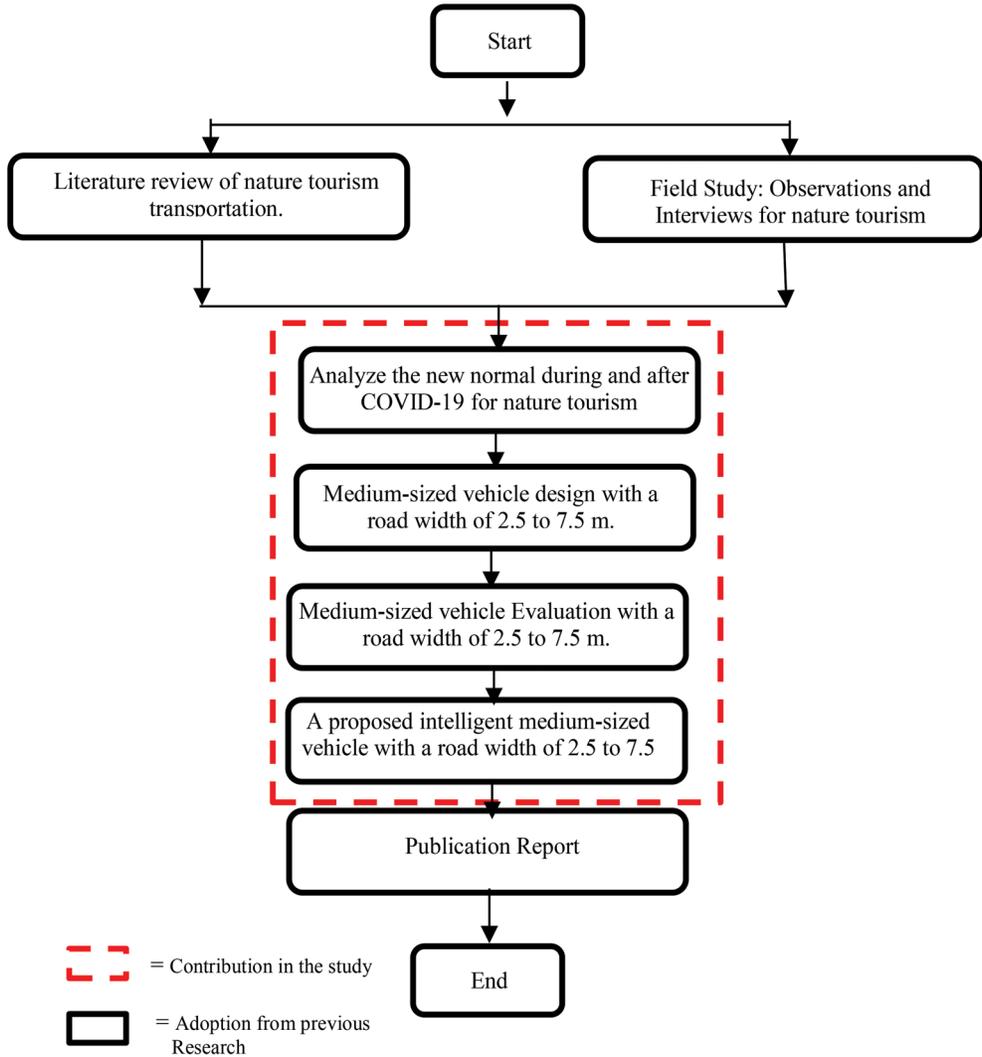


Figure 1: Research stage.

Grojogan Sewu, Pule Payung, Cendana Hill, Canthing Mas Puncak Dipowo, Segajih Live In, Flow Progo Rafting, Towilfiets, Kadilangu Sand Beach Mangrove, Wanatirta Mangroves, Mangrove Bridge of Fires, Kebon Cave, Nyi Ageng Serang’s Tomb, Rumah Sandi Negara, KWS Menoreh and KWS Jatimulyo.

Table 1 shows the number of visitors for four nature tourism: Sermo Reservoir, Kalibiru, Mudal River Ecotourism and Pule Payung because researchers observed several tourist destinations close to the YIA to Borobudur (a super-priority tourist destination). After Mudal River Ecotourism, the researcher goes to Sriti Caves as a new destination. The Kulon Progo Regency government still develops other tourist destinations besides those stated in the data above. So, the researchers observed six natural tourist destinations: Sermo Reservoir, Pule Payung, Kalibiru (Table 1 shows the highest number of tourist visits), Mudal River and Sriti and Borobudur Caves.

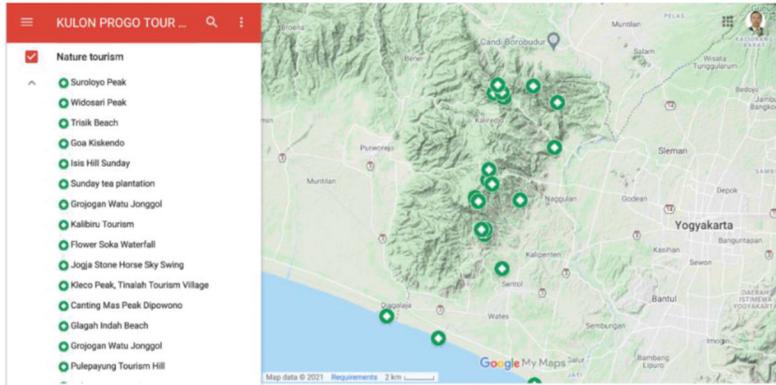


Figure 2: The Kulon Progo Nature Tourism Map (Source: GoogleMap).

Table 1: Visitors to nature tourism in Kulon Progo Regency

No.	The 33 nature tourism	2017		2018		2019	
		Visitor	%	Visitor	%	Visitor	%
1	Sermo Reservoir	123,538	8.8	104,592	5.3	107,156	5.3
2	Kalibiru	322,071	23.0	183,498	9.3	120,384	5.9
3	Mudal River Ecotourism	n.a.	n.a.	54,965	2.8	66,032	3.2
4	Pule Payung	n.a.	n.a.	107,403	5.5	81,719	4.0
5	Another (29) natures tourism	150,237	10.7	1,136,005	57.7	1,249,584	61.4
The number of nature tourism		595,846	42.5	1,586,463	80.6	1,624,875	79.8
Number of tourists to Kulon Progo Regency		1,400,786	100	1,969,623	100	2,036,170	100

Source: Yogyakarta Tourism Statistics 2017–2019 (data processed) [35].

Observations were carried out on June 7, 2021, for the route of this research is as follows:

- a. Yogyakarta International Airport (YIA).
- b. Sermo Reservoir is located in Hargowilis Village, Kokap District, Kulon Progo Regency.
- c. Pule Payung. The location is in Suropati Hamlet, Hargotirto Village, Kokap District and Kulon Progo. Famous tourist attractions in Kulon Progo carry the mountains’ natural beauty and charm with an altitude of 500 mdpl (meters above sea level). Tourists call Pule Payung a hill tourist spot. There are spots to enjoy the surroundings’ natural beauty, such as the Sermo Reservoir and the Angkasa café. Also, the built spots are instagramable spots: Lollipop Spot, Heaven Bridge Spot, Flying Fox, Wolu Spot, Angkasa Café, Gazebo, Sky Bike Rides and sky swings and chairs.
- d. Kalibiru: It is located next to Pule Payung, which is in Hargowilis Village, Kokap District, Kulon Progo. Kalibiru is located in the Menoreh Hills area, 450 m above sea level. The view is in the form of a Sermo Reservoir and a vast expanse of forest. Kalibiru offers several beautiful spots such as games and flying canoes, kites, flying fox, rocking bridge, ovale, nets, high rope bicycles and chairlifts.

- e. **Mudal River:** Mudal River is located in Banyunganti Hamlet, Jatimulyo Village, Girimulyo District, Kulon Progo. The Mudal River is an open-air tour that offers the charm of a bathing pool sourced from natural springs. There are several locations of waterfalls and beautiful bathing pools.
- f. **Sriti Cave:** Sriti Cave is located in Dusun Dukuh, Purwoharjo, Samigaluh District, Kulon Progo. Sriti Cave is a historical tour, a hiding place for Prince Diponegoro against Dutch colonialism from 1825 to 1930. There are stalactites and stalagmites in the cave.
- g. **Borobudur Temple:** Borobudur Temple is located in Magelang, Central Java. The distance from Borobudur Temple to YIA in Kulon Progo is 54 km or about 1 hour and 16 minutes.

Based on the results of interviews with residents around the Sermo Reservoir, the Sermo Reservoir is under the authority of the Special Region of Yogyakarta to manage it. The Tourism Office and the Sermo Reservoir Community Forum are trying to develop the Sermo Reservoir as nature tourism by not eliminating the primary function of the reservoir. The role of the Sermo Reservoir is not only as educational tourism and nature tourism but also as a water provider for irrigation, raw water supply for household needs and flood control. It is also an asset with potential utilization and other benefits, so it must be preserved.

Another tourism management based on interview results is Pule Payung. A non-governmental organization has managed Pule Payung, namely the Pedukuhan Soropati Farmers Group, named "Mantep Makaryo" since 2007. Nine landowners have agreed to make their land a tourist location for Pule Payung, and the model is profit sharing between landowners and residents who manage tourism. Pule Payung presents the beauty of panoramic tourism with views of the Sermo Reservoir and the Menoreh hills. In 2019, Pule Payung won 1st place in the most popular new tourist destination in the Indonesian Enchantment Award or "Anugerah Pesona Indonesia" (API) event.

The location of Kalibiru is close to Pule Payung. Kalibiru was founded in 2010 by the initiative of the community who wanted the forest not to be arid and return to green and sustainable. Then the community built Kalibiru nature tourism. Kalibiru is a protected forest area that stands on hills with undulating land and is located at 450 mdpl. The Independent Community Forest Farmers Group manages Kalibiru. The group was founded in 2001, and they won the trust of the Kulon Progo Regency Government to address the protected forest for 35 years since February 15, 2008. This farmer group then also developed the protected forest into a tourist destination. Kalibiru nature tourism has natural scenery with forest landscapes, Menoreh hills and the instagramable Sermo Reservoir.

Figure 3(a) shows that the tourist destination area between YIA and Borobudur Temple has an altitude ranging from 48 to 752 m (masl) with an altitude difference of 704 m. The maximum ascent angle is 32.77° ($\arcsin(1520/2807)$), where the vertical ascent is 1,520 m with a distance of 2,807 m). The climbing speed is deficient, at a maximum of 1.33 km/h (0.37 m/s), with a road width of about 7.5 m. It takes the ability/skill of a trained driver and understands the lane. Transportation to these tourist destinations is not easy because the location is uphill and hilly, and a narrow street. YIA to Borobudur with a distance of 68.02 km takes 2 h 6 min 31 s with a speed of 83 km/h and a minimum of 13.18 km/h. The vehicle has an average speed of 32 km/h.

Figure 4 shows road conditions to tourist destinations. The road wide is 2.5 m with the slope in the very steep category, so not all vehicles can pass it, and it requires good driver skills. The road can only be given for one car. There cannot be two lanes to cross paths.

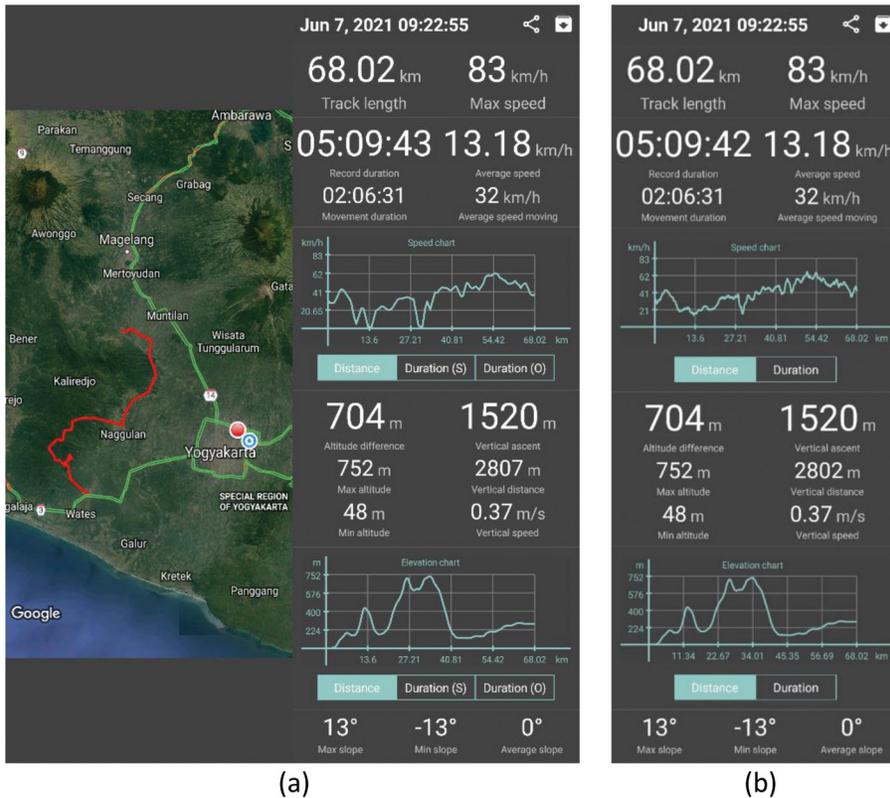


Figure 3: Transportation tracking.



Figure 4: Road conditions to tourist destinations (Source: GoogleMap).

The current situation for public transportation available to travellers in Kulon Progo is supported by car rentals in collaboration with hotel or tourism management. The advantage of rental cars comes from the fact that they guarantee the autonomy of the tourists, allowing access to various geographical points in Kulon Progo. Currently, the car rental for transportation in Kulon Progo is priced at IDR 600,000. Road transport belonging to this sector can face sustainability problems in the medium and long term. Therefore, efforts should be made to regulate transportation to ensure the future of tourism in Kulon Progo and the economic implications of tourism.

4.2 A proposed intelligent medium-sized vehicle

Tourism development has developed in Kulon Progo, but due to the ups and downs of road conditions due to the Menoreh hills with uneven land contours and roads that are not yet wide, transportation is needed following this tourist destination. Therefore, the weakness of this tourist destination in Kulon Progo is its accessibility component, which needs further improvement. This paper tries to analyse and provide innovations related to this problem.

Transport systems significantly impact the environment, and most emissions come from the direct burning of fossil fuels. Therefore, sustainable transport is needed to positively contribute to the environmental, social and economic sustainability of the communities they serve [36].

The selection of types and types of vehicles based on the ability of vehicle specifications and narrow road conditions varies between 2.5 and 7 m. Based on Fig. 3, it can be seen that the max slope $13^\circ \approx 23.0868\%$ ($\arctan 13^\circ$) = 23.096%.

Seeing the condition of the tourist area that crosses the hills of the Menoreh and is very steep, it is better to use a medium-sized vehicle instead of a large bus. Figure 5 shows a proposed intelligent medium-sized bus with 18 seats consisting of 16 passenger seats, one driver seat and one tour guide seat—the vehicle dimensions: overall height approx. $\pm 2,383$ mm, length 6,271 mm, width 1,700 mm; interior length approx. 4,115 mm and width 1,500 mm. For sustainable transport, the vehicle medium should be electric or plug-in hybrid electric vehicles (PHEVs) [37].

1. The tractive force

Hino Duotro 110 SDBL (medium size) vehicle with gross vehicle weight (GVW) = 5,200 kg, grade resistance = $5,200 \times 23.096\% = 1,201.01$ kg, rolling resistance (obstacles

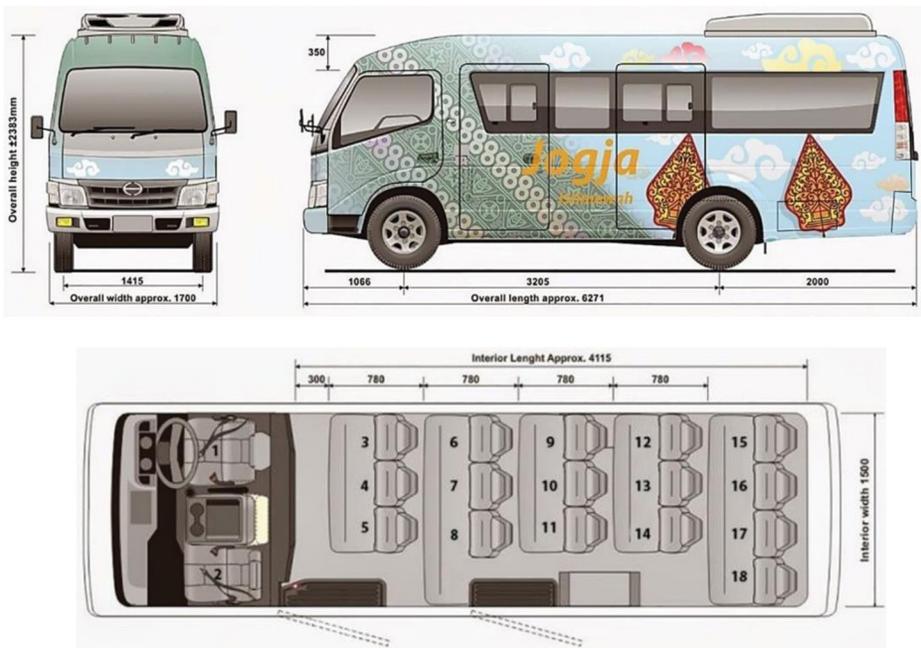


Figure 5: A proposed intelligent medium-sized vehicle.

encountered on the road traversed) asphalt road for vehicles with GVW is 52 kg so the total resistance that must be borne = 1,253.01 kg.

Hino Duotro 110 SDBL maximum torque of 29 kg m, in gear 4 has gear ratio 1,000 axle ratio of 4,625, tire size 7.50–16–12 P.R. (tire rolling radius 0.383 m), the efficiency factor of 92%.

Tractive force = (engine torque × efficiency factor × transmission ratio × axle ratio)/Tire rolling radius.

Tractive force = $29 \times 0.92 \times 1,000 \times 4,625/0.383 = 322.18 \text{ kg}$ (<1,253.01 kg).

In gear 2, the gear ratio is 2.792, the axle ratio is 4.625 and tractive force = $29 \times 0.92 \times 2.792 \times 4,625/0.383 = 900.493538 \text{ kg}$ (<1,253.01 kg).

In gear 1, gear ratio = 5.339, axle ratio is 4.625 and tractive force = $29 \times 0.92 \times 5.339 \times 4,625/0.383 = 1,720.11986 \text{ kg}$ (>1,253.01 kg).

Although medium and large buses in 1st gear are capable, with a width of 2,425 m for large buses and a length of 11,180 m, it would not be easy to move on a road width of 6–7.5 m (2 directions). Moreover, the road to tourist destinations is only 2.5 m.

2. The operating cost

Using a Hino Duotro 110 SDBL vehicle, the daily cost calculation is IDR 1,418,127. The total cost per passenger (with 16 passengers) is IDR 88,633, or passenger fare with a load factor of 75% is IDR 118,177. Table 2 shows the details of the calculation without taking into account the price of the vehicle.

3. The benefit-cost ratio

The calculation in Table 3 with the Hino Duotro 110 SDBL vehicle price is Rp. 52,325,000, and the passenger fare is Rp. 200,000 with a load factor of 75%.

Benefit-cost ratio (BCR) = 1.3118.

Payback period (PBP) = 2.9653 years = 2 years 11 months.

Internal rate return (IRR) = 0.506491 for 5 years so it is equivalent to 10.13% per year. Suppose the bank's interest is 6.5%, the IRR > the bank's interest. So it is more profitable to run a purpose vehicle, or in other words, a proposed vehicle is feasible to implement. Table 4 shows the Cumulative Present Value, which states that the value of cost < benefit or PBP is two years and 11 months in year three. So, according to Tables 3 and 4, if the passenger incurs a transportation fee of IDR 200,000 per passenger, it is a reasonable cost.

The ITS is connected to vehicles, infrastructure (e.g., roadside units (RSUs)), people and the Internet [38,39]. Therefore, the proposed intelligent medium-sized car should meet smart transportation. For example, this vehicle must be equipped with CCTVs or video cameras (in the front, rear and inside the car), global positioning system (GPS) sensors on vehicles to monitor vehicle position and fuel consumption [40], motion sensors, GPS on mobile phones, RFID sensors and other types of IoT sensors. Also, on the road equipped with any IoT [41]. The design of the medium-size vehicle with the proposed intelligent system is also similar to the Smart Application for Every Car (SAEC) [42].

Thus, we proposed an intelligent medium-sized bus with 18 seats consisting of 16 passenger seats, one driver seat and one tour guide seat that be equipped with CCTVs or video cameras (in the front, rear and inside the vehicle), GPS sensors on cars to monitor vehicle position and fuel consumption [40] motion sensors, GPS on mobile phones, RFID sensors and other types of IoT sensors.

Finally, the researcher proposes that the government provides internet speed and reliability for IoT and improves road geometry. Every tourist and traveller stakeholder is vaccinated with the COVID-19 vaccine to prevent the spread of the virus.

Table 2: Vehicle operating costs of proposed vehicle.

A. Passenger cars specification			
1.	Type	: Hino Duotro 110 SDBL	
2.	Transport capacity	: 16 Passengers	
B. Production per bus			
1.	Miles travelled per day	150.00	km
2.	Operating days per month	27.38	day
3.	Operating days per year	328.50	day
4.	Miles travelled per month	4,106	km
5.	Miles travelled per year	49,275	km
Component		Cost per bus-km	
Recapitulation of indirect costs			
1.	Depreciation cost	1,663.56	IDR/bus-km
2.	Bank interest fee	727.81	IDR/bus-km
3.	Vehicle tax	51.99	IDR/bus-km
4.	Vehicle Insurance	53.39	IDR/bus-km
5.	Technically feasible vehicle test fee	1.93	IDR/bus-km
6.	Passenger insurance fee	12.18	IDR/bus-km
7.	Bus crew fee	2,365.14	IDR/bus-km
8.	Indonesian transportation organization member fees	1.22	IDR/bus-km
9.	Route permit fee	1.42	IDR/bus-km
10.	Terminal permit fee	0	IDR/bus-km
11.	Office employee fee	1,533.23	IDR/bus-km
12.	Property tax	5.53	IDR/bus-km
13.	Office building rental	46.12	IDR/bus-km
	Total	6,463.52	IDR/bus-km
Recapitulation of direct costs			
1.	Fuel cost	735.71	IDR/bus-km
2.	Tire fee	131.43	IDR/bus-km
3.	Vehicle maintenance/repair fee	773.58	IDR/bus-km
4.	Management fee per km	321.94	IDR/bus-km
5.	Corporate profit & overhead services	842.62	IDR/bus-km
6.	Corporate tax	185.38	IDR/bus-km
	Total	2,990.66	IDR/bus-km
	Total cost	9,454.18	IDR/bus-km

Table 3: Cost-benefit.

Year	Cost	Revenue	Net benefit	Discounted factor (DF) 10%	PV cost	PV revenue	PV net benefit
Unit purchase investment cost	512,325,000		512,325,000	1.0000	512,325,000		512,325,000
1	465,854,772	788,400,000	322,545,228	0.9091	423,504,338	716,727,273	293,222,935
2	465,854,772	788,400,000	322,545,228	0.8264	385,003,944	651,570,248	266,566,304
3	465,854,772	788,400,000	322,545,228	0.7513	350,003,585	592,336,589	242,333,004
4	465,854,772	788,400,000	322,545,228	0.6830	318,185,077	538,487,808	220,302,731
5	465,854,772	788,400,000	322,545,228	0.6209	289,259,161	489,534,371	200,275,210
					2,278,281,106	2,988,656,289	710,375,183

Table 4: Cumulative Present Value (CPV).

Year	Cost	Benefit
Unit investment	512,325,000	0
1	935,829,338	716,727,273
2	1,320,833,282	1,368,297,521
3	1,670,836,867	1,960,634,110
4	1,989,021,944	2,499,121,918
5	2,278,281,106	2,988,656,289

However, the current study has several limitations that point out issues for future investigation. The findings are based on an interview with eight managers of tourist destinations. At the time of observation, the number of tourists was not much due to the COVID-19 pandemic, the rainy season, internet facilities and public transport were not available. Tourists were almost absent because the government limited the number of people who gathered, so it was difficult to get information about road problems for tourists at that time.

4.3 Future transportation

In addition, researchers propose using a convenient cable car for planetary boundary layer (PBL) observations in mountainous areas [43]. Transportation with cable cars can be a sustainable public transport in the future. Cable cars have many advantages such as electric drive, low surface area consumption [44], and travel time of 22% on average when commutes are made by cable car instead of another transport mode [45]. The cable car is a valuable alternative transport mode because it reduces CO₂ emissions and pollution and can be constructed with minimal impact on the territory [46]. Hence, there is a need to develop transport schedule planning and monitoring and a policy to guide suitable, sustainable and environmentally friendly means of transportation for Kulon Progo nature tourism. In addition, all stakeholders in nature tourism must also have vaccination passports [47]. So, tailor-made strategies must foster sustainable transportation modes at tourist destinations [48]. Thus, there are opportunities for tourist transportation using cable cars.

5 CONCLUSION

There is currently no public transportation for Kulon Progo nature tourism. Tourists use travel services for their vehicles. There are two very different paths from YIA to Borobudur: a slightly sloping path and an up and down path. For Kulon Progo's nature tourism, the road goes up and down steeply with a slope of 32.77°. The street is steep, narrow and dangerous.

This work shows that the hill is in the very steep category, so not all types of vehicles can pass it, and it requires good driver skills. The width of the road to tourist destinations, 2.5 m, can only be given by one vehicle. There cannot be two lanes to cross paths.

This work presented novel methods for an intelligent medium-sized vehicle for Kulon Progo nature tourism transportation. The proposed methods are a smart medium-sized bus with 18 seats consisting of 16 passenger seats, one driver seat and one tour guide seat that be equipped with CCTVs or video cameras (in the front, rear and inside the vehicle), GPS sensors on cars to monitor vehicle position and fuel consumption, motion sensors, GPS on mobile phones, RFID sensors and other types of IoT sensors. The proposed vehicle is feasible

to run if the load factor is 75% and the fare is IDR 200,000 per passenger because the BCR is 1.3118, the PBV is two years and 11 months and the IRR is 0.506491. With this result, the Kulon Progo local government can offer business opportunities in the transportation sector to carry out the proposed vehicle.

The three recommendations for the government are:

- (1) The Ministry of Communication and Information Technology is responsible for Optimizing Public Services through the Utilization of Information Technology for Smart Tourism Service, namely by increasing the speed and reliability of the Internet in tourist areas for IoT [49,50].
- (2) The Ministry of Public Works and Public Housing, Directorate General of Highways, is in charge of carrying out road management to carry out geometric road improvements, including reducing road slopes and widening to two lanes for cross lanes so that vehicle speed and safety can be better [51,52].
- (3) The Ministry of Tourism and Creative Economy promotes natural tourism along the YIA route to Borobudur and empowers communities in the Menoreh hills, so that the community's economy can rise after the COVID-19 pandemic [53,54].

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