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An Overview and Comparison of Small Coastal Rivers of Eastern Ghats and Western Ghats: Variations and Controls

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***Abstract*: The small mountainous rivers draining the eastern and Western coast of India (area--200,000 km^2) discharge approximately 280 km^2/yr of fresh water annually, about the same as the combined estimated loads of rivers draining from all large rivers of peninsular India. Fresh water discharges are particularly high for rivers that drain the high mountains of Western Ghats rather than the eastern Ghats, where drainage basins are high and drainage areas are small. Owing to the generally narrow (< 25 km wide) shelf of western Ghats, much of the fluvial fresh water discharge may escape directly to the Arabian sea, as evidenced by the presence of sediment-filled trenches. In contrast, many of the rivers draining the Eastern Ghats part of the land discharge onto a fairly broad shelf, where much of the fresh water presumably remains, perhaps as pro-grading estuaries.**

***Keywords*: small coastal rivers, eastern ghats, western ghats, elevation, precipitation, India.**

1. Introduction

A recent analysis of annual fresh water discharge to the oceans (38000 km^2) emphasized the importance of rivers with small drainage basins, whose individually small loads are offset by their relatively high yields and their large global number (Milliman, John D., and Katherine L. Farnsworth, 2013). These high yields reflect the decreased capacity for fresh water storage in small drainage basins. Moreover, rivers draining high elevations generally have greater yields than river basins of similar area that drain lower elevations. A high mountain rivers of Western Ghats drain less area than large planar large river however, contributes much fresh water discharge. In part these higher fresh water fluxes reflect a higher average annual precipitation and in part the effect of increased in intense rainfall event days (e.g., storms) in higher elevation basins.

Globally, fewer than 40 river basins are larger than 500,000 km^2, but many thousands of rivers have drainage basins smaller than 5000 km 2 (Milliman and Syvitski 1992, their Fig. 1). Because the yields of these smaller rivers can be many-fold greater than the yields of larger rivers, the global sediment discharge from small rivers can be considerable. Moreover, small rivers are more responsive to episodic events, such as floods and storms, and they often discharge of fresh water as well as sediment directly onto narrow active margins, allowing some of the fresh water discharged to escape to the deep sea even during high sea level. In their discussion of available river sediment data, Milliman, John D., and Katherine L. Farnsworth, 2013 speculated that small, mountainous rivers, such as those draining western North and South America, southeastern Europe, and (particularly) the high-standing islands of Oceania, may account for as much as half the present-day fresh water flux to the oceans.

In contrast, the fresh water fluxes from very large rivers may have been overestimated, as these fluxes generally come from upstream measurements that therefore minimize downstream flow do to anthropogenic influence such as constrictions of dams are inter basin transfers etc. (Gupta et. al., 2012). To date, the fresh water discharge to the sea has not been calculated accurately, as the fluxes of smaller rivers have been insufficiently monitored. The purpose of this paper is to use the extrapolation techniques to estimate the fresh water flux from coastal rivers of India, in an attempt to quantify fresh water discharge, input from a less land area dominated by small mountainous rivers.

2. Study Area and Methods

Peninsular India encompass most of the large and numerous small and medium scale coastal rivers originated in Eastern and Western Ghats respectively. Roughly, there are 10 large and 150 small rivers from both Eastern and Western Ghats are present in peninsular India. SRTM-Dem data from (http://srtm.csi.cgiar.org/) is used to generate the individual basins (Fig. 1). In western Ghats there are as many as 150 small and medium scale rivers (Basin area > 150km^2), Where as in Eastern Ghats the number may be less, due to the gaps in path of the eastern Ghats. Overall, we have cover the basins fall in 2800 km of west coast and 3400 km of east coast of peninsular India. Rainfall in east and west coast is dominated by the eastern and westerns winds from the Bay of Bengal and Arabian Sea respectively (Gosain, A. K et. al., 2011, R. Kumar et. al., 2005, S.K. Jain et. al., 2007).

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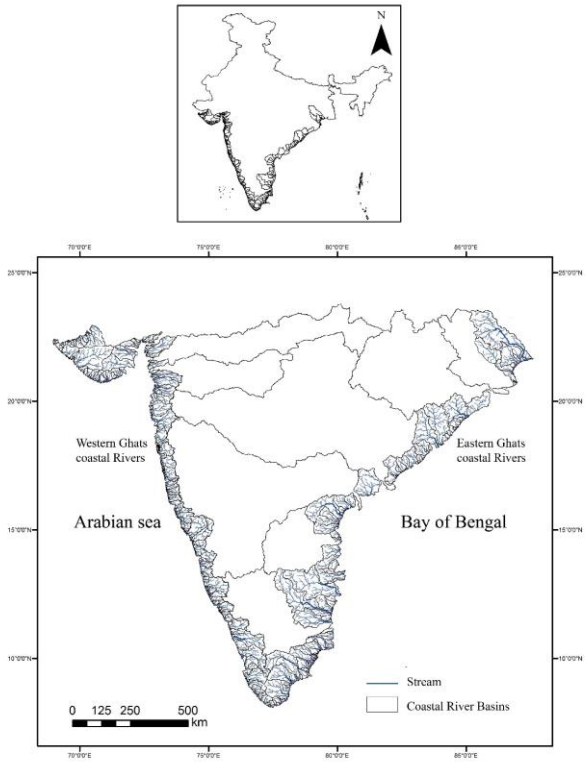

Fig. 1. Individual river basin locations of east and west coastal rivers of India

3. 3. Results and Discussions

A. Geology

Geologically, West coast is dominated by silicates from least to most weathering intensity i.e. from granitic–gneisses to Basalts and in lower reaches are occupied by coastal quaternary sediments. In case of east coast, geology variation is very much limited with most of the basins are occupied by peninsular gneisses and granitoids of mostly stable in nature (GSI-1997). In lower reaches it is occupied by coastal sediments due to east ward dipping nature of the Indian peninsula, the east coast is dominated by large rivers such as Godavari, Krishna, Mahanadi, Cauvery, Pennar. The deltas formed by these rivers are in the lower reaches of eastern Ghats. Overall, east coast is more stable than the west coast in terms of lithology and epeirogeny processes (Fig. 2).

B. Topography

Terrain features are usually expressed in terms of the elevation, slope and orientation. On physiographical basis, the basins can be divided into hilly and plain regions. The hilly regions are in the both eastern and western Ghats part, the plain regions are in between the hilly tracts and in the upper reaches are broad and fertile areas well suited for cultivation. The western basins are an almost unbroken line formed by the Sahyadri range of the Western Ghats, ranging from 600 to 2,100 m in height. Basin is very rugged in the north-eastern part and flat towards downstream side. Major area (23.09 %) falls under 10-50 m elevation zone followed by 50-100 m elevation zone (19.55 %). Highest elevation is 2674 m is present in Western Ghats (Fig. 2). The Eastern Ghats elevation ranges from <5 to 2600 m shows a broad classification in this area. The maximum elevation is about 2000-2600 m observed to have 0.05% of the total geographical area of the basin. Major area of the basin falls under 100-200 m elevation zone comprising 19.73% of the total geographical area of the basin (CWC-Basin Reports, 2014).

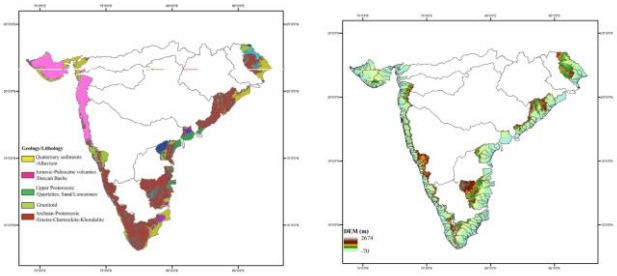

Fig. 2. Geology/lithology and elevation variations in west and east coast rivers

C. Climate

Climate in a region encompasses the statistical average of rainfall, temperature, humidity, wind, atmospheric pressure, atmospheric particle counts and other meteorological elemental measurements over long periods. The Western Ghats region enjoys an equable climate with high temperature almost throughout the year. Its mean monthly temperature ranges between 17.83 °C in the winter season to 33.26 °C in the summer season (CWC-2014). The Eastern Ghats basins are subject to a tropical climate. In the western parts of the basin, the variation of temperature is small throughout the year. In the month of January, the mean temperature over the basin varies from 19.2 °C to 29.6 °C (Figure 2), in the month of April the mean temperature varies from 24.8 °C to 35.8 °C. In July, coastal districts have mean temperature of 24.2 °C to 33.8 °C. In the month of October, in the western parts of the basin the mean temperature is between 22.9 °C to 31.4 °C whereas in the coastal districts it is about 27.5 °C (Fig. 3). The Climate of this basin is mainly of the coastal type where the seasonal variation is generally small and the atmosphere is moist or humid. The climate along the coastal belt is generally hot with a high degree of humidity reaching up to 90%. In the mountainous region, temperatures are quite low. The cool season extends from December to February. It is a period of low humidities, bright sunshine and little pre-capitation. An increase in the mean temperature in March indicates the approach of the hot season. The summer and winter climate is controlled by the south-west and north-east monsoons and the autumn and spring are practically indistinguishable.

D. Rainfall

The west and east coast basins come under the direct influence of south-west monsoon and receives heavy and assured rainfall between June and August. The Rainfall gradually decreases from north part of Kerala to south part of Kerala. In Kerala the period of south-west monsoon is from June to September and the period of north-east monsoon from September to November. The south-west monsoon rainfall is usually very heavy (about two-third of the annual rainfall). Based on daily rainfall data (0.5 X 0.5) of the last 35 years

(1971-2004) collected from IMD, the average annual rainfall in the basin is shown in Fig. 3. Most of the area receives annual rainfall is greater than 2500 mm. Ninety percent of the rainfall occurs from June to November south west monsoon period. During this season the sky is cloudy, the air humid and there is gusty and squally rain. However, around 163 blocks of 2 districts (1-Karnataka, & 1-Tamilnadu) falling in the basin are drought prone (Source: Drought Prone Areas Program, DPAP, Government of India, 2002). Overall, the rainfall is uniformly high in western Ghats or in the west coast than the eastern Ghats or east coast (Fig. 3).

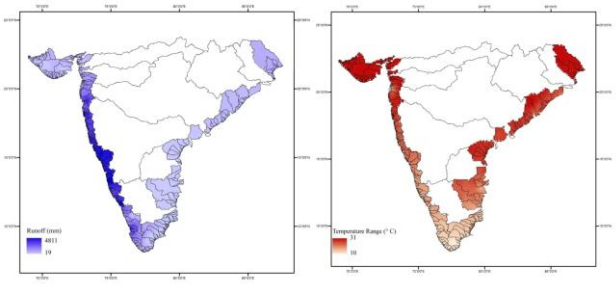

Fig. 3. Rainfall and temperature variations in west and east coast rivers

4. Conclusion

East and west coasts of the India are dominated by orogenic belts of continuous stretch. Western Ghats are dominated over eastern Ghats in the aspects of lithology, topography, rainfall and temperature parameters. These two mountain chains are making the middle peninsular part as dry. The eastern Ghats has many gaps over which most of the large rivers of the Peninsular India are draining to the Bay of Bengal. In contrast, Western Ghats are limited gaps such as Palghat and Goa gap. The average length of the rivers originates in the western Ghats is lower than the average length of the rivers originates in Eastern Ghats which facilitates the West coast rivers high channel gradient than east coast rivers. Further, the east coast basins are inactive in case of weathering intensity over west coast rivers. Geomorphological, structural, tectonic evolutional comparison of east and west coast basins of Peninsular India may through a light in understanding and differentiating these two basins.

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