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Geoinformatics Based Modelling of Channel Planform Dynamics for River Ramganga

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It is certified that the work contained in the thesis titled ‘‘**Geoinformatics Based Modelling of Channel Planform Dynamics for River Ramganga”** by **Mr. Ashwani Kumar Agnihotri** has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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DECLARATION BY THE CANDIDATE

I, **Ashwani Kumar Agnihotri**, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of **Dr. Anurag Ohri** from July-2015 to November-2020, at the **Department of Civil Engineering**, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

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Acknowledgment

Initially, I would like to express my deep sense of gratitude to my supervisor ***Dr. Anurag Ohri****, Department of Civil Engineering, Indian Institute of Technology (Banaras Hindu University), Varanasi, for his valuable guidance, constant support, critical and motivating comments throughout the completion of this research work. It has been my great honour to work with such renowned professors. I gained a lot of experience in my area of research as well as improved my communication and writing skills. It is my pleasure to express my deepest admiration and heartiest thanks to him for helping me to learn the subject and to develop an interest for further research in this area.*

Very special gratitude goes to the Head Department of Civil Engineering (IITBHU), for their support and making available resources such as the Geoinformatics Engineering Laboratory, and the Geotechnical Engineering Laboratory that was instrumental in the fieldwork of this research. I would like to acknowledge the University Grants Commission (India) for providing financial support for the research work. I am also thankful to my RPEC members Dr. Rajesh Rai as an external expert from the Department of Mining Engineering and internal subject expert Professor S. B. Dwivedi, for their valuable suggestion. Then, I would like to thank Dr. Prithvish Nag, Dr. B.N. Singh and Dr. Shishir Gaur for reviewing the manuscript of the thesis and for their encouraging comments.

I am also thankful to all technical staff, teaching and non-teaching staff specially Mr. Akhilesh Kumar and Mr. Lalji of the Department of Civil Engineering for *their support during research work. Finally my sincere regards and thanks to all those who have supported me one way or the other during my entire Ph.D. period.*

With a special thanks to my colleague Dr. Sachin Mishra , Mr. Akhilesh Mishra, Mr. Ankit pandey, Mr. Neelendu Das, Mr. Shivam, Koshal Ganrg` love and encouragement, they selflessly encouraged me to explore new directions in life and seek my own destiny. A very special thanks to Alka for her understanding and encouragement during all these years of research work. I also thanks to family and friends for their support during this thesis.

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PREFACE

Channel planform can be defined as the planimetric geometry of an alluvial river as display in the maps or satellite images. Channel planform dynamics has been studied for its geomorphological and engineering importance using empirical and theoretical models for better river management activities. It is one of the major problems of alluvial streams around the globe, which causes natural hazards like horizontal channel shifting, bank erosion and flooding which damage the hydraulic structures, transport network, agricultural land and settlement along the river.

The Ramganga river is a first major tributary of the Ganga river. It shows dynamic nature in lower reach due to frequent floods and flat topography of the region. Numerous engineering structures, e.g. the bridge, roads, gas pipelines, and settlement along the river bank, are damaged due to the meandering nature of Ramganga. It is published in the Hindustan Newspaper that seven bridges have become useless due to shifting of river Ramganga and near about Rs 1000 Crore of government money is wasted due to unpredictable behaviour of Ramganga river.

Therefore, the present work can be used to identify the most stable reach for the construction of infrastructure facilities, e.g. bridge, school, settlement, roads etc. The present study provides recent and reliable information's on the channel planform dynamics that will help as a decision support tool for designing and implementation of drainage development works in the study area. Over the past decade, Geoinformatics based modelling of the fluvial environment has substantially increased. However, morphological models provide the controlled environment in which channel planform dynamics can be modelled for future analysis

Therefore, a strong necessity is now being realized to model the channel planform dynamics in present hydrological conditions. So that this work is focused on the Geoinformatics based modelling of channel planform dynamics for river Ramganga. The motivation for conducting this research comes by observing the hazardous impact on surrounding settlement in the floodplains. The entire thesis has been divided into eight chapters, and their brief explanation are specified as follows:

The first chapter describes the introduction and objectives of the study, followed by the morphological characteristics of channel planform dynamics. The second chapter describes the literature review on Geoinformatics based predictive modelling of channel planform dynamics. This chapter explains also explain about the available morphological models which simulate the channel planform for predictive modelling. In the present study, the RVR Menander found suitable and has been used for predictive modelling in a GIS environment. The third chapter explains the geographical background of the Ramganga river in the details. It describes the variable which controls the channel planform dynamics of Ramganga river land use/ land cover, climate, geomorphology, geology, the soil of the river, hydrology basin and its impact on the channel morphology. In chapter four, the Landsat archive and historical topographic maps are used in a GIS platform to understand the channel planform dynamics of Ramganga river over ~237 years. Chapter five discussed the impact of monsoonal discharge on the morphology of the Ramganga river using SAR data. Monsoon is the leading cause of flood in the Ramganga river, which is the main controlling factor of channel planform dynamics. Chapter six focused on the evolution of the Ramganga river using remote sensing data and the hydrological data. The results showed that the study reach of the Ramganga river has significantly changed in the past~46 years in different hydrological conditions. The objective of the seventh chapter is to develop a physically-based predictive model for modelling of channel planform dynamics in a GIS environment for the next 100 years. In this chapter, the Ramganga river morphology has been studied through RVR Meander model. The last chapter deals with the results and discussion, followed by the limitation and scope for future research.

The present study provides recent and reliable information on the channel planform dynamics, and it will be helpful as decision support tools for designing and implementation of drainage development works in the Ramganga basin. This work will also be useful for providing information for future river management activities like construction of bridges, roads, embankments and other infrastructure development activities.

Ashwani Kumar Agnihotri