



Geo-Ecological Perspective of Hydropower Projects in Siang River Basin

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ABSTRACT: Most of the major rivers in the North East India are largely free-flowing, which is a rarity in India and the world. Their basins are home to unbelievable ecological and cultural diversity. 'Siang' is the most important river in Arunachal Pradesh which form the main trunk of mighty Brahmaputra. The present scenario of hydropower developmental activities and issues related to anti-dam movements certainly demands to know the geo-ecological profile of Siang River Basin; its fragile eco-system; people's dependence, their traditional attachment to Siang and their perception on dam and an overall environmental assessment. The need of the hour is to look into the issues related to hydropower projects in a holistic manner. Our approach of development must be geo-ecological and people-centric and in tune with the best accepted model of development, i.e. sustainable development of the region in question.

KEYWORDS: Hydropower, Ecosystem, Environment, Fragile, Sustainable development

Received 25 May, 2021; Revised: 06 June, 2021; Accepted 08 June, 2021 © The author(s) 2021.

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I. INTRODUCTION

Developers, planners and politicians view Arunachal Pradesh as an ideal site for hydroelectric power projects largely due to the presence of numerous major river basins and the state's sparse population. Harnessing the huge hydropower potential of the state may be considered as a great initiative for the economic development of the region as well as to meet the growing power demands. However, such mega developmental process needs to be examined in context of geo-ecological distinctiveness of the region as well as its age-old nature-dependent cultural panorama. Any developmental activities must ensure credible public consultation and protection of aesthetic quality of environment and cultural values. Let me quote Verrier Elvin, "the people of NEFA cannot be spoon-fed and coddled for ever. If they are to be strong, they must emerge one day from their seclusion and battle on equal terms with the outside world. Before this happens it is essential that they should be provided with clear titles to their lands and forests, so that even though the protecting hand of the present Administration may be withdrawn, they will be comparatively secure". He mentioned that the voices of officials pleaded in favour of granting greater ownership rights to tribesmen were largely unheeded. "I believe that history will judge us primarily on two things: how we solve the problem of tribal culture, and how we deal with the problem of tribal land".

The present scenario of hydropower developmental activities and issues related to anti-dam movements certainly reminds us the views of *Elvin* and compel us to rethink over the issue. Our approach of development must be geo-eco-centric and in tune with the best accepted model of development, i.e. sustainable development of the region in question.

LOCATION OF SIANG RIVER BASIN

River basins are considered as the most ideal geographical unit for any spatial analysis because of their natural homogenous geo-ecological characteristics in numerous elements. Siang basin of Arunachal Pradesh is a well-defined river basin under the macro Brahmaputra basin. The basin is centrally located in the state of Arunachal Pradesh within the geographical ambit of 27°30'-29°20'N Latitudes and 93°48'-95°35'E of Longitudes. It's an area of mountainous and complex relief feature wherein elevation varies from a low of 133m to a high of 5248m. The entire basin replicate superb scenery of mountain landscape encompassing biomes from tropical grasslands and moist evergreen forest to alpine scrub and permanent icefields. Identified as the most species rich region, the forested area in this valley is 83.06% according to latest satellite imagery. It becomes appropriate to say that wherever the basin is forested, it is forested indeed.



Fig. 1: Location of Siang Basin in Arunachal Pradesh

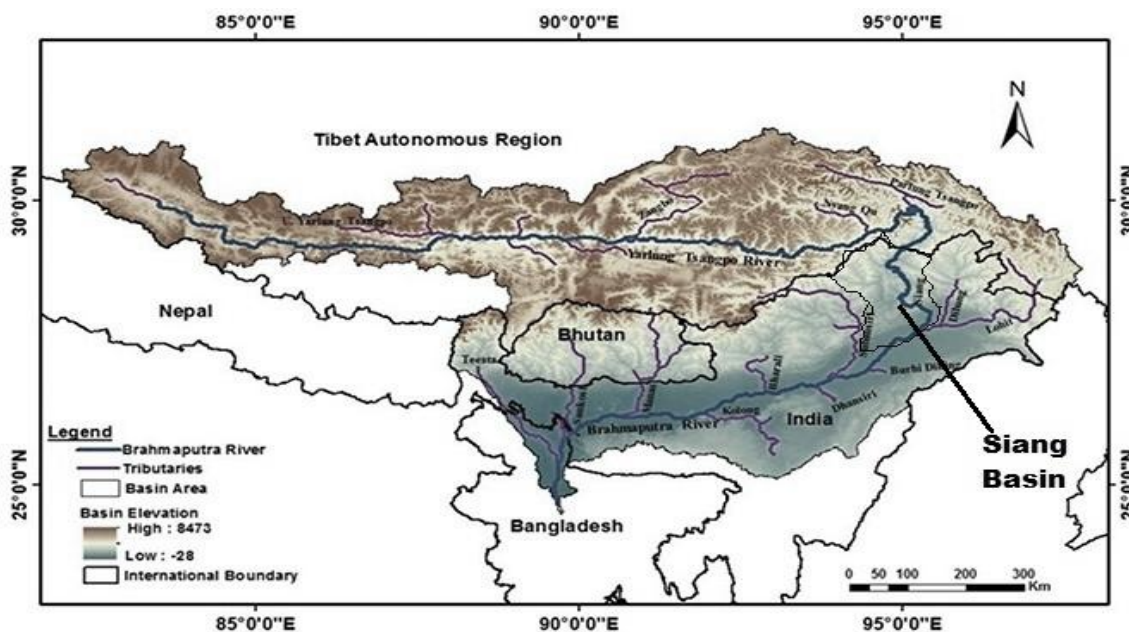


Fig. 1: Drainage Line of Siang and its Tributaries

The basin area which is almost the areal extent of old Siang District is now divided into 5 districts, namely, Upper Siang, East Siang, Siang and Lower Saing Districts. The total number of inhabited villages in the basin is 634. The basin is dominated by Adi and Galo group of tribes having lots of traditional and customary practices which endowed them with remarkable distinctiveness from other parts of the Region, Nation and the World at large. The workforce and the livelihood of the people is largely related to primary nature of activities in which dependence on agriculture and forestry are apparently visible.

SIANG RIVER BASIN: ORIGIN AND EXTENT:

The Siang river originates in the Chemayungdung mountain ranges which is nearly hundred km south-east of Mansarovar lake in the Mount Kailash range in Southern Tibet at an elevation of 5300m. A spring called Tamchok Khambab spills from the glaciers which later gather breath and volume to become the Tsangpo, the highest river in world. Tsangpo River flows 1625 km in Tibet parallel to the main range of Himalayas before entering India through Arunachal Pradesh.

Before entering India, the river passes in Tibet and suddenly turns to the north and northeast and cuts a course through a succession of great narrow gorge between the mountain Gyala Peri and Namcha Barwa (7755m) in a series of rapids and cascades. The river then turns south and southwest and flows through a deep gorge across the eastern extremity of the Himalayas with canyon walls that extends upward for 5,000 meters and

more on each side. Shimong, Yamne, Siku, Sibia, Ringong, Sigang, Nidyang and Siyum are the major tributaries of River Siang.

The river enters Arunachal Pradesh near Gelling from where it is known as Siang. The total length of Siang River is 294 km till its point of confluence with Dibang and Lohit River. After entering India the river traverses approximately 197.0 km to join the Siyom River. From there the length of the river till Assam border is 86.3 km. Flowing further 10.6 km in Assam the river joins the confluence of Lohit and Dibang. From this point forward it flows as Brahmaputra river in Assam and traverses a distance of about 195 km up to the confluence of Subansiri river on its right bank. Further downstream it is joined by Kameng at Jamugurihat near Tezpur, after another 123 km. Geographically, Siang Basin of Arunachal Pradesh is a part of Eastern Himalaya, which is the youngest mountain system of the World exhibit a high degree of fragility; making the area inherently prone to hazards, e.g. earthquake, landslide, floods, forest fires etc.

The elevation of Siang river catchment area ranges from 90 m to around 5800 m. The total catchment area of Siang River from its origin to its confluence with Lohit and Dibang rivers is 251,521 sq. km. Out of this 236555.7 sq. km area lies in Tibet. The total catchment area of Siang River in India up to its confluence with Lohit and Dibang rivers is 14965.30 sq. km.

As mentioned earlier that more than 4/5th area of the Siang basin is under forest cover accounting approximately 15,000km², is very rich in orchids with more than a hundred species, 16 species of rhododendrons, 14 species of Bamboos and 14 species of canes and overall 27 RET species and 46 endemic plant species. 25 mammalian species found are Schedule I of WPA (Wildlife Protection Act), while 26 are under Schedule II. There are 447 species of birds, of which 31 are Schedule I species. Identified as Ecological Hotspots, this gifted region has been able to maintain its serene natural beauty and resources largely because of conservation oriented sustainable ways of resource extraction under the traditional and customary practices of indigenous people. The age-old best possible Man-Nature interaction has started deteriorating in recent times due to imposing modern culture of developmental activities.

GEOMORPHIC FEATURES OF SIANG RIVER BASIN AND IMPACT OF DAMS

A natural question arises here, what will be the condition of the 294 km long Siang River if the proposed 44 dams are being built on the river. The answer is actually alarming because the observation made by SANDRP “Only 85.5 km (29%) of free flowing water regime of Siang River will be left out of its total course in India, i.e. 294 km of lotic ecosystem will be converted into 208.5 km of lentic ecosystem altering the entire Siang river aquatic system which will adversely impact the aquatic biodiversity and seriously affecting fish populations and their migration behaviour.”

The above observations simply suggest that any developmental activities especially related to the fragile ecosystem of the basin need to be carefully assessed. Some basic characteristics of the Siang River Basin may be noted as under:

- Covering an areal extent of 15408 sq.km Siang River Basin is the second largest river basin of Arunachal Pradesh only after Subansiri river basin. It has a perimeter of 1882.71 km.
- The whole basin is divided into 8 sub-basins, namely, Lower Siyom, Upper Siyom, Yamne, Sike, Sigong, Yamsang, Shimong and main Siang interfluve.
- Sessari River Basin should also be included in the study of Siang Basin because it is not only adjacent to Siang Basin but also an extension of Pasighat plain physiographically. It covers an area of 1051 sq. km.
- Hypsometric characteristics i.e. area under different elevation category of the basin may be noted as under:

Table 1: Area under Different Elevation Category in Siang Basin

Elevation (meter)	0-500	500-1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500	3500-4000	4000-4500
Area (%)	10.84	13.09	9.03	14.67	13.54	10.61	13.99	8.57	5.87

Source: Resource Atlas of Arunachal Pradesh

- Elevation of Siang Basin in Arunachal Pradesh varies from a low of 120m to a high of 5248m. About 30% Siang Basin area appears above 3000m.
- Siang and Siyom are the two main rivers in terms of length (180 and 164 km respectively).
- Morphometric characteristics of a river basin holds immense significance. Drainage frequency, drainage density and bifurcation ratio are the significant morphometric characteristics. These fundamental elements with respect to Siang River Basin have been put together in the tabular form as under:

Table 2: Geomorphic Characteristics of Sub-basins of Siang River Basin

Basin/ Sub-basin	Area (km ²)	Average Slope (%)	Drainage Frequency (N/L) I order	Drainage Density	Bifurcation Ratio
SIANG BASIN Lower					
Siyom	2249.6	9.58	22	176.03	4
Shimang	613.5	13.45	5	135.75	5
U. Siyom	2490.1	16.70	11	100.00	5
Sike	871.9	19.60	5	107.24	5
Sigong	2122.8	20.75	16	137.04	5
Yangsang	1739.6	15.63	19	183.89	5
Yamne	1379.1	17.45	16	161.92	5
U.Siang	1655.7	16.63	11	134.69	6
L. Siang	1234.9	3.80	6	116.77	6
SESSARI BASIN					
Sessari	411.4	14.80	3	149.00	3
Sessari Interfluve	640.1	6.03	-	86.71	1

Source: Compiled from Resource Atlas of Arunachal Pradesh (S. Singh)

➤ The dense drainage network is quite evident in case of Siang basin. Stream frequency for the sub-basins varies from a low of 5 for Sike to a high of 22 for Lower Siyom. The highest drainage density follow almost the stream frequency order as it also accounts 107.24 for Sike and 176.03 for Lower Siyom; however, the lowest Drainage Density is for Upper Siyom (100) and the highest for Yangsang (183.89).

➤ Together with topography, rainfall is a determining factor for morphometric character of any river basin. Siang Basin is an area of high rainfall. The average annual rainfall of the basin is 248.24 cm.

Based on the above mentioned Siang River Basin characteristics (in terms of its sub-basins), it is important to note that the developmental activities- be it dam, road or transport connectivity or any other activities involving land and water in this area must take care of terrestrial and aquatic ecology, plant and animal biodiversity including wild life, hydrology of the basin, indigenous practices and rights over the resources and their traditional ways of management etc. Any developmental activities without the prior careful and an all-inclusive cumulative impact assessment may create series of adverse consequences. Overall development of the region in question is required but all such development needs to be people friendly as well as eco-friendly.

The planned hydropower projects will have irreversible destructive impacts on the society, forests, rivers, biodiversity, ecosystems, cultural identity and downstream Assam. SANDRP sent comments of over 1500 pages to the Expert Appraisal Committee, Ministry of Environment and Forests on Siang River Basin for consideration. The study and report has very serious short comings and bias, e.g.

- In the study, there is no mention of social and cultural impacts by 44 projects which will together submerge more than 21,000 hectares of forests and affect the entire Siang Basin adversely. As a matter of fact local communities depend heavily on the basin resources like fish, medicinal and food plants, and timber varieties for their livelihoods. It has been estimated that more than 2000 hectares of multi-cropped, irrigated rice fields will be submerged by Lower Siang Project alone.

- Downstream impacts on Assam not studied in detail. The study assesses impacts specifically on Dibrugarh, Bokaghat (Kaziranga) and Guwahati. However, there are several villages, settlements, tea estates, agriculture, forests etc. on the Right Bank of Siang in Assam after Pasighat. This includes a major part of Dhemaji District of Assam. Impact on this region needs to be assessed.

- Impacts on the stretch between D. Ering Wildlife Sanctuary and Dibrugarh, for nearly 70 kilometres are not assessed.

- Upper Siang Stage I, Stage II and Lower Siang are huge projects with direct impact on downstream states, especially Assam. The report does not include critical issues like dam safety, cumulative risk assessment, risk of landslips and landslides, seismic zones of projects, past earthquakes in the region, possible mitigation measures, disaster management, etc. There is no assessment of baseline situation about disaster vulnerability of the region and how the projects will change that.

- It is important to note that the minutes of 62nd EAC meeting noted, “The main objective of the study is to bring out the impact of dams being planned on the main Siang River and its seven tributaries on terrestrial and aquatic ecology, plant and animal biodiversity, including wild life, hydrology of the basin, etc.” Moreover the minutes of 62nd meeting of EAC says: “The Consultants were also asked to study and recommend on silt management considering “no dam” and “with dam” scenario as silt substantially impact the ecology and cause sedimentation particularly when its velocity is affected due to construction of dam.” No such study has been conducted. In fact globally, sediment balance on cascade projects is a crucial element of study, which is completely left out in the study.

- The study ignores about the people, biodiversity and other stakeholders. It ignores vital issues like fluvial geomorphology, cultural practices, hydrological requirements and sediment balance etc.

- Climatic issues related to such issues has got global significance. Unfortunately, there is no emphasis on climate change in the study. How changing climate would affect the rivers and projects and how project construction would add to climate change impacts and how they will reduce the adaptation capacity of the people and environment to cope with the changing climate. Deforestation to the scale of 21000 hectares of thick forests and complete loss of a biodiversity rich free flowing river has strong impacts in the context of climate change and these need to be assessed.
- Three mega projects on Siang Main stem, namely the 6000 MW Upper Siang I, 3750 MW Upper Siang Stage II and 2700 MW Lower Siang may have a destructive impact on the entire ecology and society of the region. It is estimated that these projects together will submerge 18,100 hectares of dense forest area and will convert entire river length into highly interrupted natural flow of water.
- The report does not do an assessment on how much length of the rivers will be compromised. The B K Chaturvedi committee had recommended that not more than 50% of the river can be compromised. However, this report did not taken care of this aspect.
- No proper investigation and assessment has been made on the loss of endangered species of flora and fauna, the greatest gift given by the nature to this species rich geographical region. Moreover, the measures of conservation and management has not been properly taken care of.

II. CONCLUDING REMARKS

The North-East is a unique region of India in many ways but the most remarkable among them is the dominance of numerous tribal communities especially occupying the hilly terrain and preserving their rich heritage and culture. Siang Basin being a part of N E India display such distinctiveness both in terms of its unique geo-ecological make up and socio-cultural set up. Siang Basin possesses immense potential of development and in any course of development environmental degradation is bound to happen. By way of environmental impact assessment, such degradation can be minimised to a significant extent. Its rich cultural heritage along with diverse bio-diversity and hilly terrain with beautiful water lines have the potential to develop all types of tourism.

Any developmental exercise, especially the development of hydropower projects must give due impetus to credible public consultation across the basin. Study should not be finalised without a comprehensive Study of Siang Basin. Only by way of comprehensive study we can have a cumulative picture of impacts on basin and on basin residents, including downstream population in Assam. The need of the hour is to address environmental issues earlier in planning and policy making processes. This could be done through cumulative impact assessment.

The people of the region are emotionally attached with Siang since time immemorial. For them the river means everything to the communities along the Siang valley in central Arunachal Pradesh. "I agree to development, but not at the cost of my people being washed away," said Vijay Taram, a lawyer and spokesman for an anti-dam group called the Forum of Siang Dialogue.

Due to the genuine public concern about their environmental concern and cultural attachment with the river regime, the construction agencies like NHPC and Jaypee Group faced the challenges from massive anti-dam movements from time to time. No doubt, their argument "Hydro projects are a boon to the society and the population in and around the projects," a statement on NHPC's website reads. "With enhanced employment opportunities, increased earnings, enriched life style and improved standard of living, the people in these localities experience an economic and social upliftment" also hold significance but the compromise with the ecological effects need to be assessed.

It may also be an idealistic picture that the advantages include exchange of ideas and cultures between various groups of people which would not have been possible otherwise. Due to longer residence of this population in one place, a new culture, having a distinct socio-economic similarity would develop which will have its own entity. Work opportunities will drastically improve in this area. However, the other side of the coin based on practical experience is that today, people living downstream of the Ranganadi dam are migrating to the state capital of Itanagar because of the disruption to their lives caused by the occasional release of massive quantities of water from the dam, according to Tongam Rina, editor of the Arunachal Times.

For developmental issues, especially in context of hydropower projects, the Siang River Basin requires lots of technical expertise, social science insights and philosophical outlook. The management principles must be based on region's and sub-region specific needs and social order's demand. The issues related to the dam must not ignore the sustainable model of development for the Siang Basin area where people have the experiences of such model from centuries and millennia.

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