Ringkasan penelitian tidak lebih dari 500 kata yang berisi latar belakang penelitian, tujuan dan tahapan metode penelitian, luaran yang ditargetkan, serta uraian TKT penelitian yang diusulkan.

SUMMARY

Mount Merapi, located on the border of the Special Region of Yogyakarta and Central Java, is one of the most active volcanoes in Indonesia. Since 1548 the volcano has erupted 68 times. The Merapi eruption in 2010 with a scale of VEI 4, produced materials of different sizes, from small (finer) to large size (boulder). The volume of material produced is estimated at 140 million m^3, equivalent to an eruption that occurred in 1822. The material has had an impact on several factors, one of the factors is morphological changes in rivers in the Merapi area. The morphological changes can be caused by the results of erosion and sedimentation processes due to pyroclastic flows and debris flows. In addition, the changes in river morphology can be caused by human activities, such as mining sand in a river channel. Monitoring changes in river morphology can be investigated with Digital Elevation Model (DEM) and remote sensing data. This study aims to determine morphological changes in rivers in the Mt. Merapi after the 2010 eruption and to determine a suitable sand mining capacity in the rivers on the Mt. Merapi area, especially in the Progo River. The research on river morphology changes is conducted by comparing the condition of rivers at different times. The data used are the 2012 DEM, the 2015 DEM, the results of digitization of Google Earth Pro and field surveys. To determine the capacity/volume of sand mining is done by field surveys and measurement of hydraulic parameters of the rivers. The output of this study is to determine changes in river morphology and suitable sand mining capacity in rivers in the Mount Merapi area. The target outputs are planned to publish in a Sinta indexed Journal (minimum Sinta 3) or a Scopus indexed proceeding or an International Journal. The proposed research is fundamental research. The results obtained can be used as input for the determination of river management policies in the Mount Merapi area, in the context of efforts to mitigate disasters caused by sediment. The level of Technology Readiness (Tingkat Kesiapan Teknologi (TKT)) of this study is TKT one (1) and the target TKT after the process / stage of the research is TKT two (2).

Keywords: 5 words

Mt Merapi; Eruption in 2010; River Morphology; DEM; Sand Mining Activity.

Latar belakang penelitian tidak lebih dari 500 kata yang berisi latar belakang dan permasalahan yang akan diteliti, tujuan khusus, dan urgensi penelitian. Pada bagian ini perlu dijelaskan uraian tentang spesifikasi khusus terkait dengan skema.

BACKGROUND

In Indonesia, there are 129 volcanoes that are still active. Therefore, volcanic eruptions often occur in Indonesia. Mount Merapi is one of the most active volcanoes in Indonesia, where eruptions can produce millions of cubic meters of hot volcanic material and gas with temperatures of 900º C - 1200º C. Since 1548, the volcano has erupted 68 times. In July 1998, a big eruption occurred and resulted in sedimentation in the upstream of Senowo River, Lamat River, Blongkeng River and Pakis River. In 2006, Mount Merapi erupted again and issued lava and sediments, mostly cold lava flowing into Kali Gendol. Mount Merapi erupted in 2010, releasing 140 million m^3 of eruption material, equivalent to the eruption of 1822. On October 26, 2010, Mount Merapi erupted and released hot clouds (nuee ardente) and pyroclastic materials such as gravel and sand. On November 4, 2010 a second eruption occurred, releasing 5 million m^3 of material with a range of 15 km. The risk of Mount Merapi is not only a primary hazard, but also a secondary hazard, namely cold lava/debris flow/lahar. The debris flows on Mount Merapi can occur due to steep slopes, so that when it rains, the erupted material deposited in the form of sand, gravel, and large rocks will be mixed with rainwater that flows down and debris flows/lahars occur. Based on estimates from the Meteorology and Geophysics Agency, the area around Mount Merapi is an area affected by land, so that it is expected to occur rain with quite high rainfall. Therefore, the eruption material eruption has the potential to flow downward because it is carried by rainwater and flows through rivers to downstream during the rainy season. On November 7, 2010, the debris flow/lahar of Mount Merapi damaged 2 check dam units located in Kali Putih. On December 9, 2010, a debris flow in the peak area of Mount Merapi caused 9 bridge bridges between Yogyakarta and Magelang to be slightly and moderately damaged. The above incident is shown in Figure 1. A debris flow that occurred in December 2010 also flooded the settlements in Ngepringan Hamlet, Wukirsari Village, Cangkringan District, Sleman Regency. This incident repeated for several years after the eruption.

If not properly anticipated, cold lava flooding at Mount Merapi can cause disaster for the community and damage the surrounding facilities. In addition, cold lava floods or pyroclastic flows can change environmental conditions, especially river morphology (river physical condition). In addition, cold lava floods produce an abundant source of sediment for the rivers in this area. This material is used by residents as a source of material through sand mining activities. This mining activity has a positive impact, such as providing employment, increasing income and reducing the amount of sediment in the river, so that the river has a reservoir in controlling sediment disasters. But on the other hand, sand mining activities can cause losses if not controlled properly, such as the emergence of serious river degradation, threatening the stability of water structures and so forth. In addition, sand mining activities will also have an impact on changes in river morphology. To determine the impact of cold lava floods and sand mining activities, it is necessary to study the changes in river morphology and safe sand mining activities. The purpose of this study was to determine the morphological changes of rivers in the Mount Merapi region and the determination of safe sand mining capacity in terms of hydraulic aspects. The innovation of this research is to provide information on the impact of cold lava floods, especially on the phenomenon of degradation and aggradation. In addition, this research also tries to determine the capacity / volume of safe sand mining in terms of river stability or disaster management aspects.

Tinjauan pustaka tidak lebih dari 1000 kata dengan mengemukakan *state of the art dan* peta jalan (*road map*) dalam bidang yang diteliti. Bagan dan *road map* dibuat dalam bentuk JPG/PNG yang kemudian disisipkan dalam isian ini. Sumber pustaka/referensi primer yang relevan dan dengan mengutamakan hasil penelitian pada jurnal ilmiah dan/atau paten yang terkini. Disarankan penggunaan sumber pustaka 10 tahun terakhir.

(a) (b)

Fugure 1. (a) A Damage *Check dam* in Putih River, (b) Deposited Sediment in Salam Sub District, Magelang Regency

LITERATURE REVIEW

Mt. Merapi Eruption in 2010

The Mt Merapi eruption in 2010 is the largest VEI 4 scale eruption during the 20th to 21st centuries (Surono et al. 2012; Pallister et.al, 2013; Jenkins, et.al, 2013). The last eruption with VEI 4 occurred in 1872 (Surono et al. 2012; Pallister et.al, 2013; Jenkins, et.al, 2013). The eruption phase in 2010 can be divided into 4 phases: 1) Intrusion Phase (31 October 2009 - 26 October 2010) marked by an increase in seismic activity, temperature and gas emissions (CO_2, and H_2S); (2) Initial explosion phase (October 26 - November 1, 2010) is marked by the formation of an eruption column and sulfate gas release; The Magmatic Phase (1 - 7 November 2010) is characterized by the formation of lava domes which rapidly reach 25 m^3/s; and Declining Phase (8 - 23 November 2010) is characterized by a decrease in the intensity of seismic activity (Surono et al. 2012; Pallister et.al, 2013). The volume of eruptions released through the PDC mechanism is between 30-60 x 106 m3 (Surono et al., 2012; Komorowski et al., 2013; Charbonnier et al., 2013; De Belizal et.al, 2013). During this incident recorded around 400,000 people were evacuated in the period between 25 October 2010 to 3 December 2010 (May et.al, 2013; Jenkins et.al, 2013).

Debris Flows/Lahar in Mt. Merapi Area

Lavigne, et al. (2003) conducted a study to describe why debris flows are one of the main risks caused by Mount Merapi. Aisyah and Purnamawati, (2012) conducted a study to find out the impact caused by the debris flows due to the eruption of Mount Merapi in 2010. Puspitosari and Sumaryono, (2011) conducted a study to find out the damage that occurred in Sabo buildings due to debris flows in Merapi area the post Merapi eruption in 2010, where 77 sabo buildings were damaged. Munawaroh and Widiyanto, (2013) conducted a study to determine the level of danger of lahar and the distribution of damage that occurred in sediment control structures, infrastructure, settlements and agricultural land of Putih River after the eruption of Mount Merapi in 2010. Widagdo and Hadmoko, (2015) conducted research for investigation the morphological changes of Kali Putih after the 2010 Merapi eruption and the effects on the surrounding environment.

Figure 2. A Debris Flow in Putih River, Magelang Regency

River Morphology

Morphology (Morpologie) comes from the Greek language morpe which means form and logos which means knowledge; thus, morphology means the study of form. River morphology is the study of river shape changes, a more specific explanation of river morphology is that it concerns the geometry (shape and size), type, nature and behavior of the river with all aspects of its change in the dimensions of space and time. Thus, the dynamic nature of the river and its environment are interrelated. Hadmoko et. al (2013), have conducted a research related impact of debris flow on river morphological change in Pabelan River, Magelang. The research used DEM Data of 2006 and DEM Data of 2012. Based on the result, the debris flow made the deposition and erosion on the river. Dipayana et. al (2013) also done research related impact of debris flow in Gendol River, Sleman Regency. Based on the result, it showed that the river cross section are wider due to debris flows impacts.

Sand Mining Activity

The increasing demand for sand for infrastructure development has resulted in uncontrolled mining activities in the rivers on Mt. Merapi area. Mining of type C after the eruption of Mount Merapi was conducted in the river channel and paddy fields. Mining in the river channel has been exhausted since 2015. Socio-economic sand mining has caused the majority of people to depend on mining activities. This condition resulted in the expansion of the mining area in the rice field area which is on the edge of the river. The negative impact of this sand mining activity is the reduced agricultural land as well as the destruction of river-equivalent areas which should be a water protection area. By removing sediment from the active channel bed, in-stream mines interrupt the continuity of sediment transport through the river system, disrupting the sediment mass balance in the river downstream and inducing channel adjustments (usually incision) extending considerable distances (commonly 1 km or more) beyond the extraction site itself. The magnitude of the impact basically depends on the magnitudes of the extraction relative to bed load sediment supply and transport through the reach (Kondolf et al., 2001). Therefore, there is an urgent need to identify appropriate policy guidelines that guarantee environmental protection with minimum regulatory costs and high levels of public cooperation (Gunaratne, 2010).

Research Road Map

The research is carried out to be in line with the university's research road map in the field of disaster, as shown in Figure 3 below:

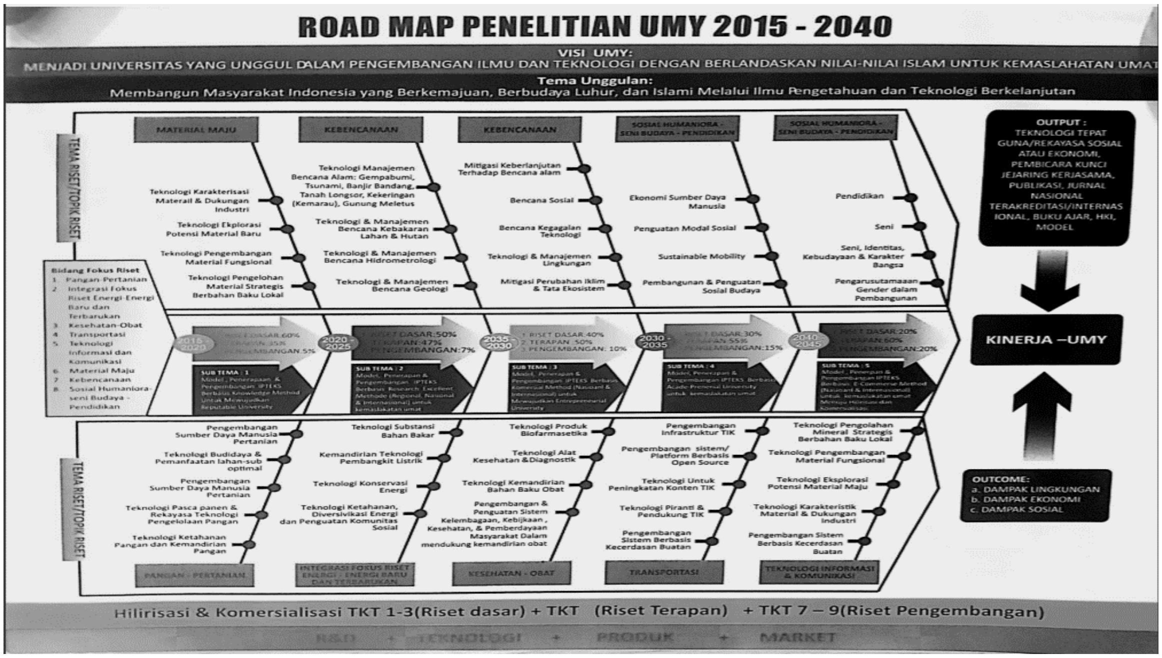


Figure 3. Research Road Map of UMY 2015-2040

This study is also in line with the 2015-2025 research road map of UMY Civil Engineering on the topic of floods and debris flow as shown in Figure 4.

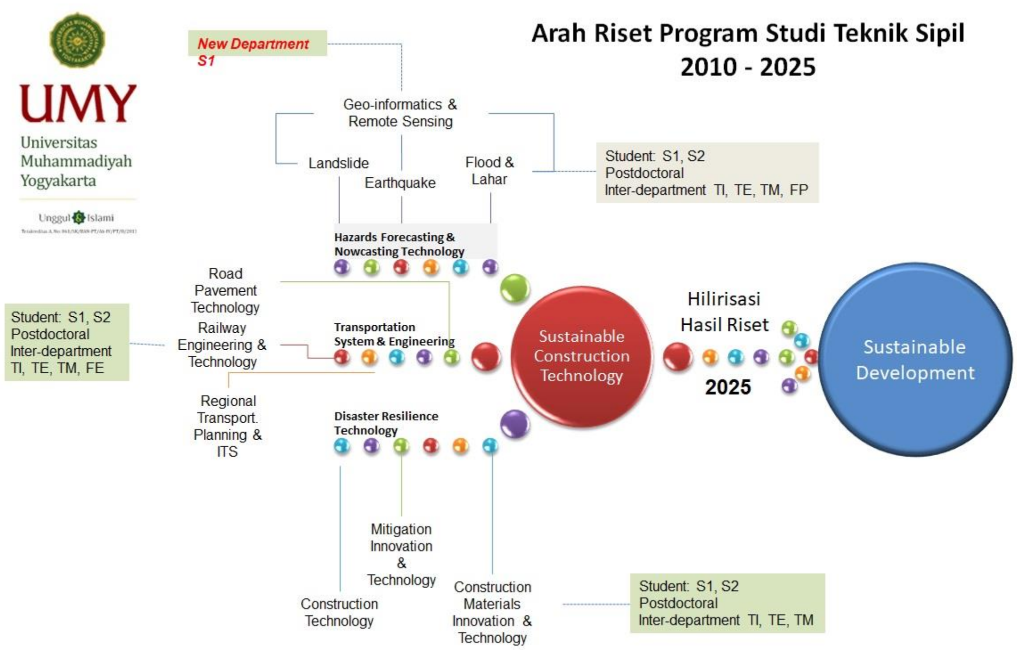


Figure 4. *Roadmap* research of Department of Civil Engineering UMY 2010-2025

The research has the main objective of arrangement disaster management policies in areas affected by cold lava, specifically the impact on the river environment and the management of sediment resources, especially sand mining. The study was divided into two stages. The first stage, monitoring the morphological changes of the eruption psca river, and the second phase examines the sand mining activities and determining the permitted mining capacity / volume. A map of the step research plan is presented in Figure 5.

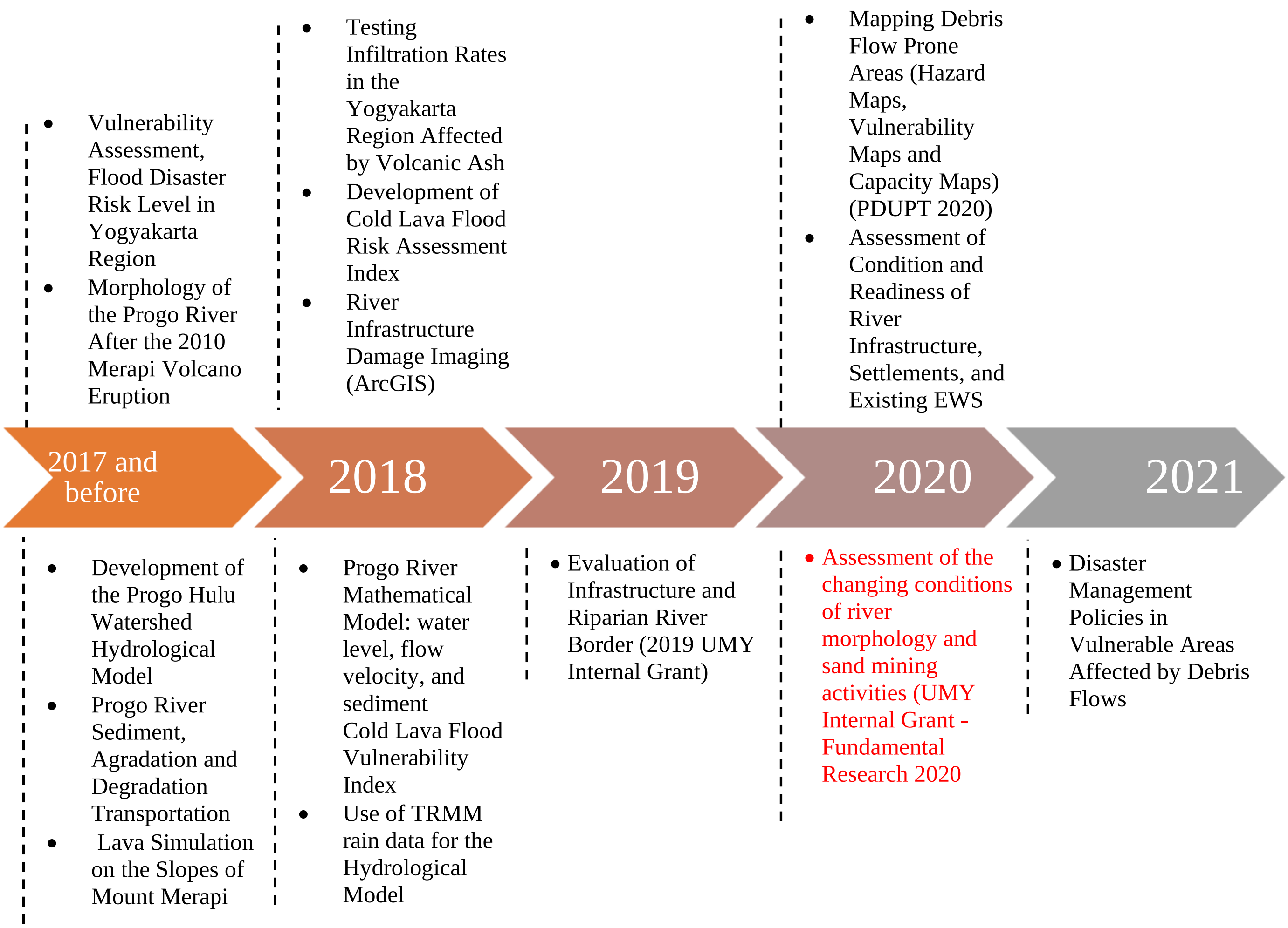


Figure 5. The road map research

Metode atau cara untuk mencapai tujuan yang telah ditetapkan ditulis tidak melebihi 600 kata. Bagian ini dilengkapi dengan diagram alir penelitian yang menggambarkan apa yang sudah dilaksanakan dan yang akan dikerjakan selama waktu yang diusulkan. Format diagram alir dapat berupa file JPG/PNG. Bagan penelitian harus dibuat secara utuh dengan penahapan yang jelas, mulai dari awal bagaimana proses dan luarannya, dan indikator capaian yang ditargetkan. Di bagian ini harus juga mengisi tugas masing-masing anggota pengusul sesuai tahapan penelitian yang diusulkan.

METHOD

Research Location

The study is focused on rivers that originated at Mount Merapi and flow through DI Yogyakarta. The research location can be seen in Figure 6.

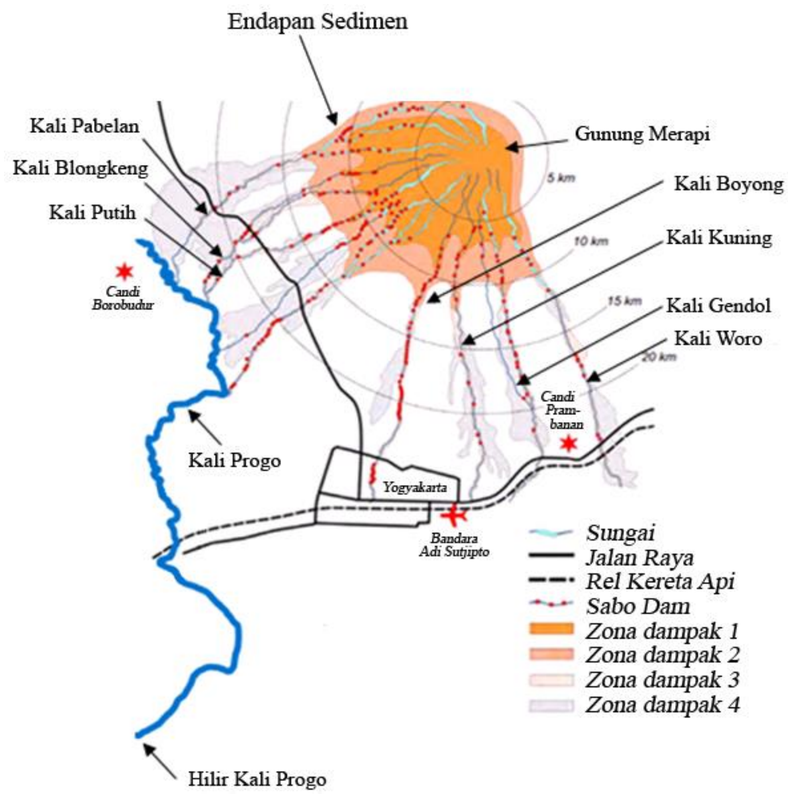
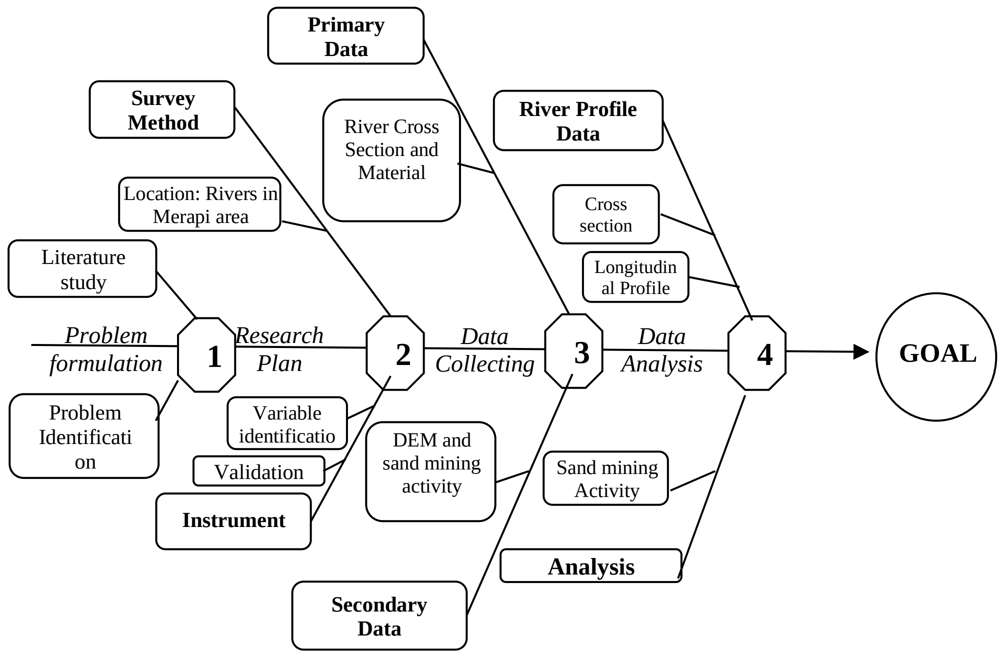


Figure 6. Research Location Map

Research Method

This research is conducted to determine the morphological changes of rivers in the Mount Merapi area caused by lava floods or sand mining activities. In addition, this study was also conducted to determine the mining activities of sand and the potential capacity / volume of mining that is still permitted. To find out the change in river morphology, it is based on Digital Evaluation Model (DEM) and remote estimation (JP) data. DEM data used are the results of LIDAR (Light Detection and Ranging) measurements in 2012, DEM from Digital Globe Satellite (2015) and DEM from Google Earth Pro. From the DEM data, a morphological change projection is made for the cross section changes and cross river profile. From the results of these projections it can be seen that riverbed agradation-degradation and river bank erosion-sedimentation. The projection process for the transverse and longitudinal profile of the river is also assisted with the results of imagery from Google Earth Pro for 2012, 2015 and 2020. Results from projections based on digital data, will be confirmed by field surveys for several sample points reviewed. This survey will also take samples of materials that are in the sample points that are reviewed for grading tests in the laboratory. Monitoring of sand mining activities is carried out with secondary data from several sources. To determine the permissible sand mining potential, carried out by hydraulic measurements or based on the results of projections from DEM and Google Erath Pro. The flowchart of the study is shown in Figure 7.



Gambar 7. Research steps

The output from this research is information about changes in river morphology and sand mining activities / potential sand mining capacity. In addition, the results of the research outcomes are planned to be submitted and published in Scopus Indexed Proceedings (ICETIA) or International Journal (Journal of Engineering Research, indexed as Scopus Q4) (Table 1). The level of Technology Readiness (TKT) of this study was TKT one (1) and the target TKT after the process / stage of the research was TKT two (2). The division of tasks from research members is shown in Table 2.

Table 1. Output Research Plan

No	Output				Year	
	Catagory	Sub Catagory	Mandatory	Additional	TS	TS+1
1	Journal paper	Accredited Journal		v	Submitted	Accepted
2	Proceeding paper	International Seminar	v		Published	
3	TKT				1	2

Table 2. Name, position dan task in the research

No	Name	Postion	Task
1	Jazaul Ikhsan, ST., MT., Ph.D	Leader	Coordinate all stages of the study, including draft publications and reports
2	Ani Haerani, ST., M.Eng	Member 1	DEM data processing
3	Dr Mohd Remy Rozainy (Universiti Sains Malaysia)	Member 2	Hydraulic measurement and analysis potential sand mining capacity
4	CITRA IKAVENI SHADILA (NIM 20160110064)	Student	Data processing and survey
5	SYAFIRA RAMADHANI NASTI (NIM 20160110098)	Student	Data processing and survey
6	ULFA INTAN RAHMAWATI (NIM 20160110104	Student	Data processing and survey
7	CHINTIA NUGRAHENI (NIM 20160110117)	Student	Data processing and survey

Jadwal penelitian disusun dengan mengisi langsung tabel berikut dengan memperbolehkan penambahan baris sesuai banyaknya kegiatan.

SCHEDULE

No	Activity	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Problem formulation: a. Literature study b. Problem identification												
2	Research Plan: a. Survey Method b. Instruments c. Software is used												
3	Collecting Data: a. Primary Data: sediment, cross section, field projections, sand mining ans hydraulic measurement for suitable sand mining capacity b. Secondary Data: DEM LIDAR, DEM Global Satellite, Google Earth Pro												
4	Analysis												
5	Report and publication												

Daftar pustaka disusun dan ditulis berdasarkan sistem nomor sesuai dengan urutan pengutipan. Hanya pustaka yang disitasi pada usulan penelitian yang dicantumkan dalam Daftar Pustaka.

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