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Comparative study of flood modelling with the steady and unsteady flow analysis for development of irrigation canal around Swarna River basin.

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Abstract

A flood is a natural disaster that results in the death of people and the destruction of property. Due to climate change and severe rainfalls, flash floods are an overflow of water that submerges lands and properties, harming lives and habitats all over the world. While it is impossible to minimize risk or prevent it from occurring, we may mitigate its impacts using a variety of technical strategies. Due to changing climatic conditions in the environment, floods and droughts have become increasingly common in our country in recent years. The River stage during a flood need mathematical modelling of the river. This paper describes a study undertaken in Udupi district, Karnataka, at the confluence of the River Swarna. To identify various flood risk zones of irrigation land around Swarna River basin. This will aid in the development of a flood mitigation strategy for the Udupi district as a preventative step for flood management through comparative analysis of steady and unsteady flow analysis for developed irrigation canal around Swarna River basin. This model also calculates the depth of water, velocity, and elevation of the water surface with time.

Keywords: flood modelling, steady and unsteady flow analysis, irrigation canal.

Introduction

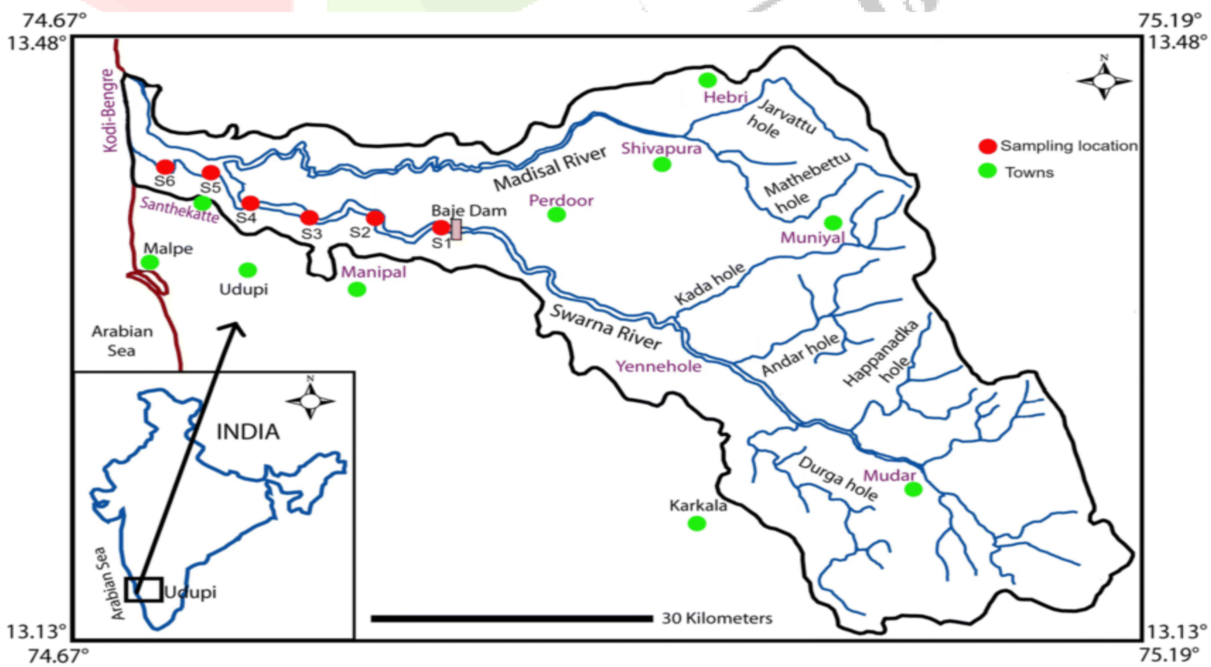
Water is a priority because it is a limited resource that needs to be protected (Conde et al.2020). Nearly 70% of the water consumed in the world is used for irrigation, and most of the water is transported through open channels (Conde et al.2020). Global climate has changed due to frequency of extreme precipitation and increasing flood disasters in coastal region). Floods are ranked first in the world's natural disasters, causing nearly 42 million people of the world's population to be affected (Natarajan and Radhakrishnan 2020). India is ranked first on the worst flood-hit country in the World where approximately 4.84 million people are living in a flood-risk zone (Kumar et al.2019). Periodical events of flash flood that occur primarily by water overflowing from the main drainage channel of natural or artificial systems to the adjacent areas, occupying riparian areas and floodplains within a short period. When a flood occurs in human occupied areas and interacts negatively with society and agricultural land(irrigation), it is considered to be a natural disaster As a result one of the flood types flash flood has become a major natural hazard all over the world (Liu et al.2018). Climate change alters the risks of hydrological extremes on regional scales, and the hydrological response of a catchment can vary substantially, not only due to its location but also depending on the characteristics of the catchment (Hsu et al.2017. Thus cropping intensities have not fulfilled planners expectations due to high flash flood has occurred at the upstream coastal region or mountainous region of Western Ghats. The same has occurred in the irrigation canal and affected water logging around the low-lying areas or low-lying floodplains. There is a challenge to mitigate growing different crops through supplied water from irrigation canals. There is a need of comparative study of flood modelling with the steady and unsteady flow analysis for development of irrigation canal in low lying flood plains.

The aim of the study are Development of hydraulic simulation model for a steady and unsteady flow simulation for irrigation canal. To improve the efficiency of irrigation through hydrological simulated model. The HEC-RAS model can be able to simulate the surface runoff profiles formed in different recurrent flows.

Materials and methodology

2.1 Study Area

Swarna River originates in the Western Ghats. The river flows for a length of 61.05 km and then joins the great Arabian Sea near Kameshwara village in Udupi Taluk. The latitude and longitude of Swarna river is 13^{O} 25’ 56”N and 74^{O} 42’ 0”E respectively. Udupi district gets highest annual rainfall in Karnataka state, about 4000 mm. In this coastal district, bulk of the rainfall over 85% occurs during monsoon season. The rainfall increases from west to east with co-efficient of variability ranging from 18.7 to 18.9%. Average Annual Rainfall is 4136.3 mm. The district is covered with three types of soils i) sandy soil covering the beaches and the adjoining stretches ii) yellow loamy soil and iii) red lateritic soil. The sandy soils are confined to a narrow strip of the coast having width ranging from less than 100 m to as much as a kilometer. These fine to medium texture sands are characterized by their extremely high rate of infiltration and act as a good recharge media for ground water. Yellow loamy soils are transported from origin and are found mostly along riverbanks and lower reaches of valleys. The texture of these soils varies from fine to coarse.



Flow Map of Swarna River

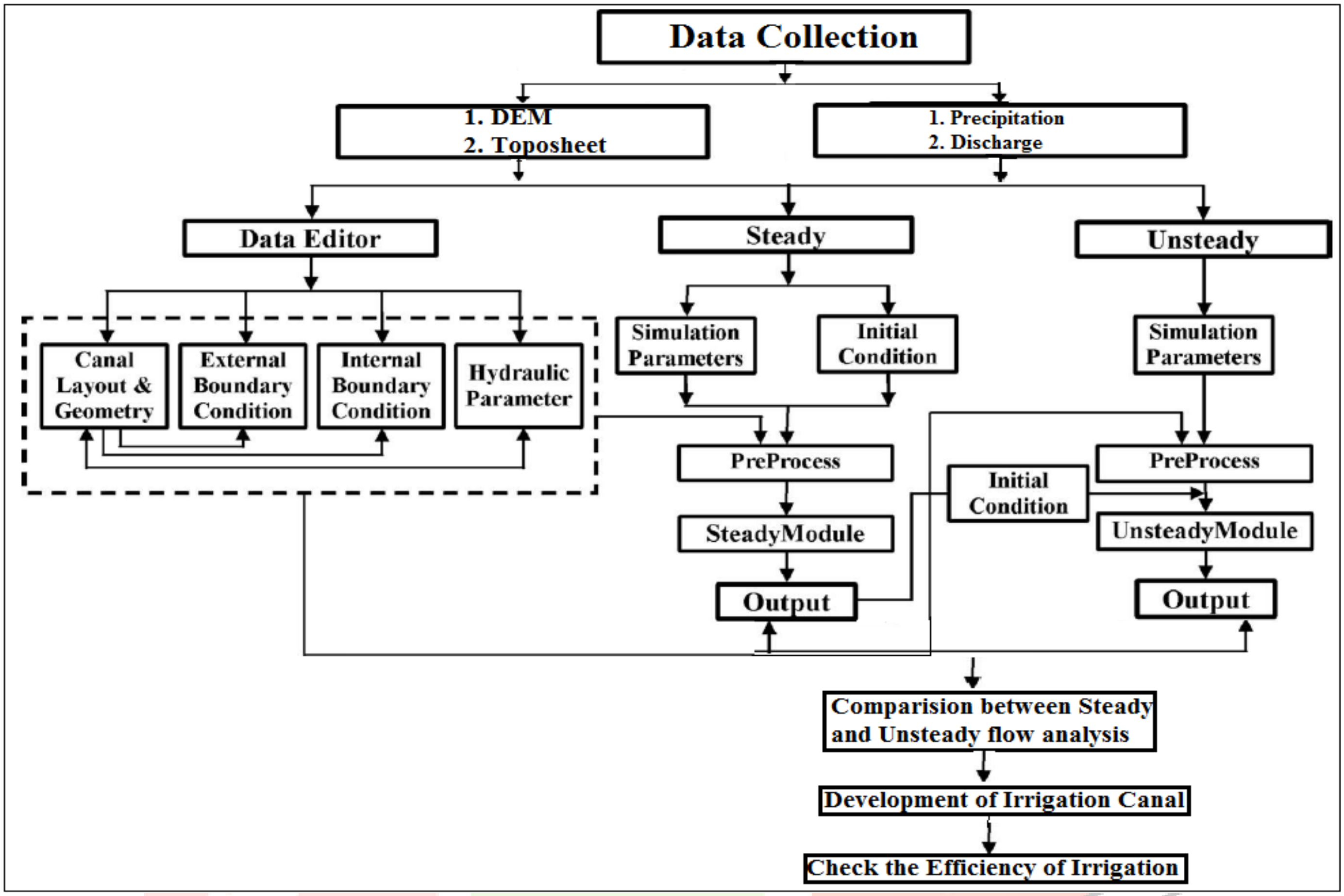
Udupi district is essentially an agriculture district with more than 80% of population depends on agriculture for their livelihood where as only 40% of the available land is used for agriculture. Paddy is the main crop raised by 75% of the cultivated area in kharif season. The other crops are chillies, sweet potato, ginger and vegetables. In rabi season, paddy, chilies, black gram and green gram are raised. Pulses are raised during dry season. The crops raised during summer are limited with chief crop being sugarcane, groundnut, paddy and sweet potato. Plantation crops include coconut, cashew nut, areca nut and pepper. Cardamom is also grown in valley areas.

Swarna River,Udupi

2.2 DATA COLLECTION

Rainfall data is to be collected from Directorate Economics and Statistics, Karnataka. Discharge data is to be collected from India WRIS. Toposheet data to be collected from Survey of India. DEM data is to be collected from USGS Earth Explorer.

METHODOLOGY



Flow chart of present methodology

Editing canal network description, running the steady and unsteady flow simulation modules, and displaying the results. Thus, there are three components of the model: Data editor, steady flow simulation module, and unsteady flow simulation module. The model also has a preprocessing module, which performs data checking and prepares data files in the format required by steady and unsteady flow simulation modules. The data editor component consists of network editor, external boundary condition editor, internal boundary condition editor and hydraulic parameter editor. The network editor allows for entering the layout of the canal network graphically. Once the network layout is drawn, cross-sectional data can be entered by selecting a particular reach. In addition to the canal geometry, other parameters such as seepage loss and Manning's roughness coefficient to be specified. Compare the result and development of irrigation canal for both steady and unsteady flow analysis. Check irrigation efficiency of canal.

Results and discussion

When considering the potential of the calibration process to improve flood modelling in the DCs, it's important to remember that such discussions usually end with the concept of uncertainties or systematic errors, which must be identified and incorporated into the modelling procedure in order to make sense of the final result. TIN to be created in ArcGIS utilising 3D Analyst Tools and DEM as input data. RAS geometric data such as stream centerlines, bank lines, flow route lines, and XS cut lines will be developed in HEC-GeoRAS utilising TIN as the base layer data and delineated in ArcGIS using the Editor tool. As a result, geometric data was obtained, which was then exported as RAS data and used in HEC-RAS for modelling. The model may output a variety of data based on the amount of rain that fell on certain days. Peak discharge of water volume, time of peak discharge at any point, and water speed at the moment of peak discharge are all examples of this information. This data is valuable for flood analysis. The water volume is derived from the chosen discharge time and amount of water, which is highly valuable for flash flood studies.

Conclusion

This paradigm provides a novel platform for assessing coastal flood risk, with larger financial costs than earlier estimates due to the anticipated entire destruction of the current crop. Flood modelling is an important tool for creating flood risk management policy. There is usually a condition that spans from total data paucity, lack of access, to limited availability of high resolution data to employ in models, as explored extensively in the literature. The HEC-RAS model is able to simulate the surface profiles formed in different recurrent flows. The goal of flood frequency analysis is to employ probability distributions to relate the magnitude of extreme flood events to their frequency of occurrence, and several approaches are available in the current literature.

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