CHAPTER 1. INTRODUCTION

1.1. BACKGROUND OF STUDY

Hydrological analysis advances water resources management. The hydrological field encompasses many problems caused by human activities or natural events, such as sedimentation, erosion, water quality degradation, and flooding(Kamarudin et al., 2023). A hydrological model can be created using physical models, mathematical analogues, and computer simulations. Hydrological models can represent the complex water system and allow for to prediction the behaviour of water resources (Nujhat et al., 2024). River discharge, which is the key to the hydrological cycle, is influenced by climate change and structural changes in water resources. Rainfall as the main source of river discharge plays an important role in determining runoff (Budhathoki et al., 2024).

The complicated procedures of rainfall–runoff are influenced by numerous variables, the two main elements influencing runoff generation are rainfall parameters and watershed characteristics. According to Tiwari et al., (2024),rainfall-runoff modelling is an essential tool to comprehend how precipitation inputs are translated into river flow outputs within a watershed. Hydrologists are able to make well-informed decisions regarding water resources, flood forecasting, and the management of environmental impact by understanding the rainfall-runoff modelling.

Analysis of rainfall–runoff modelling can be used to identify areas with high flood risk. Rainfall–runoff characteristics can determine the point of the area that is predicted to flood and provides information to stakeholders to carry out flood mitigation treatment. Floods are the most common disaster that happen in Malaysia. The mainly cause of flooding is due to the continous heavy rainfall that raise the water level on river, these condition is the reason for the flood in Kelantan, Pahang, Perak, and Terengganu on December 2014 (Ismail & Haghroosta, 2018).

The Melantai River in Kluang, Johor, has experienced significant hydrological changes in recent years, including variations in rainfall patterns and increased flood events. Interpreting these changes is crucial to finding an efficient management of water resources and preventing floods. Recent study has found abnormalities and trends in rainfall patterns in Johor, Malaysia. For example, studies that examined historical rainfall data in Johor from 1991 to 2020 used the

slope analysis developed by Mann-Kendall and Sen to identify patterns, which showed notable shifts in the distribution of rainfall (Abdul Talib et al., 2024). The rivers in the Kluang District often experience flash floods due to continuous heavy rainfall. This condition causes the capacity of the riverbanks to be unable to accommodate rainwater runoff, resulting in river overflows. Melantai River is one of the rivers that often overflows in the Kluang District, which has an impact on flooding in the surrounding area, especially in Kampung Bentong. According to the 2019 Annual Flood Report, Melantai River experienced flooding that caused 10 people in Kampung Bentong to be relocated. Based on the 2020 Annual Flood Report, it was recorded that in 2020, Kampung Bentong experienced flooding with water depths ranging from 0.3 m to 0.5 m. These results highlight the need for regional research to comprehend the unique patterns of rainfall in the Melantai River area.

The Melantai River basin is undergoing significant transformations due to evolving land use patterns and soil types. Urbanization, deforestation, and agricultural expansion are altering the natural landscape, impacting the hydrological processes within the watershed. Understanding these changes is crucial, as land use and soil characteristics directly influence water infiltration, storage, and runoff dynamics. Studies have shown that Differences in soil types produce different responses to land use and hydrological outcomes. The differences in soil types also affect how the soil modifies vegetation under climate constraints. (Wang & Feddema, 2020).

Climate change further complicates the hydrological dynamics by altering precipitation patterns, leading to changes in rainfall-runoff relationships. Research indicates that climate warming can significantly affect precipitation and runoff, thereby influencing drought risks (Gu et al., 2020). The Soil and Water Assessment Tool Plus (SWAT+) is hydrology model that capable of simulating the impact of land use and climate changes on water resources. However, the utilization of SWAT+ in the context of the Melantai River basin remains limited. Utilizing SWAT+ can provide valuable insights into how land use and climate variations influence runoff, aiding in evolving a continuous management strategy.

Given these challenges, this study aims to characterize the current land use and soil types in the Melantai River basin, analyze the impact of climate change on rainfall-runoff relationships, and estimate the basin's rainfall-runoff using SWAT+. This in-depth study will give a clearer insight of the basin's hydrological responses to environmental changes.

1.2. OBJECTIVES AND BENEFITS

1.2.1 Objectives of Study

The objectives of the study are listed below:

1. To characterize the land use pattern and soil type.
2. To analyze the rainfall-runoff relationship of Melantai River using SWAT+
3. To analyze the impact of climate change to rainfall-runoff in Melantai River

1.2.2 Benefits of Study

This research provides an understanding of rainfall-runoff dynamics in the Melantai Watershed, using a SWAT+ hydrological modeling tool. The discussion of land use and soil type characterization provides basic knowledge of the physical attributes of the Melantai River Catchment, which are determinants of runoff behavior. This study gives a knowledge that influence runoff in the Melantai River Catchment. These findings are crucial in solving critical challenges by providing reliable simulations of peak discharge and runoff distribution.

In addition, this research contributes to regional efforts in mitigating the consequences of climate change and urbanization on hydrological systems. The outcomes of climate change help to identify potential risks associated with changing rainfall patterns, such as increased flood frequency or water shortages. The SWAT+ approach allows simulation of hydrological responses to various environmental and climate scenarios. SWAT+ improves runoff prediction accuracy. This study helps policymakers, urban planners, and engineers in designing more effective flood mitigation strategies and continuous management strategy tailored to the specific needs of the Melantai River Catchment.

1.3 SCOPE OF STUDY

This study is to assess the rainfall runoff characteristics of the study area, focusing on Melantai River Catchment, Kluang, Johor. The study understands land use and soil types in Melantai River Catchment by involving spatial and environmental data to characterize these factors. The Soil and Water Assessment Tool (SWAT+) was used to estimate runoff volumes within the period of time 2010-2021 and simulate hydrological processes. The study emphasizes the shifting rainfall pattern and its influence on the hydrological response. The study also uses the global climate model data from 2040-2060 to study how climate change

impacts the rainfall-runoff dynamics in Melantai River, assuming that there are no changes in future land use.

1.4 WRITING SYSTEMATIC

This study begins with an introduction by emphazing the importance of study hydrology and rainfall-runoff processes in the Melantai River Catchment. Subsequently, the literature review explores the outcomes of climate change on the hydrological cycle, factors influencing rainfall-runoff, methodologies for rainfall-runoff analysis, several hydrological model software, and mitigation measures taken for rainfall-runoff. The methodology section describes the study area by outlining the site location, characteristics, and climate conditions. A methodology flowchart represents the stages of the research process from collecting data to estimate rainfall-runoff using SWAT+.