



# LAHAR RISK MAPPING OF BANAHAW VOLCANO, SOUTHERN LUZON USING LAHARZ



**Zaballero, R.D.\* , Belmonte, S.K.\* , Binwag, M.L.\* , & Herras, J.\* ,**

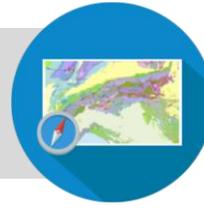
\*Mining, Geology and Ceramic Engineering Department, College of Engineering, Adamson University, Ermita, Manila

**Thesis Adviser: Dr. Ma. Mylene M. Villegas**



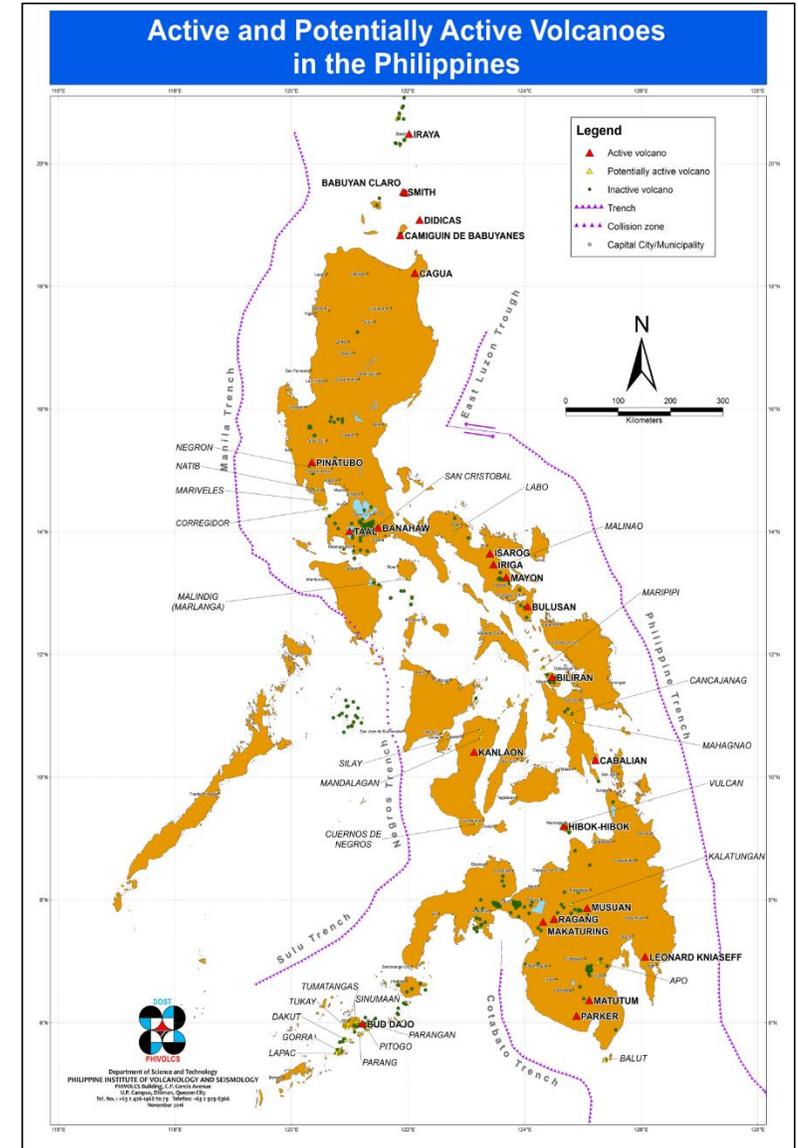
# INTRODUCTION

# BACKGROUND



- Banahaw Volcano is considered as one of the Philippines's 24 active volcanoes (PHIVOLCS, December 2017).
- Geographic Information System (GIS) tools are useful and have great potential in assessing volcanic hazards (Yeats, 2014).

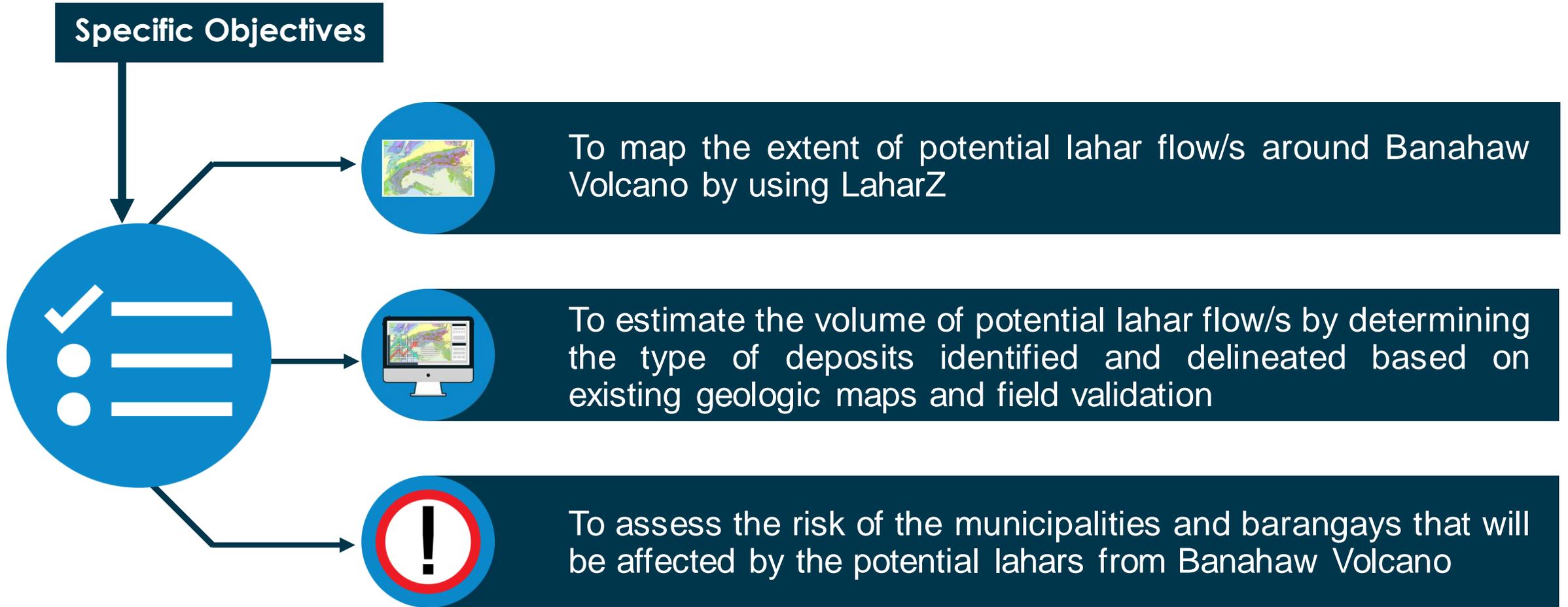
Figure 1. Active and Potentially Active Volcanoes in the Philippines. From DOST-PHIVOLCS, November 2016.



# OBJECTIVES OF THE STUDY



## Specific Objectives

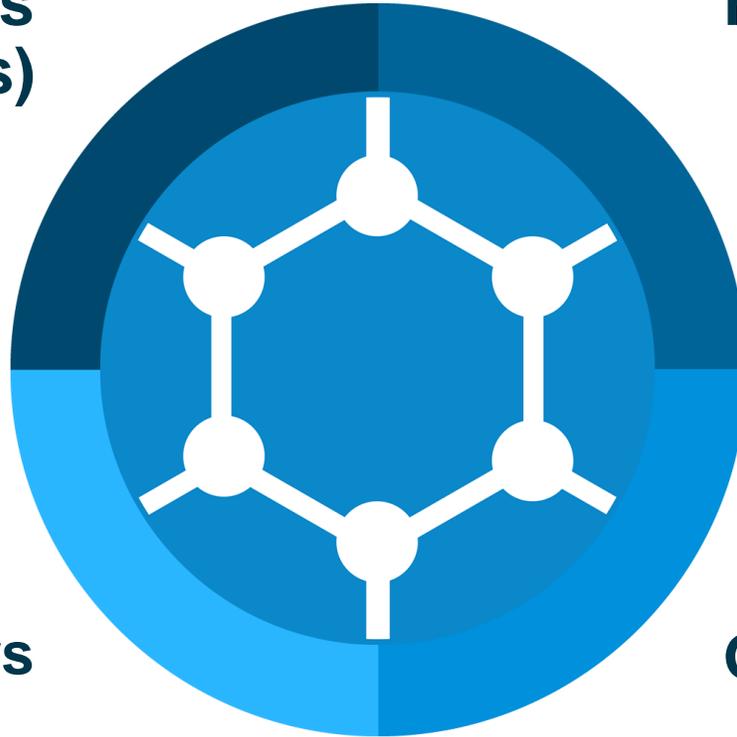


# SIGNIFICANCE OF THE STUDY



**Local Government Units  
(LGUs)**

**Field of Geology**



**Future Researchers**

**General Public**

# LIMITATIONS



- Risk assessment based on population and land area
- Results were limited to syn-eruption lahar
- Buildings and infrastructures were not considered
- Sampling was limited along the volcano's gully
- Volume of lahar input in LaharZ was limited to 10,000,000 to 50,000,000m<sup>3</sup>
- SRTM 3-Arc Second Global



# **REVIEW OF RELATED LITERATURE**

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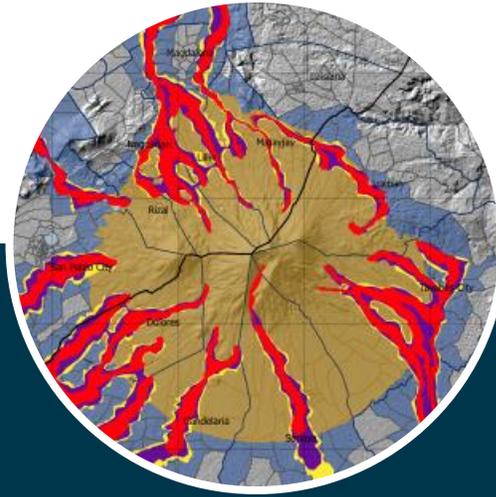
# LITERATURE REVIEW



**Banahaw Volcano**



**Lahar**



**Hazard-modelling  
using GIS**



**Risk assessment  
on volcanic  
hazards**

# CONCEPTUAL FRAMEWORK

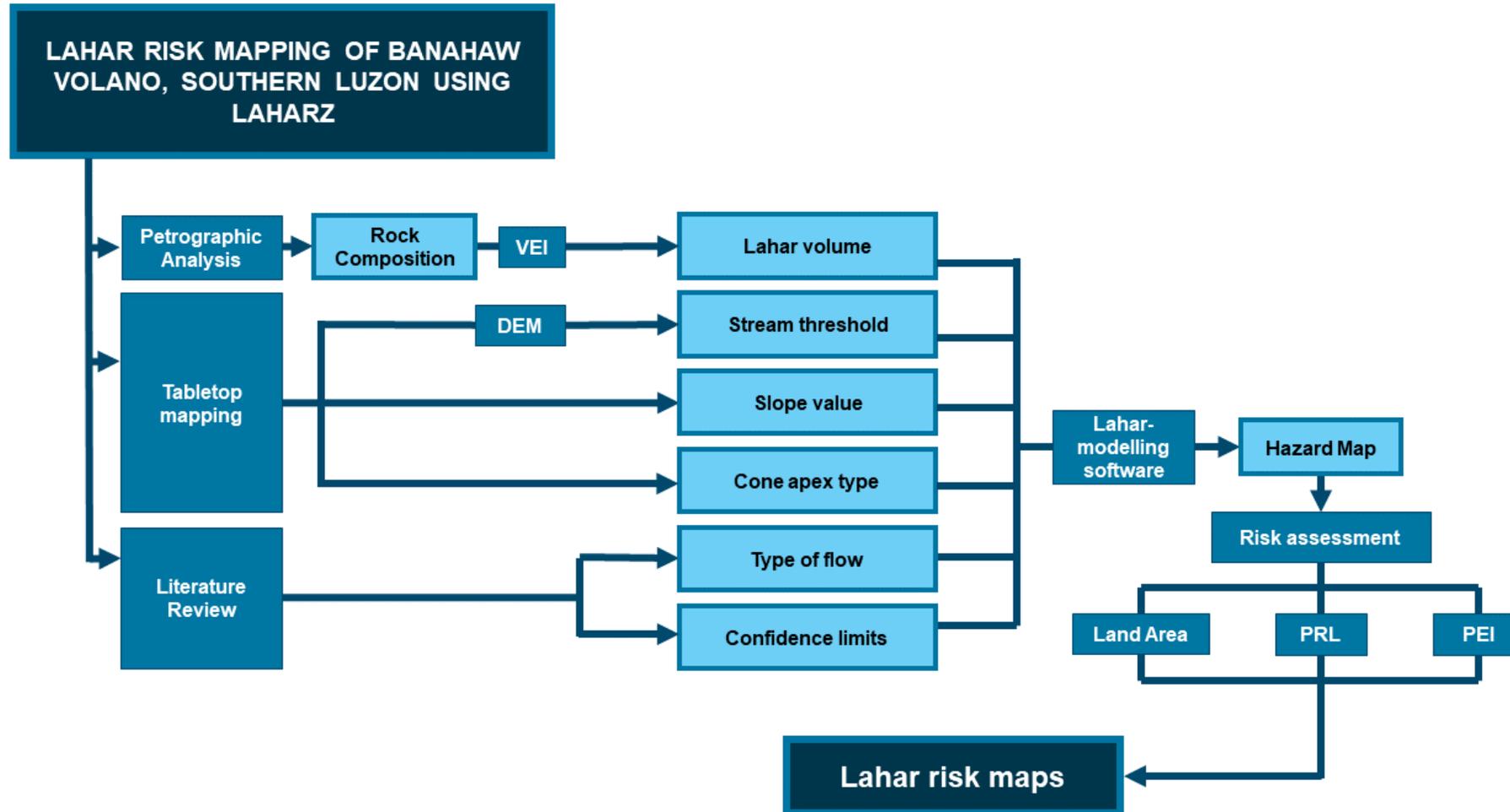
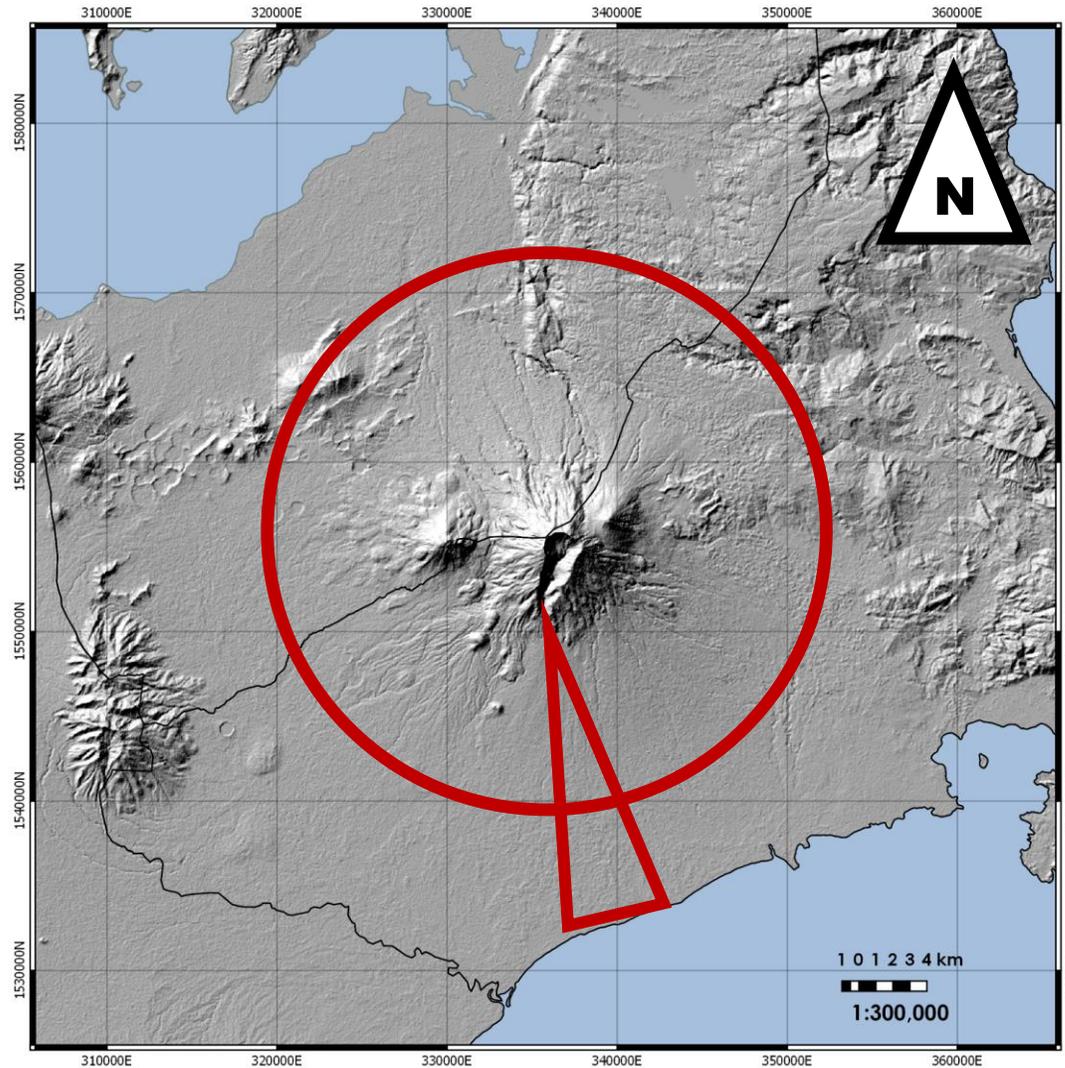


Figure 2. Conceptual Framework of the study

# HYPOTHESIS



**VOLCANO  
HAZARD LEVEL:**

**1-2**

# METHODOLOGY

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# STUDY AREA

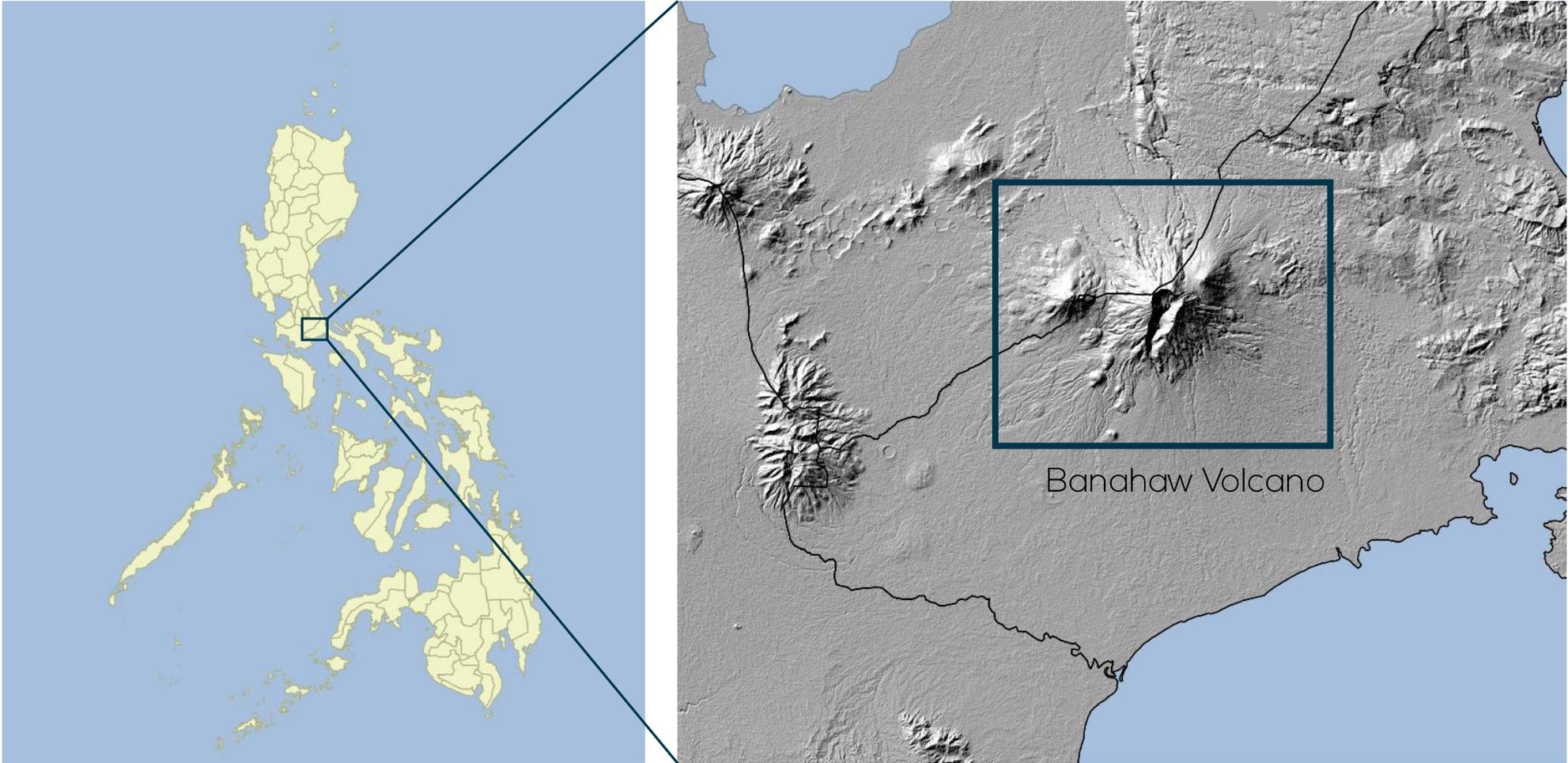


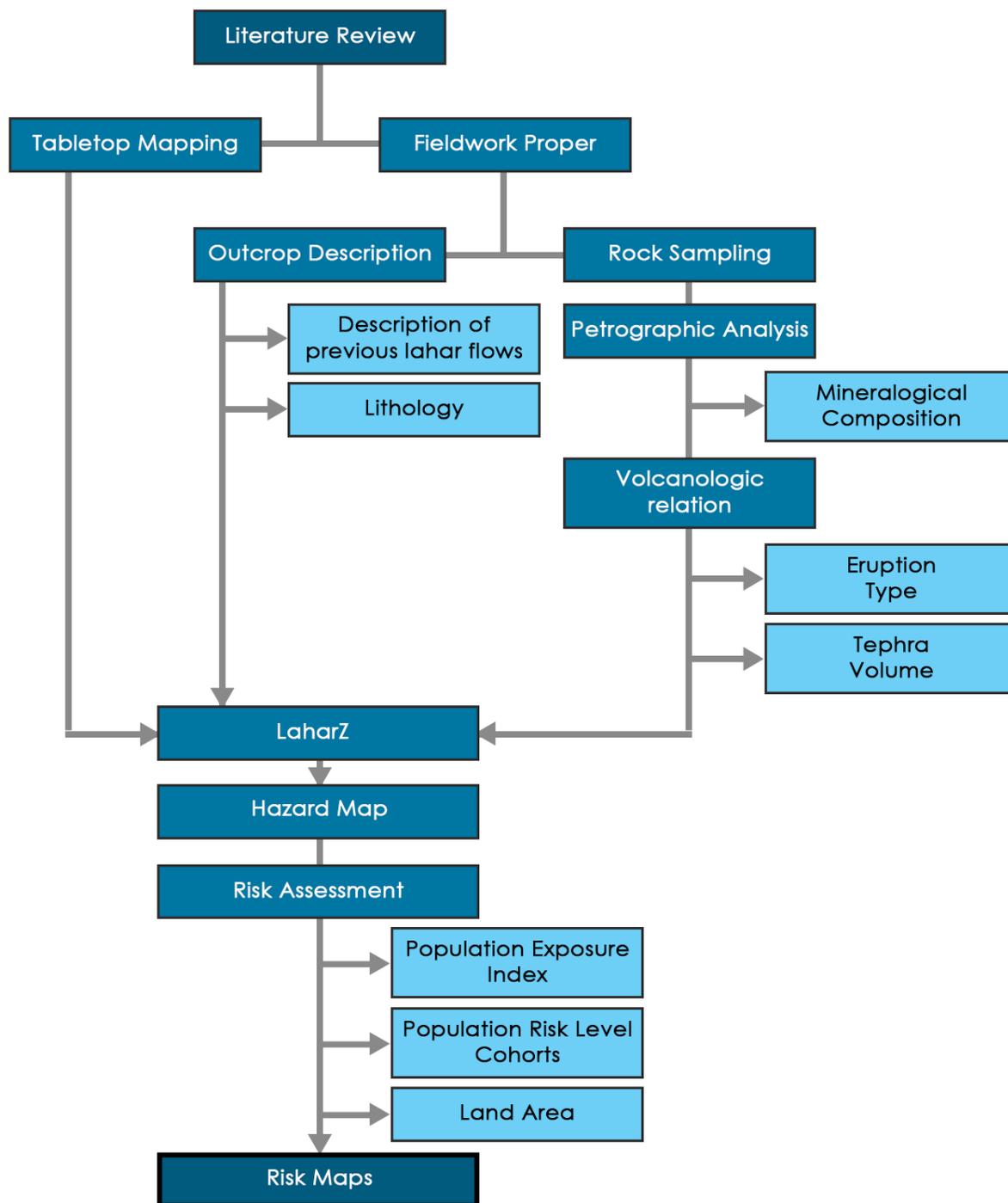
Figure 3. Study area

# METHODOLOGY



- Quantitative research
- A methodology designed to correlate data gathered in the outcrop description and samples collected with the existing geologic and hazard maps to produce risk maps of Banahaw volcano.

Figure 4. Flowchart showing methodology of the study





# RESULTS AND DISCUSSION

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# FIELD OBSERVATIONS

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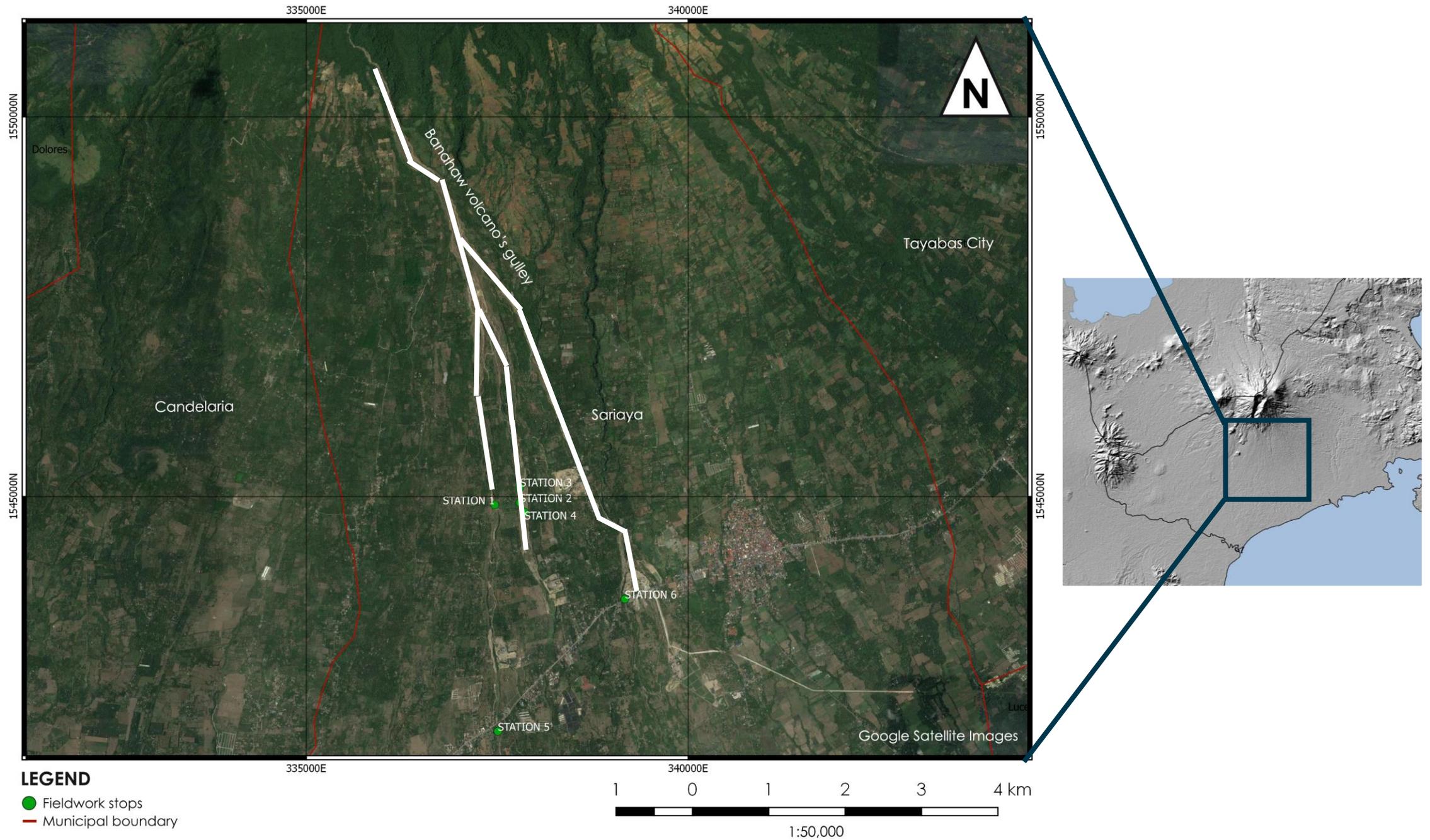


Figure 8. Map showing the stations where samples were collected.

# FIELD OBSERVATIONS





Figure 9. Station 1

- The walls along the gulley had been observed to have a coarsening upward sequence
- The field ID for the rocks were identified as Andesite Porphyry

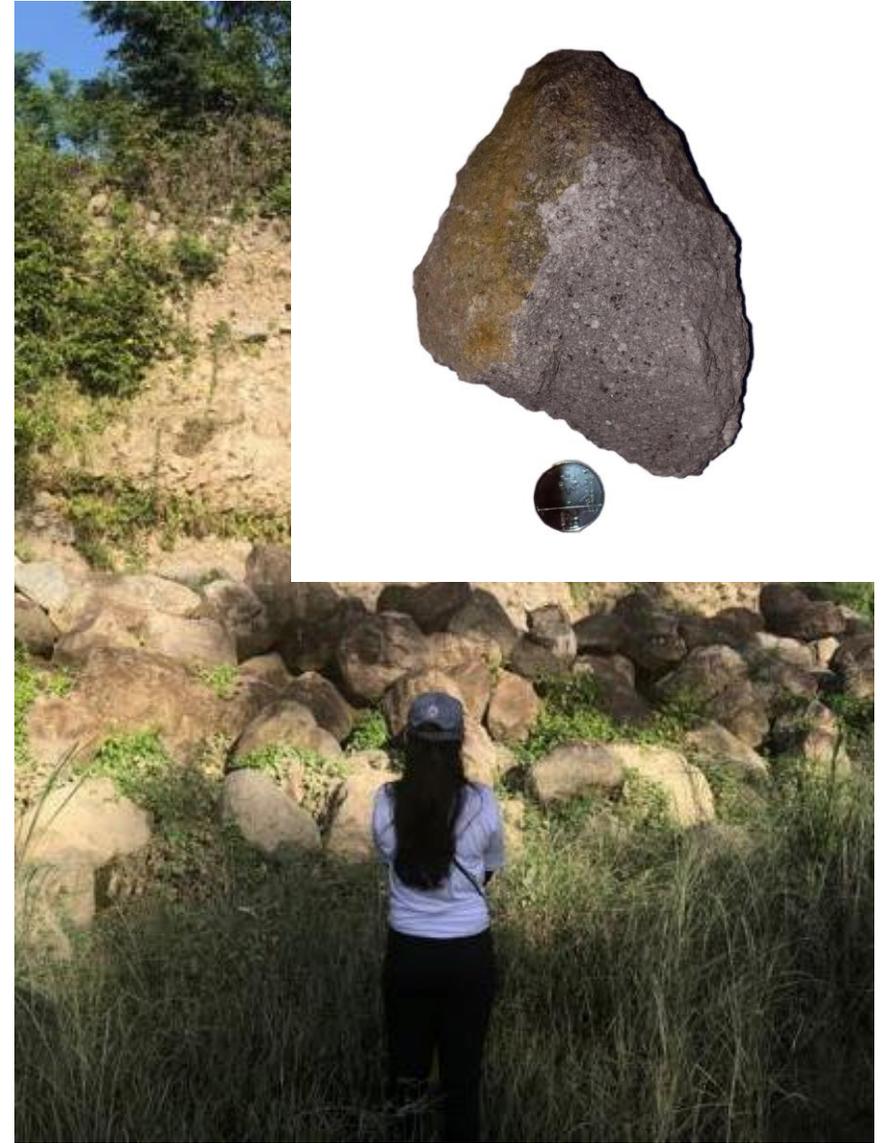
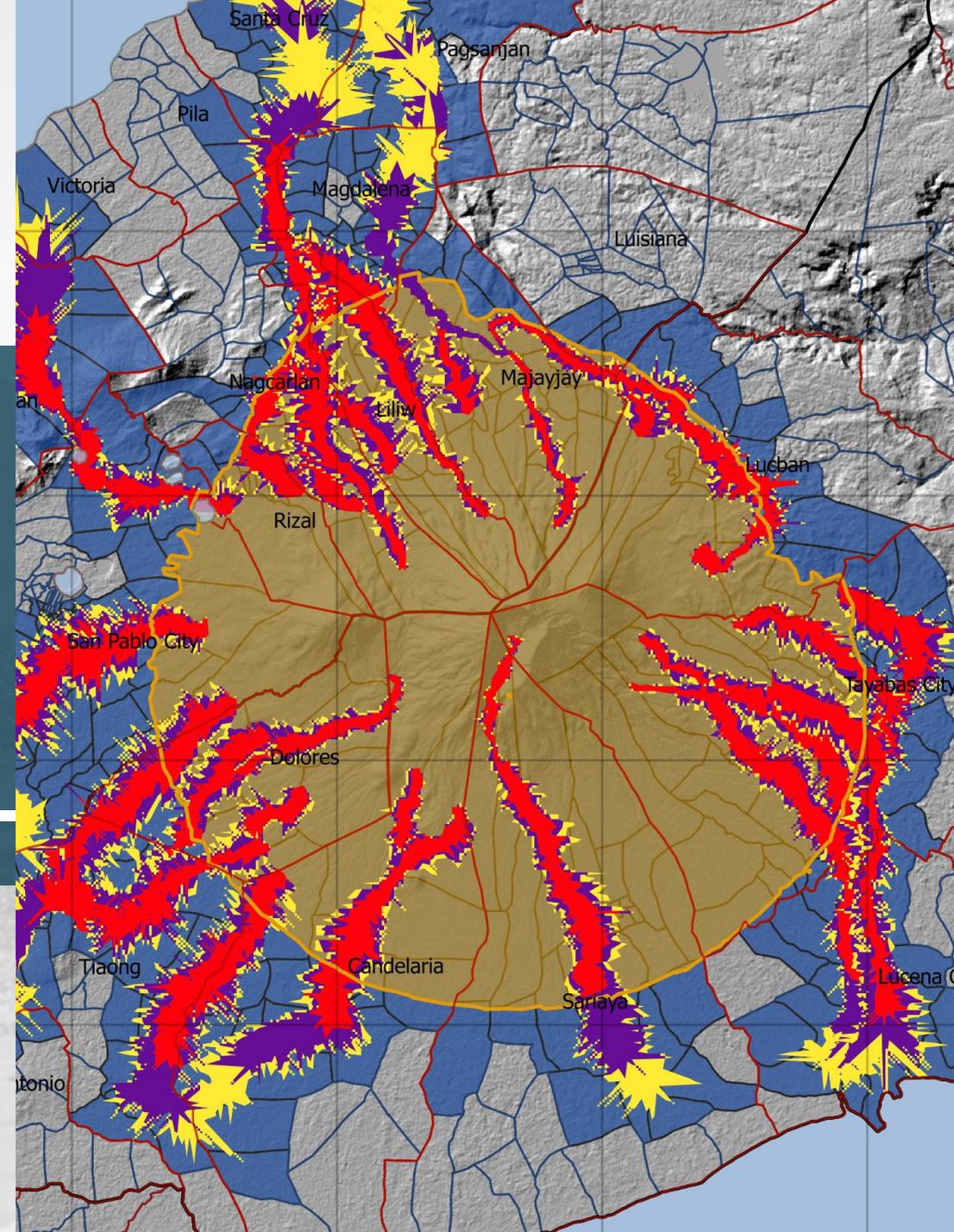


Figure 10. Station 2

# LAHARZ

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# LAHARZ



ArcGIS

LaharZ

Proximal  
Hazard Zone

Proximal Hazard Zone

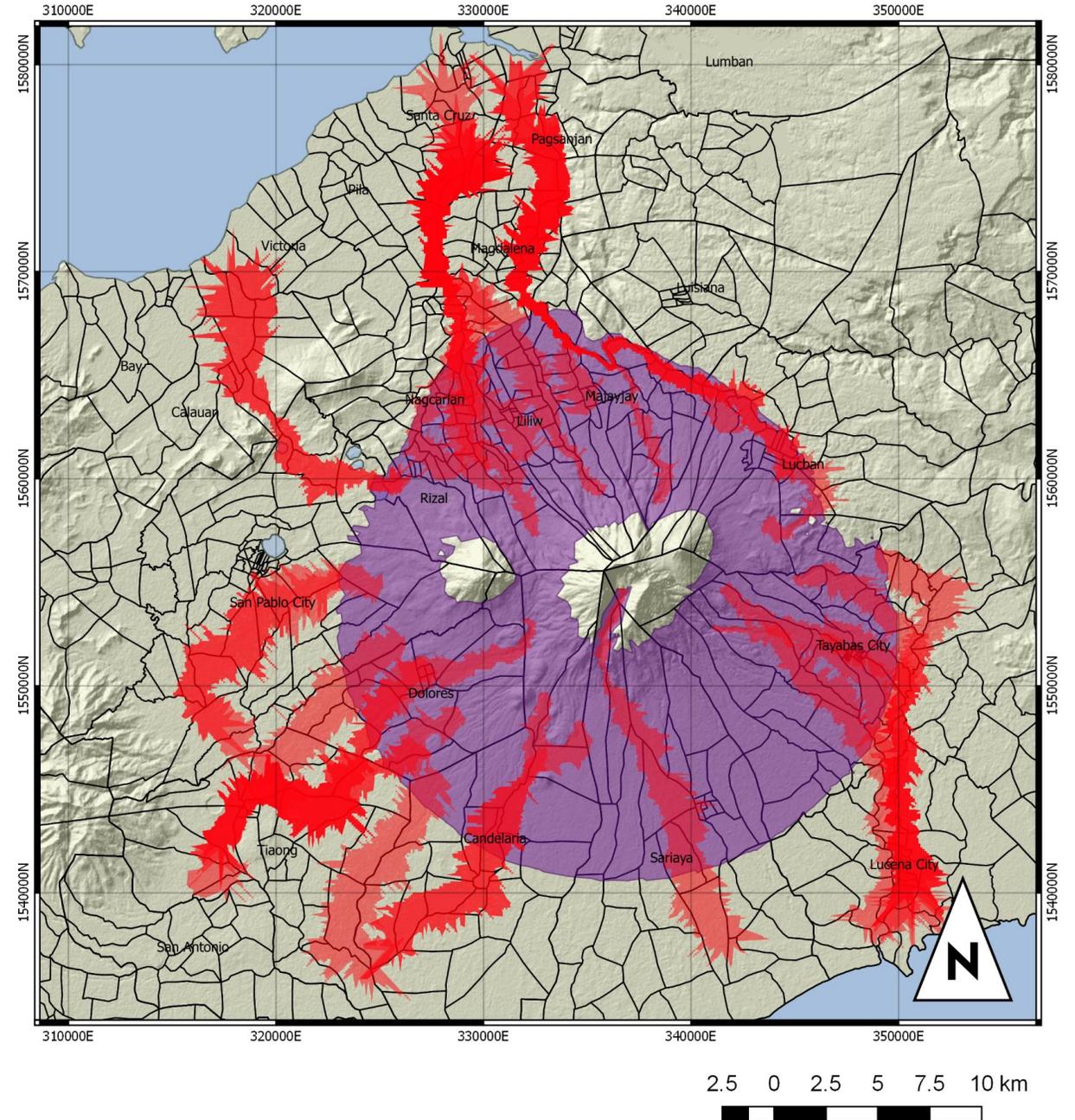
Distal Hazard Zone

Preliminary  
Hazard Map

Distal Hazard Zone

- Defined by the lahar path with a volume ranging from 10,000,000 to 50,000,000m<sup>3</sup>

Figure 5. Preliminary Hazard map



# Preliminary Lahar Hazard Map

\*Shows affected barangays

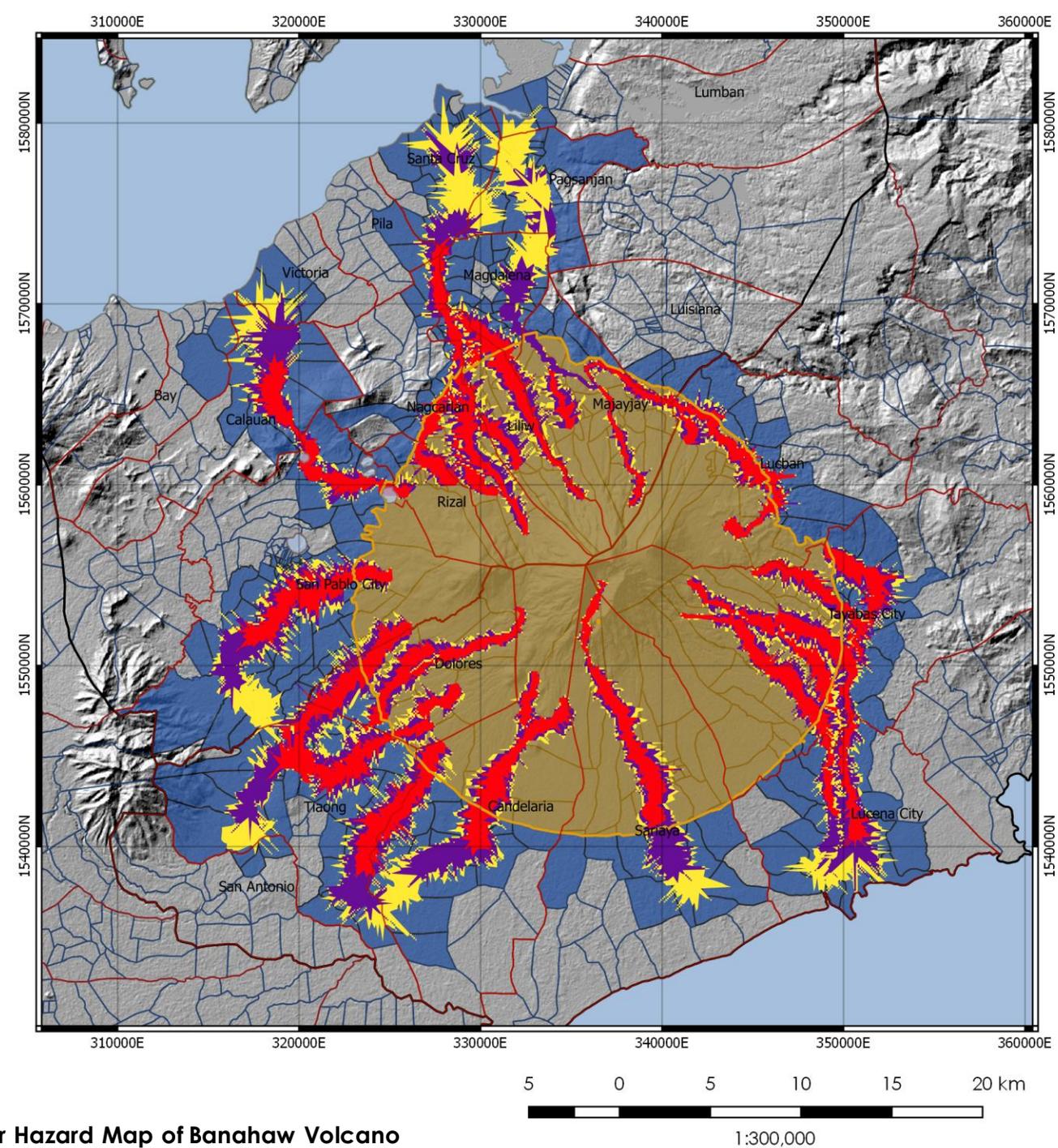


Figure 6. Preliminary Lahar Hazard Map of Banahaw Volcano

# Refined Preliminary Lahar Hazard Map

\*Shows affected district

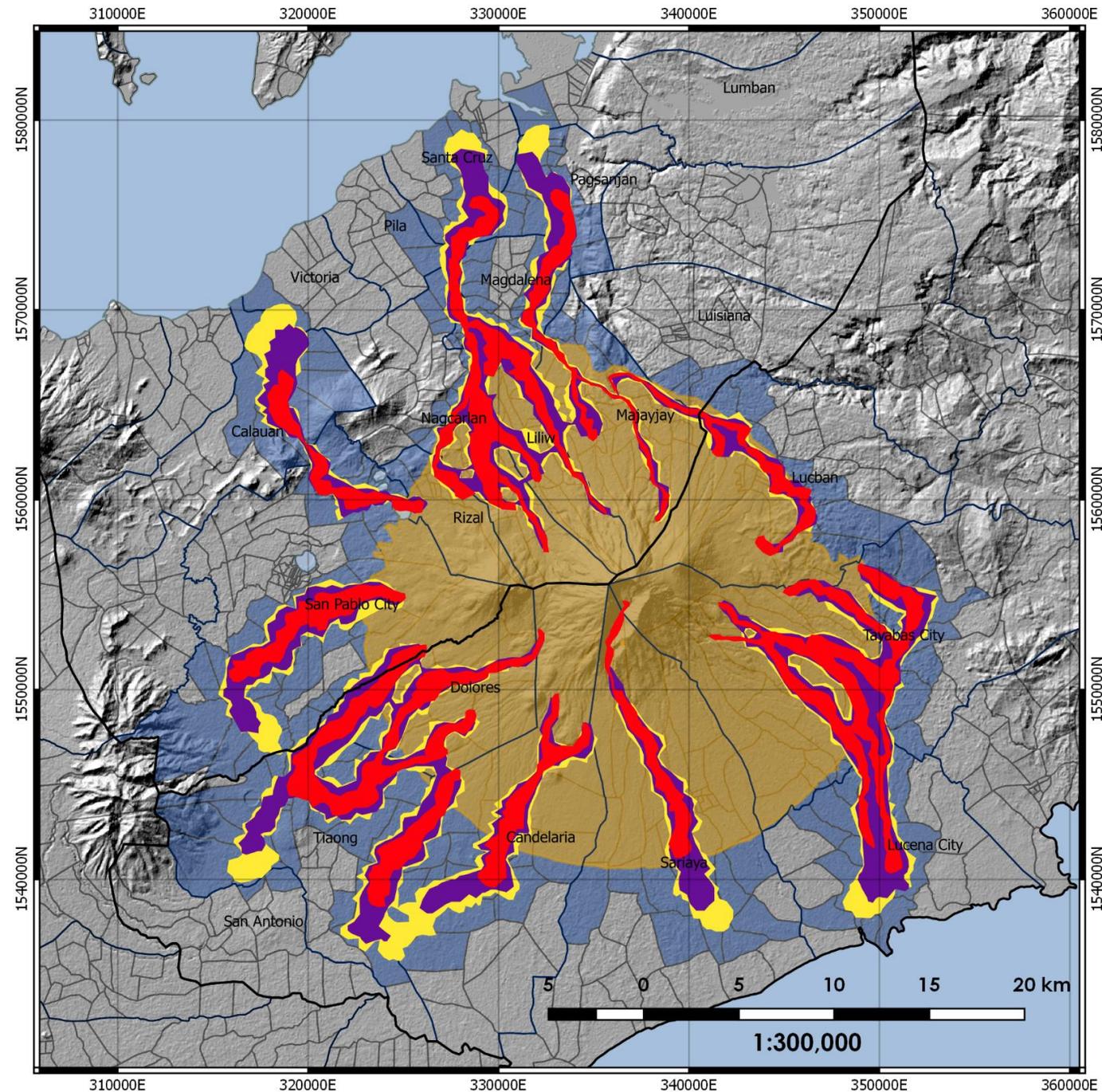


Figure 13. Preliminary Lahar Hazard Map of Banahaw Volcano

# Risk assessment through PEI and PRL

Weighted Summed Population	Population Exposure Index
0	0
<3,000	0.5
3,000 – 9,999	1
10,000 – 29,999	1.5
30,000 – 99,999	2
100,000 – 300,000	2.5
>300,000	3

**Table 1. Population Exposure Index (PEI)**

Source: From GFDRR, Volcano Risk Study: Volcano Hazard and Exposure in GFDRR Priority Countries and Risk Mitigation Measures, p. 19 by Aspinall, W., et al., University of Bristol.

Population Exposure Index	Volcano Hazard Level		
	1	2	3
0, 0.5	1	1	1
1	1	2	2
1.5	1	2	3
2	2	2	3
2.5, 3	2	3	3

**VOLCANO HAZARD LEVEL:**

- 1 – Lowest hazard and uncertainty
- 2 – Moderate hazard and uncertainty
- 3 – Highest hazard and uncertainty

**Table 2. Population Risk Level (PRL) cohorts**

# Risk assessment through PEI and PRL

FACTOR	CERTAIN	RANGING	UNCERTAIN
Volcano type	1		
Crater lake/Snow cap	1		
Pyroclastic flow hazard	1		
Lahar hazard	1		
Lava flow hazard		2	
Number of subfeatures			3
Maximum VEI		2	
Eruption frequency		2	
Exact Volcano Hazard Level			1.625
Apparent Volcano Hazard Level			<b>2</b>

Table 3. Scoring of factors determining Volcano Hazard Level. From GFDRR, *Volcano Risk Study: Volcano Hazard and Exposure in GFDRR Priority Countries and Risk Mitigation Measures*, p. 18 by Aspinall, W., et al., University of Bristol.

# Risk assessment through PEI and PRL

	Volcano Hazard Level		
Population Exposure Index	1	2	3
0, 0.5	1	1	1
1	1	2	2
1.5	1	2	3
2	2	2	3
2.5, 3	2	3	3

## VOLCANO HAZARD LEVEL:

- 1 – Lowest hazard and uncertainty
- 2 – Moderate hazard and uncertainty
- 3 – Highest hazard and uncertainty

# Preliminary Lahar Risk Map

Based on population of affected districts

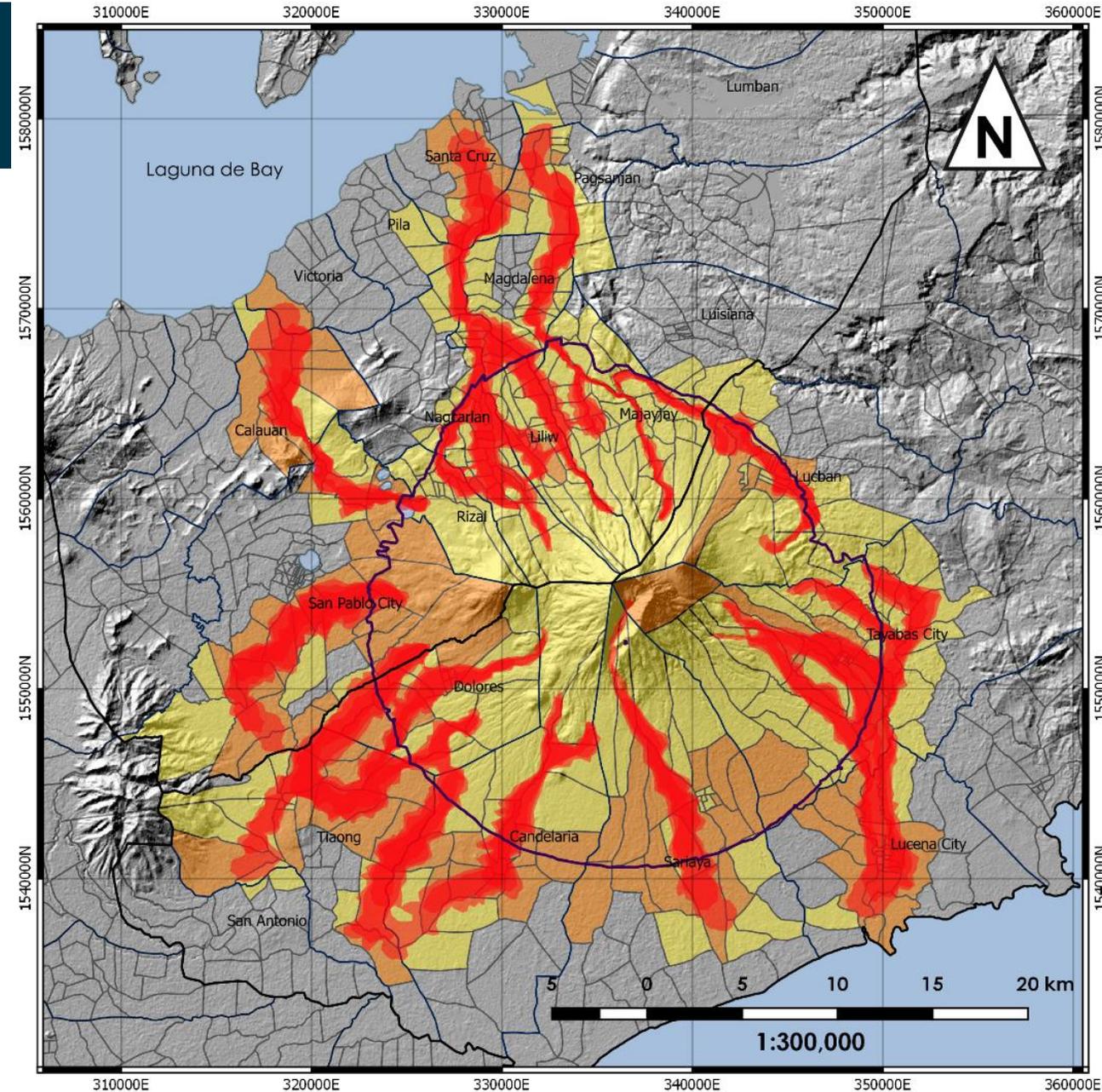


Figure 14. Preliminary Lahar PRL Risk Map of Banahaw Volcano.



# SUMMARY AND CONCLUSION

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# CONCLUSION



- Banahaw Volcano's VEI ranges from 2-4 due to its andesitic composition
- The lahar flow path traversed and affected 22 municipalities and 456 barangays.
- Comparing with existing geologic and lahar hazard maps, most of the lahar paths conformed, while new paths were created.
- The risk levels of the affected barangays ranged from 1-2 due to having a Volcano Hazard Level 2.

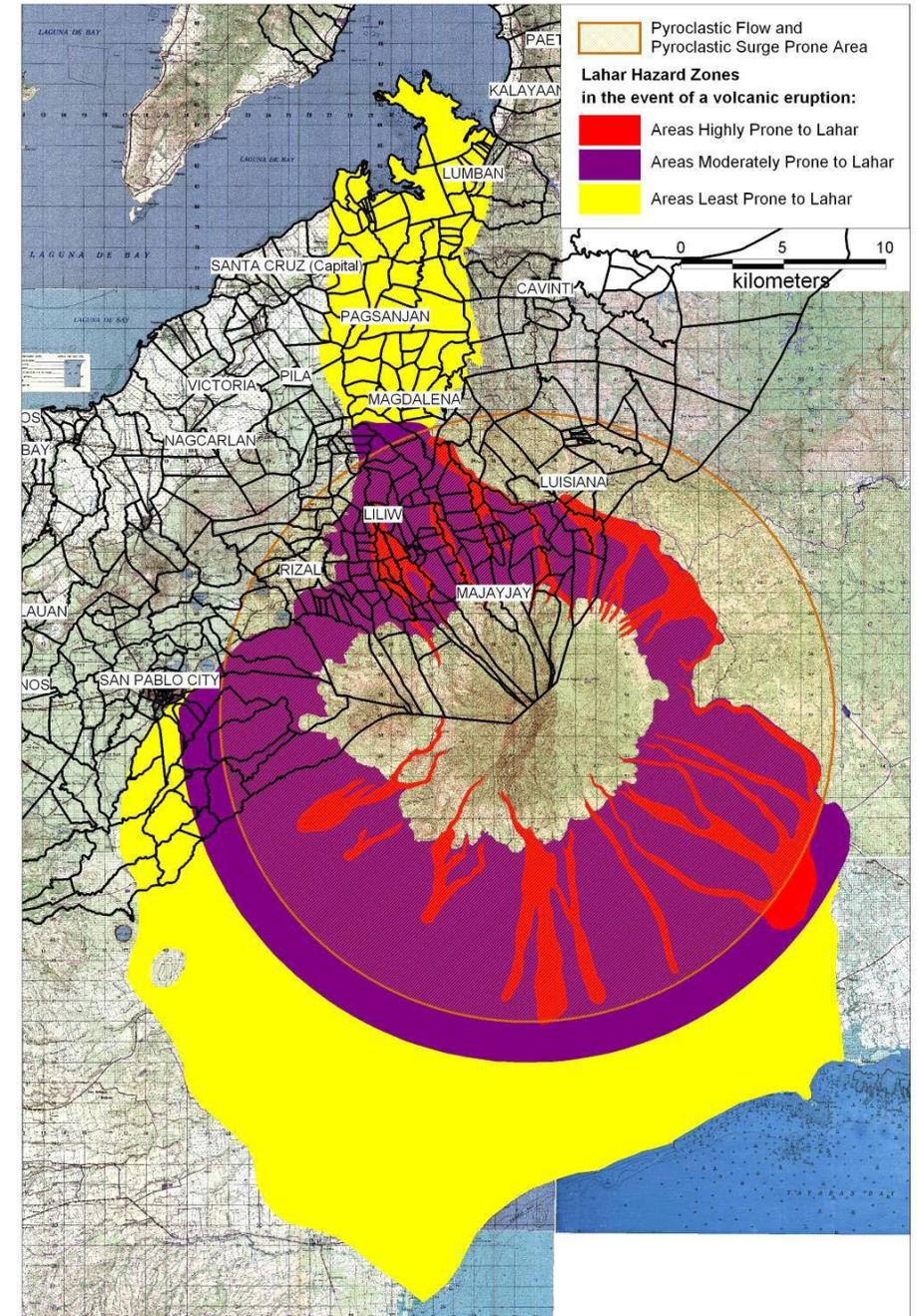


Figure 8. Volcanic Hazards Map for Banahaw Volcanic Complex (PHIVOLCS, 2008)

# RECOMMENDATIONS



- Run models with greater volume input using higher resolution DEMs
- Installation of evacuation centers, and water, power and food source facilities outside the proximal hazard zone and affected barangays
- Include post-eruption lahar
- Field validation of lahar hazard and risk maps
- Conduct more comprehensive researches about Banahaw Volcano

# ACKNOWLEDGMENTS



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**Mrs. Charmaine V.  
Villamil**



**THANK YOU**

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