DECLARATION

I, Sanjay Biswas, hereby declare that the subject matter of this thesis is the record of research work done by me, that the content of this thesis did not form the basis of the award of any previous degree to me or to do the best my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University or Institute.

This is being submitted to the University of North Bengal for the degree of Doctor of Philosophy in Geography and Applied Geography.

Sanjay Biswas

Dated: 16.08.2023

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From: **Professor D. K. Mandal,** Ph. D

7.08.2023

CERTIFICATE

This is to certify that **Sanjay Biswas,** a Research Scholar of the Department of Geography & Applied Geography, University of North Bengal, Raja Rammohunpur has carried out this research work entitled **"Causes and Effects of Flash Flood in Alipurduar District, West Bengal"** under my supervision which is being submitted to the University of North Bengal for the award of Doctor of Philosophy in Geography & Applied Geography under the faculty of science.

This thesis is based on the original work done by the researcher. He has fulfilled all the requirements as per the regulation of the University for submission of the Ph. D Thesis.

This thesis as a whole or any part of it has not been submitted to any other University/ Institution for any other degree.

7.8.23

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i CAUSES AND EFFECTS OF FLASH FLOOD IN ALIPURDUAR DISTRICT, WEST BENGAL A Thesis submitted to the University of North Bengal for the Award of the Doctor of Philosophy in Geography & Applied Geography Submitted by SANJAY BISWAS Under the Supervision of Dr. D. K. MANDAL Professor Department of Geography & Applied Geography UNIVERSITY OF NORTH BENGAL AUGUST, 2023

1 CHAPTER I: INTRODUCTION 1.0 Introduction Flash floods are rapid and devastating natural phenomena that pose significant threats to both human lives and infrastructure. They occur when an excessive amount of rainfall overwhelms the capacity of the drainage system or when intense rainfall occurs in a short period. Flash floods can arise in various geographical regions, affecting both urban and rural areas, and are known to cause significant damage and loss of life worldwide. The study area, i.e. Alipurduar has a variety of physical characteristics. The northern part of the District shared a boundary with Bhutan Himalaya, and southern border joined with the Coochbehar District. Physically the District is marked by the river Sankos in the eastern part, and the Jalpaiguri District marks the western region. There are many rivers which are flowing through the District. Sources of these rivers are mainly from Bhutan Himalaya. All the rivers are flowing north to south direction. In the last few decades, flash floods have frequently affected the study area, which create aggradations in this area. Flooding is the unusual presence of water on land to a depth that affects normal life. There are many types of floods, like river floods, flash floods, coastal floods, tidal floods, etc. Defining a flash flood is difficult because flash floods are complex phenomena and partly because they are viewed differently by different people., a flash flood is a body of water which rises to overflow land which is not normally submerged and subsides after only a few hours (Roy,1978). River flood and flash flooding usually result from abnormally high rainfall over relatively short period. Flash flood are most frequently associated with violent, convectional storms which tend to be of short duration, often measured in minutes rather than hours (Morgan,1966). There is a term used, hours for flash floods and days for river floods. A flash flood is, in short, a sudden local flood of great volume and short duration which follows within a few (usually less than six) hours of heavy or excessive rainfall, or due to dam or levee failure, or the sudden release of water it takes place in a saturated area where rain has previously fallen or the sudden release of water impounded by an ice log jam. A flash flood can be caused by intense rain, particularly when it takes place in a saturated area where rain has previously fallen or the ground is frozen. In these conditions the additional rain runs off over the surface and accumulates in streams and rivers at a much-accelerated pace. Heavy rain, most frequently connected with convection clouds, cover small regions and are short-lived (from a few minutes to a few hours), but very intense such a 100 mm (or 100 litres per square meter) in the span of an hour or more. Violent rainfall causing flash floods can be accompanied by strong winds and heavy hail formation. They can also appear locally in a large area covered

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Dedicated to

My father, Shyamal Biswas

and

Mother, Sandhya Biswas

PREFACE

Flash floods pose a significant challenge in regions with diverse topography, and the Sub-Himalayan Dooars area is no exception. Alipurduar District, located within this region, regularly experiences the devastating effects of flash floods. This study aims to provide an overview of the factors contributing to flash floods in the District, the impact on the local ecosystem and socio-economy, and the potential measures that can be undertaken to minimize the damage caused by these natural disasters. The Sub-Himalayan Dooars region is characterized by its varied topography, which directly influences the severity of flash floods. Alipurduar District, situated in the heart of the Dooars area, faces recurring flash floods in its hilly areas and foothills, particularly those to the north. The rivers originating from the Bhutan Himalayas play a crucial role in triggering sudden slope changes and heavy rainfall. As these rivers traverse the Alipurduar District, they carry substantial amounts of water, sand, and stones accumulated during their long journey through the Bhutan Himalayas. When these rivers reach the foothill areas, they deposit excess water, sand, and stones, leading to the elevation of riverbeds. Consequently, flash floods occur sporadically during the monsoon season. While natural factors contribute significantly to flash floods in Alipurduar District, human activities such as mining, quarrying and deforestation have further exacerbated their impact. These activities directly disrupt the natural balance, making the District more vulnerable to flash floods. However, the presence of forests in the foothill areas has played a crucial role in minimizing the effects of flash floods, serving as a natural barrier against their destructive force. Regrettably, the occurrence of flash floods in Alipurduar District has far-reaching consequences. The District's economy heavily relies on the tea industry and cultivation, both of which suffer significant disruptions due to flash floods. The damage caused by these floods extends beyond the economic sector, impacting the local ecosystem and livelihoods of the residents. In some instances, residential areas in the northern part of the District become isolated and inaccessible during the monsoon period, exacerbating the challenges faced by the local population.

While natural disasters like flash floods are beyond human control, there are measures that can be implemented to mitigate their impact on Alipurduar District. The adoption of sophisticated forecasting and warning systems can provide crucial lead time for residents and authorities to prepare and respond effectively to impending flash floods. Additionally, raising awareness among the District's population about the dangers associated with flash floods and promoting community resilience can contribute significantly to minimizing the damage caused

by these events. Co-operation between local communities and the District administration is paramount in implementing effective strategies to prevent and mitigate the devastating effects of flash floods. Finally, the challenges posed by flash floods in Alipurduar District require a comprehensive understanding of the factors contributing to their occurrence. This study highlights the influence of topography, river systems, human activities, and the economic and ecological impact of flash floods. By implementing proactive measures such as advanced forecasting systems, community awareness initiatives, and collaborative efforts between stakeholders, it is possible to minimize the damage caused by flash floods and build a more resilient Alipurduar District.

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List of Abbreviations

BDO	Block Development officer
BIS	Bureau of Indian Standards
CWC	Central Water Commission
DBITA	Dooars Branch Indian Tea Association
DDMP	District Disaster Management Plan
EC	Electrical Conductivity
FFMI	Flash Flood Magnitude Index
GIS	Geographic Information System
ICAR	Indian Council of Agricultural Research
IFRC	International Federation of Red Cross
IHDB	Integrated Hydrological Data Book
IMD	Indian Meteorological Department
IRS	Indian Remote Sensing Satellite
ITPA	Indian Tea Planters Associations
LISS	Linear Imaging Self Scanning
LULC	Land Use Land Cover
MSL	Mean Sea Level
NBFCC	North Bengal Flood Control Commission
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
OLI	Operational Land Imager
PWD	Public Works Department
RADAP	Rader Digitizer and Processor
RI	Recurrence Interval
SOI	Survey of India
SSB	Sashastra Seema Bal
TA	Total Alkalinity
TDS	Total Dissolved Solids
TG	Tea Garden
TH	Total Hardness
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USGS	United States Geological Survey
USNWS	United Nations National Weather Service
WAWQI	Weighted Arithmetic Water Quality Index
WHO	World Health Organisation
WMO	World Meteorological Organisation
WQI	Water Quality Index

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