

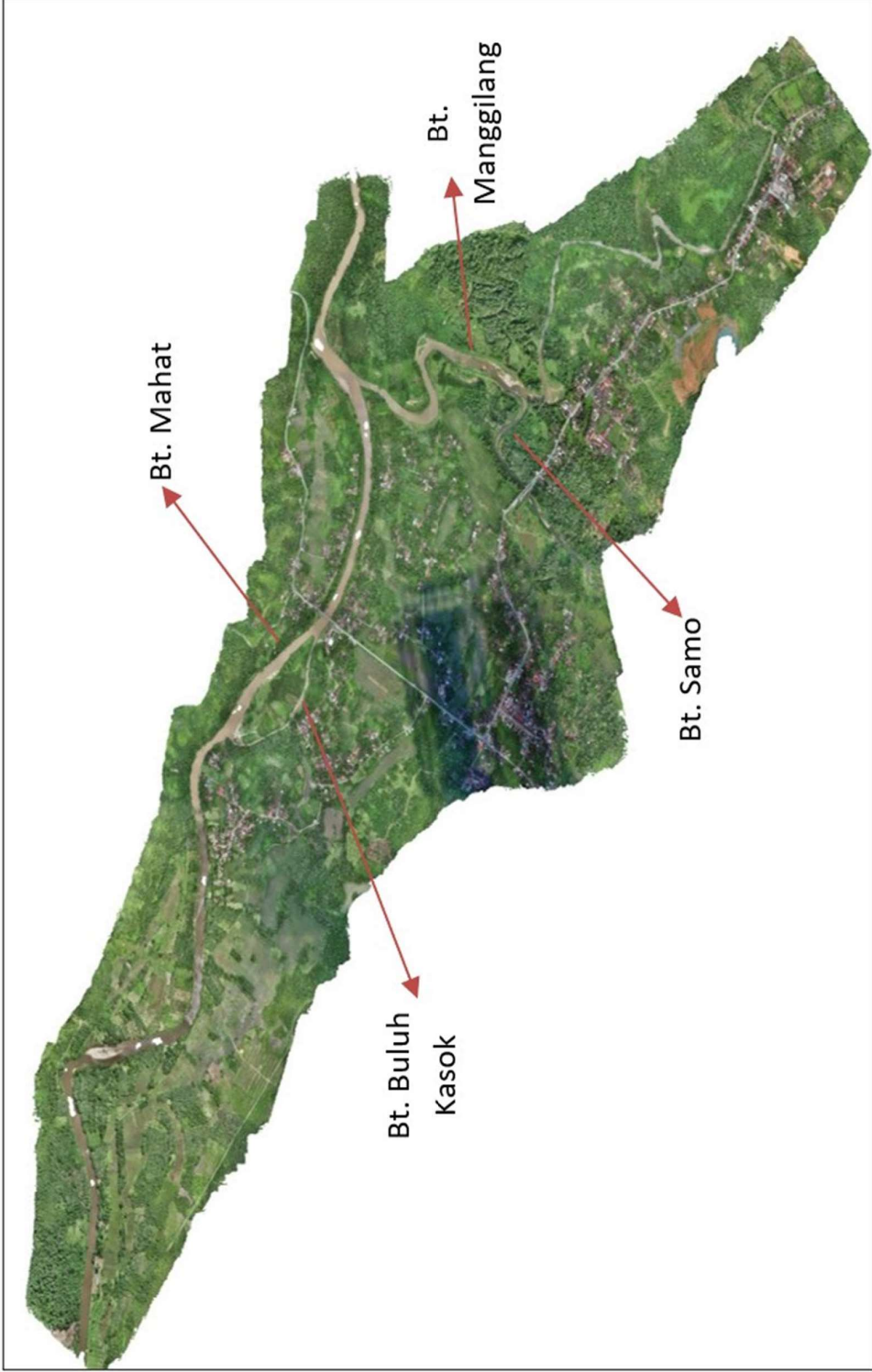
# CHAPTER1. INTRODUCTION

## 1.1 Background

Floods are natural phenomena that form destructive water forces due to high rainfall and insufficient water bodies' capacity (rivers or drainage channels) to accommodate and drain water. A flood can cause fatalities, displacement of people, environmental damage, and severely end economic development. However, some human activities (such as increasing human settlements and economic assets in floodplains and reducing natural water retention by land use) and climate change also contribute to an increase in the likelihood and adverse impacts of flood events (EU Floods Directive 2007). Flood damage often affects residential areas and infrastructure around river basins.

Batang Mahat in Lima Puluh Kota Regency administratively located in 2 (two) provinces. The upstream part of Batang Mahat is Pangkalan bridge in Lima Puluh Kota Regency, West Sumatra Province and the downstream part is the Koto Panjang hydropower weir intake (PLTA) in Kampar Regency, Riau Province. The Batang Mahat area in this study has a catchment area of 879.78 km<sup>2</sup> which is taken from the narrowing location in Batu Kisok to the upstream part. In this area, Batang Mahat has several tributaries, as shown in Figure. 1.1. Namely, Batang Bulu Kasok and Batang Malagiri which also have a tributary namely Batang Samo.

Batang Samo and Batang Malagiri often overflowed based on information from the community, which caused flooding in the Pangkalan area. The flood-affected areas of Batang Mahat and its tributaries in Pangkalan District are found in several Jorong/sub-district, namely; Jorong Sopang, Jorong Pauh Anok, Jorong Tigo Balai, Jorong Pasa Usang, Jorong Koto Panjang, Jorong Lubuk Tabuan, Jorong Lubuk Gadang, Jorong Lubuk Nago, Jorong Baja Ranah and Jorong Desa Baru (PSDA, 2018).



*Figure 1.1 Batang Mahat and Its Tributaries.*

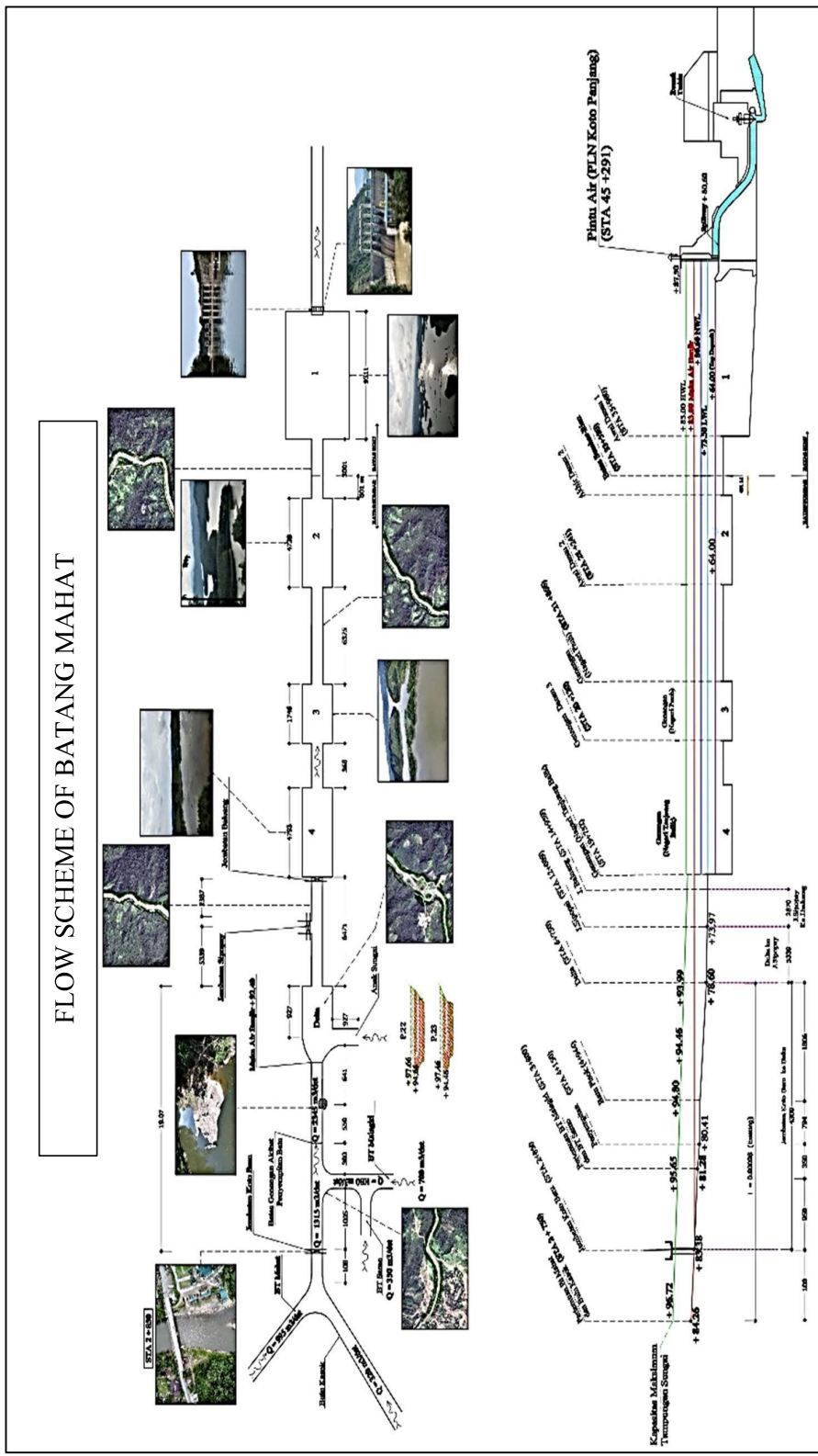


Figure 1.2 Flow scheme of Batang Mahat.  
Source: PSDA 2020

Also, based on the flow scheme shown in Figure 1.2 obtained from the PSDA, the water that flows from Batang Mahat to the Koto Panjang hydropower plant passes through several lakes connected by several river sections. This condition causes the possibility of inundation in the upstream area and flooding in the residential areas of Batang Mahat.

The flooding phenomenon in Batang Mahat almost occurs every year. Significant floods events recorded to have occurred in 1961, 1968, 1972, 1978, 1984, 1991, 1998, 2005, 2017, 2019 and 2020. In January 1991 (due to 174 mm per et mal rainfall, which resulted in a flood discharge of 918 m<sup>3</sup>/s), the highest inundation elevation reached +91.15 meters. While, a flood in 1998 (due to rainfall as high as 175 mm per et mal, resulted in a flood discharge of 995 m<sup>3</sup>/s), with the highest inundation elevation of +92.40 meters (PSDA, 2018). Then, the flood incident occurred in March 2017 (Peak Discharge of 2,345 m<sup>3</sup>/s), which inundated Pangkalan Koto Baru and Bukit Barisan Districts, resulting in enormous casualties and material losses (Mukmin, 2017). The highest inundation level occurred in march 2017 is about +93.40 meters (PSDA, 2020). The most recent flood occurred on February 3<sup>rd</sup>, December 11<sup>th</sup> and 20<sup>th</sup>, 2019 (2 victims), and February 11<sup>th</sup>, 2020, which inundated National roads, residential areas, and schools (PSDA, 2020). In April 2021, a flood also occurred in the Pangkalan area, which inundated about 150 housing units with water levels between 50 cm - 100 cm (BNPB, 2021). According to PSDA (2018), the lowest national road elevation around Batang Mahat is +90.10 meters, the lowest settlement is +88.30 meters, and the lowest agricultural land is +86.50 meters.

Due to several flooding events in Batang Mahat, various assumptions and hypotheses have emerged regarding the causes of Batang Mahat flooding. First, by looking at Batang Mahat, hydraulic characteristics, specifically found around the Pangkalan Koto Baru bridge, are characterised by a lack of smooth flow due to the shape of the floodplain terrain and the relatively gentle slope of the riverbed and the meandering system. Such conditions are related to hydrotopographic (rainfall) and geological (river bedrock) characteristics, cliff erosion activity (widening), sedimentation (silting),

and narrowing of the river channel (bottleneck) hampered by hard rock blocks (PSDA, 2018). There is also an assumption that the influence of the Koto Panjang Reservoir's inundation and narrowing in the river channel at Batu Pisok could be a factor causing flooding in 2017 (PSDA, 2020). On the other hand, Angga et al. (2019) said that flooding on March 3rd, 2017, with a flood discharge of 2,745 m<sup>3</sup>/s, was a rainfall phenomenon that caused the water discharge to exceed the carrying capacity of the Batang Mahat River. Therefore, this research will create the flood inundation map and analyse the causes of flooding in Batang Mahat using HEC-GEORAS software.

### **1.2 Research Aims**

The aims of this research are:

Create the flood inundation map of Batang Mahat and analyse the causes of flooding in Batang Mahat by using HEC-GeoRAS software.

### **1.3 The benefit of The Research**

The benefit of this research is:

1. Find out the inundation and flood-affected areas in Batang Mahat.
2. This research can be considered in decisions making for flood control in Batang Mahat.

### **1.4 Scope and Limitation**

To prevent the discussion become too broad, this research required to scope the problem into several items below:

1. The location of this research is in Batang Mahat River, Lima Puluh Kota Regency.
2. This research will only analyse the narrowing location in Batu Kisok to the upstream area of about 9.26 km<sup>2</sup>.
3. Analyse the design of flood discharge based on rainfall data.
4. The flood inundation mapping for this study uses ArcGIS 10.8.1, HEC-Ras 6.2, and HEC-GeoRAS 10.8.
5. This research uses a one-dimensional steady flow analysis to create the flood inundation simulation.

6. This research will use high-resolution DTM data to create the flood inundation map.

## **1.5 Systematic Writing**

This research will be organized as a final project, which consists of five chapters below:

### **CHAPTER I Introduction**

This chapter consists of four sub-chapter that present the research foundation, including background, research aims, the scope of the problem, and systematic writing.

### **CHAPTER II Literature Review**

To keep the research validity and reliability, this chapter reviews the literature related to the research. The literature review was obtained from various scientific works and journals, which will be listed as references.

### **CHAPTER III Methodology**

This chapter includes a research design, samples, data collection, data instrument, and data analysis. It consists of systematically how this research is done from the beginning to get the result of the research.

### **CHAPTER IV Result and Discussions**

This chapter consists of the result and discussion of the research.

### **CHAPTER V Conclusions and Suggestions**

This chapter will explain the final results and a brief review of the research.

