Perception of Local People towards Ecological Flow in Tamakoshi River Basin, Bagmati Province, Nepal

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Abstract

The perception of people living nearby river flow differs from the people, particularly, the policy makers, who live far away from the river. The river basins are natural corridors which are increasingly in pressure from development activities, especially hydropower in Mountain region. It's very difficult to know about idea of local people toward the use of flow regime in the basin area. The existing knowledge on the use of flow regime is difficult to understand and few studies have been done on the interaction between river flow and adjoining settlements. The aim of this paper is to assess perception of local people towards ecological flow (e-flow) and overall flow diversion based on FGD. In such state, spatial understanding of these activities isuseful for planning and understanding its interaction. The researcher had not found any changes in the issues for the last one decade spatially and temporarily. The present study was conducted in the Tamakoshi River Basin during 2014 and 2015. It concludes that there is strong relationship between use of flow water and riparian settlement with fishing, graveling, sand extracting, which contribute to ecological condition and share expectation. The expectation of obtaining hydropower shares (IPO) is increasing but majority of them are unaware about long term ecological disruption. If this trend continues along the river basin, many of the settlements from the upper part to middle part will expect IPO shares. The interaction with people highlights major opinion that the flow disruption is good for the power production, but long run impact must be taken into consideration and this article will make a valuable suggestion towards policy level.

Keywords: River flow, ecological flow, settlements, share, hydropower development

Introduction

Perception is the way for individual to recognize and interpret the environment. Flow regime is the main force of geomorphologic change in the river valley. The perception of people living nearby river flow regime differ from the people living far away (Policy people) from the river valley. Although there is growing awareness of ecological flow caused by development activities, it remains unclear how the local people perceived the ecological flow and its consequence in river ecology. It also differs from theoretical or model than empirical knowledge.

River basins, particularly in Nepal Himalaya forms the majority of wooded, natural habitat, biodiversity, which are essential for regulating natural flow of water in the river which fortunate many of these flow regimes of the rivers are undergoing rapid change from the development activities. Many local people and local government themselves rather unequipped to handle this rapid change. A more holistic approach is needed at present to create working for the river corridor which include local perception

The vast altitudinal variation within the short span of about 193 km, ranging from 60 meter to 8848.86m above the sea level makes the country an abundant storehouse of biodiversity and ecological niches with diverse eco-climatic zones e. g Humid tropical in Tarai, moist in Siwalik, temperate in Siwalik, temperate in middle hills cool to sub- alpine in High Mountains and alpine to arctic in High Himalaya (CST, 1997).

Observations of regional and seasonal variation at different parts of the country resulted in high rainfall regions and season are recording increases in precipitin and becoming wetter whereas low rainfall regions and season are recording deceased in precipitation and becoming drier. Rainfall in Nepal is influenced predominantly by the southwest summer monsoon in the east and western

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disturbances in the west, along with altitude changes. Yearly rainfall increases as altitude increases up to 3,000 meters, and beyond that decreases with increasing altitude and latitude. Almost 80 per cent of the annual rainfall average of 1,900 mm occurs due to southwest summer monsoon between June and September Nayava, 1974). The changed intensity and amount of monsoon rains positively correlate with the increment in water induced disaster like floods and landslides (Ministry of Home, quoted in DWIDP and Nepal, 2011). Torrential rains during the monsoon render the country highly susceptible to water induced natural disasters such as floods, landslides, flash floods, debris flows, slope failures and Glacial Lake Outburst Floods (Paudyal udyal & Pandey, 2009). The rainfall pattern also make difference in the flow regime spatially and temporarily.

Research on perception, attitude, and behavior emerged as a distinctive area of enquiry during the early 1960's. As Burton (1964) has observed, 'the social role of attitude and perception studies is to provide an input into the planning process and to serve as a vehicle for public participation in decision making (Mitchell, 1979). "Perception" is the process by which we receive information or stimuli from our environment and transform it into psychological awareness. People infer about a certain situation or phenomenon differently using the same or different sets of information (Ban and Hawkins 2000). Knowledge, interest and culture and many other social processes that shape the behaviour of an actor who uses the information and tries to influence that situation or phenomenon (RECOFT 2001 cited in Banjade, 2003).

The local people perceived two major flows of river: summer flow and winter flow. The perception of flow of water and its interaction with local river is high on people's experience. This varies with the proximity to the local people, free services from the water flow and their knowledge of ecology. The time dimension and surrounding environment is also reflected by this expression. The knowledge experience differs spatially and temporarily. The aim of this paper is to assess perception of local people towards ecological flow (e-flow) and overall flow diversion.

Rationale of the study

The concept of ecological flow for requirement of river health and downstream riparian settlements started since 1996 with the Integrated Treaty on the Mahakali River with India. It had a provision for releasing 10 m^3/s flow for ecosystem needs. (SWECO, 2010). According to the Hydropower Development Policy in Nepal (1992) and first amended 2001 Act 6.1.1, 'provision shall be made to release such quantum of water which is higher or either at least ten per cent of the minimum monthly average discharge of the river/stream (MOWR, 2001)

As per government rules, the Upper Tamakoshi Hydroelectric Project (UTHP) with capacity of 456 MW has adopted policy of compliance release of 1.3 m^3/s is enough for the maintenance of adequate wetness conditions to support the ecosystems. The stretch of the e-flow is about 11 km between Lamabagar to Gonger. Moreover, the additional 2 km of dewatering stretch in Rowling valley is proposed. Thus, there will be 13 km of de-watering zone in Upper Tamakoshi Project site. The Tamakoshi 3 HEP (600MW) is proposed in the middle part of the Tamakoshi River Basin. The e-flow of the project is fixed at 15.25 cm^3/s, which will make dewatering zone of 20 km stretch. (SWECO, 2010). Similarly, The Khimti Khola Hydropower (60MW) which has been regulated since 2000 minimum release or E-flow is maintained at 500l/s throughout the dry season (HPL, 2002).The total stretch of dewater zone is 11.90 km. The number of fishes and its habitat has decreased inversely with its altitude after adoption of E—flow. Similarly, Environmental Protection Acti (2019) and Environmental Protection Regulations (2020) and environmental guidelines also approved that the release of flow regime 10 percent enough to maintain river ecology and its interaction with local settlements.

Theoretical and conceptual framework

The present study is guided by positivism and humanistic philosophy. It has been carried out with knowledge of ecological phenomena of the water flow. The applied theory in the study are cycle of erosion (Davis 1889), hydrological theory (Sherman, 1932), river flow models (Moss, 1988), natural

river system (Whoel, 2012). The adopted tools like biological, use of mathematics and statics tools which has been adopted to a new approach in the geography. The part of the natural flow are with ecological flow (EPA 2019, EPR, 2020). This is a paradigm shift in the use of flow regime in water basins of Nepal. The idea also attracts the theory of natural flow and its relationship with local settlements

Thus, positivism of this study is consisted of formal observation, flow measurement of the river, statistics derived from different offices, field survey with questionnaire, etc. The knowledge of ontology and epistemology are applied. The study interaction between river ecology and local communities takes positivism as research has carried out the research on his value and burdened the appraise through information collected from various sources so the axiology is considered as value laden.

The humanistic philosophy is also adopted in the sense that the researcher has collected qualitative data from discussions with local people, key informants, perception of people regarding hydrology of flow diversion, resource extraction (sand, gravels) and fishing activities.

This has been examined by with help of their feeling and attitude towards the flow regime and its further consequences. The difference of feelings their association with river –ecology is thoroughly examined with help of different techniques like Multi Cariteria Decision Analysis (MCDA).

Based on the literature, a conceptual framework has been prepared for this study The conceptual framework model demonstrates the river basin hydrology and its interaction with flow regime and riparian communities. The desired environmental flows maintain basic hydrology–ecology aquatic ecology fish, terrestrial fauna associated with different riparian altitudinal ripples, pools, and community. It provides basic goods and services for food security, recharge in clean air and water, and contributes to local livelihood and economic development that are essential for achieving SDG by raising livelihood (Fig 1).

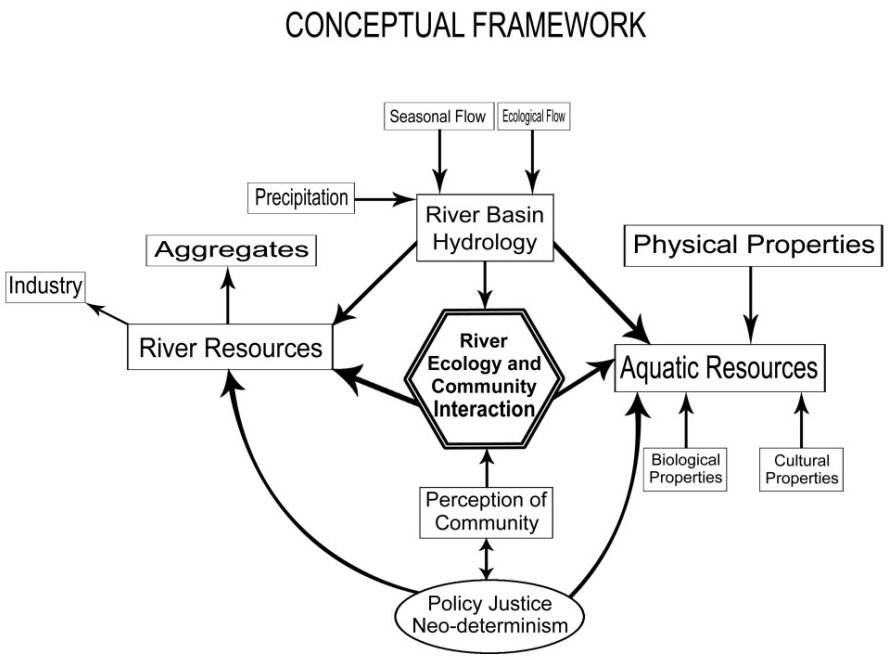

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Figure 1: Conceptual Framework

Based on the review and conceptual framework developed for this study, a research methods and material prepared which is discussed below.

Materials and methods

The perception on the water flow study was collected for two successive years during pre-monsoon, monsoon and post- monsoon period of 2014 and 2015 using area flow method and Pigmy method for collection of tributary flow. The researcher had started the study in the topic in 2014/2015 and has been waiting for the changes in the situation since 2015. Since then people's perception regarding the flow exploitation and government policy on e-flow regime have remained unchanged. This validates the data valid for even today. The focus group discussion (FGD) with at least 10 local villages was adopted to acquire information regarding perception of flow regime. Its ecological services, religious value, and local livelihoods. A total of 10 FGDs along the river basin was organized. The number of people attending the discussions were ranges from eight in the Lamabagar to 10 in the Manthali total 92 people attended in the focus group discussion.

Moreover, the informal discussion and 15 key informant interviews (KII) were also held with local key persons and information was also acquired from the concerned stakeholders of watershed offices, District Coordination committee members from the administrative units covered from 10 Rural Municipalities and two municipalities: Bhimeshwor and Manthali municipality. The observation was made from Lapchi to Tribeni confluence of Tamakoshi and Sunkoshi River.

For socio-economic view, a total of 412 sample households were selected from 58 sample riparian settlements accounting for 20% (at 95% with 4% error) of the total households of 2,102 all along the river covering its Ist sector (China Nepal boarder to sipring Khola), IInd sector (Sipring Khola – dolti Khola), IIIrd (Dolti khola- Tilbung Khola) and IVth sectors (Tilbung khola – Tribeni, confluence of Tamakoshi and sunkoshi River). The sectors are division of study area into four divisions for classification. The households by settlements were based on the 2021 population census (NSO, 2021) ().

The analysis of the flow data results related to the river hydrology and E- flow ecological has been performed in graphs, SPSS with reference to the relevant studies. The analysis of all data and information has been based on the four sectors: Ist , IInd, IIIrd and IVth of the study area.

The Study Area

Located in the central mountain region of Nepal (Figure 2), the Tamakoshi River Basin consists of two types of relief features in terms of elevation, namely high Himalayas and lesser Himalayas, according to the physiographic divisions of Nepal (Burathoky & Malla, 1968). The elevation of the terrain rises from 380 meters at the confluence points of the Sunkoshi River and the Tamakoshi River in the south to as high as 7,117 m (Mt. Gaurishankar) to the north. The basin has been extending from the Tibetan (China) border in the north to the confluence, locally known as 'Tribenighat' in the south. The Tamakoshi is the main river, and 72 feeder streams join it in the basin. The basin has a total area of 2700 km^2 out of which 50 percent lie in the Tibetan Autonomous Region of China (DHM, 2011).

For the study, a buffer zone of 1000 meters on either side (east & west) of the Tamakoshi river has been defined. The study area comprised 30 local administrative units, including 28 village development committees or village areas and two municipalities of two districts–Dolakha and Ramechhāp (Figure 2). The estimated number of households of the basin were 68,163 (with a mean household size o 3.4 persons), consisting of various castes and ethnic groups, such as Janajatis (ethnic), Bahun-Chhetri, and Dalits. The Lamosangu-Jiri Road passing through the basin is the main thoroughfare, which connects with the Araniko highway at Khadichaur linking Kathmandu Valley with Tibet. The Araniko or Kodari highway was built in 1966 and is the country's second oldest highway.

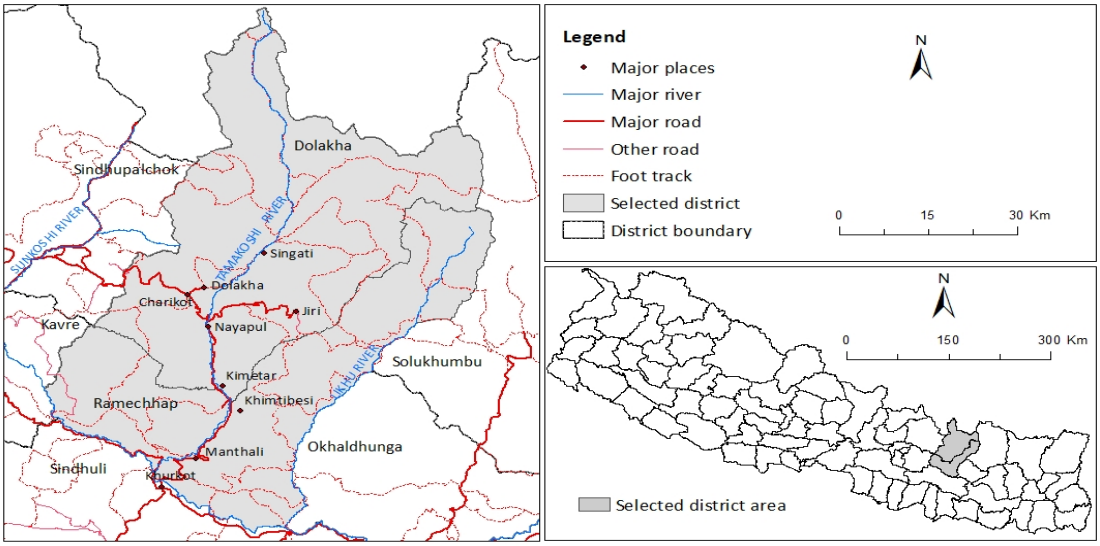

Fig. 2: Location of the Tamakoshi River Basin, central mountain region of Nepal

Geographically, the study area extends from 27° 19' 00" North to 28° 10' 00" North latitude and 85^0 30' 00" East to 86^0 30' 00" East longitude. It's surrounded by the Tibetan Autonomous region of the People's Republic of China in the North, Sindhuli district in the South, Okhaldhunga district in the East, and Sindhupalanchowk district in the West.

Results and discussions

Hydrological Characteristics

The TRB has a basin area of 2.753 sq. km with a mean annual basin precipitation of about 1.153mm (DHM, 2011) The mean annual precipitation for year at Nagdaha and Charikot is about 2190 mm and 2100 mm, respectively. The average rainfall of Jiri is equivalent to 2300 mm. Higher distribution of rainfall in these locations is due to altitude, location as well as the east of the basin which effect local climatic phenomena. The southern part near Manthali receives less than 50 per cent (1029.03 mm) only (DHM Climatological Records). The southern part represents the driest region while the northern part is snow cape mountain. The rain fall pattern is strongly related with month of July and September. From, January, temperatures increase, reaching a maximum in August. Relative humidity varies between 65% and 90%. (DHM, 2011)

The river runoff is nearly 72 per cent of the total precipitation and nearly 90 per cent of the above and 63 per cent of the total runoff occurs within three months i.e. July- September. This can be correlation within rainfall and discharge. In the east Nepal the calculation must be multiplied by 1.5 to go near the observed one whereas for western Nepal the calculations reach near to observed. In Bagmati River the calculation must be divided by 3. This value still can help to some extent. (Sharma, 1977).

The flow of water in upper part of Lamabagar is gentle but in other part it's mostly deep and has high gradient. The people in these areas mostly use water from the local spring because it is warmer and mostly the water is in the form of snow. The flow is mostly noisy and physical types of erosion are observed. The water flow is good for hydropower production since most areas are gorge types. The minimum flow of the Tamakoshi ranges from 19.88.m^3/s in Lapchi to 258.76m^3/in Tribeni within distance of 110 km. The corresponding flow rises from 19.88 m^3/s in Lapchi to 258.76m^3/s in Tribeni. The temporal variation of the flow during pre-monsoon, monsoon and post monsoon has been recorded 32.08m^3/s,360.04m^3/s and 67.76m^3/s respectively. The figure represents 6.9%, 78.43% and 14.71%in pre-monsoon, monsoon and post monsoon respectively (For detail see Shrestha, 2023).

The middle parts slope is moderate and water discharge is between 147 m^3/s 197 m^3/s (Busti, Station No 647, DHM). But water is mostly used for irrigation and other purposes. The flow in the water in Manthali location is distributed equally all over: the valley. In this part the people are using grazing, irrigation and other purposes in river side of the Tamakoshi (Shrestha, 2015).

Perception on Flow Regime

The flow of water in the Tamakoshi is viewed as gods' gift by local people. The upper most northern part of the basin is covered by Gaurishanker Himal, meaning God of Mahadev and Parvati, according to Hindu Methodology, the whole basin is termed as a *Tambakhusi* meaning a river with brass, symbol of Manadev. So, the local people think that the flow of river is the symbol of God gifted water or jal (pure water) The existence of Bhimshewor temple is one of the main symbols of the Mahadev in Dolakha. However, the paradigm on the flow has shifted from traditional to modern thought. The new generation views the flow as a development driver in addition to traditional view on agriculture, forest and other activities.

During the field, people of the Tamakoshi Naya Pool share view that the flow of the river is more erratic in 2015 than 2014. These types of erratic flow occur usually in the upper part during monsoon season each year. But the scene is found everywhere this year probably due to the earthquake of 25 April 2015. The fat was also proved by the researcher's observation of the flow during two weeks field visit in July and August 2015. Change was seen every two to three hours frequently during these filed visits (Observed in August 15, 2015). According to the Jyamire people, the water flow by Betine was nearly on the one sided about a decade ago but now it is flattened and covers wide area. Similar types of views were also expressed by people of Singati, Nagdaha and even Manthali.

Local people have observed different types of flow in the basin during the past one decade. They also have change diverse aspects of the flow pattern. Some of them linked all those flow with different types of ecological significance. The responses acquired in the 10 FGD from Lamabagr to Manthali are classified in to three themes of perceived interaction are mention below:

Table 1: *Perceived products and ecological interactions*

Major ecological services	Perceived products and ecological interactions
Natural and aesthetic • Religion/spiritual elements	• Development and maintenance of temples with arts at confluence site of two and more rivers, aesthetic elements and value, sacred river
Product resources • Water supply and irrigation	• Water as means of livelihood, life blood, health and sanitation; irrigation to increase production of food crops; growth of plants
• Sand and gravel	• Means of livelihood of marginal groups; commercial use for infrastructure construction; over extraction and ecological degradation, losing traditional catching methods of fish species
• Miscellaneous (drift wood, water mills, boat, share benefits, etc.)	• Wood collection for fuel wood; use of non-timber forest products for fishing and domestic purposes; boating and rafting; hill-basin interactions in flow of people, products and resources; micro-watershed conservation; terrace farming and soil conservation; growth of settlement built-ups; water mills and micro hydroelectric plants; landslides and floods; distribution of shares of hydro-electric projects among local people; increasing landless groups
• Fishing	• Means of livelihood of Majhi and other marginal groups with no own land for food production; increasing demand of fish due to rising hotels; decreasing in fish abundance due to use of noisy devices; prohibition of fishing around Buddhist monastery area
Ecology of riparian belt	• Aquatic biodiversity of indigenous and migratory fish species and trans migratory birds, abode of fish and other insects and animals and indigenous people and their ecological interdependence; flow of river water and maintenance of chemical properties; interventions of human activities affective riparian ecology, displacing indigenous people by migrants; efforts to maintain river ecology are essential; participatory of indigenous groups in policy decision

Source: Field Survey 2014-2015

The number of focus group discussion (represents general people of the local area) and KII (District Forest Officer, District Engineer, District Soil Conservation Officer, mayor of the municipality, Chirman of ward and Rural Muncipalityetc,) inthe area shows that the local people's knowledge on the Importance of flow in the basin has increased. From FGD it has been found that the people have been thinking the flow as the main sources of economic development which where not conceived by people before. Out of the total household surveyed in the basin, one fifth (20%) are aware on the flow and its relationship with whole basin ecology but majority of the people (almost 50%) either on HH survey or on the KII and FGD were unable to provide the right decision on its use as most of them are from rural area. (Shrestha, 2015). The location wise interaction of the flow of water is presented in Tale 2 f.

Table 2 : Location wise Interaction with flow regime

S. N.	Interaction Area	Lamabagar	Singati	Gumukhola	Charikot	Nagdaha	Charange	Malu	Devitaar/Share	Gelu	Manthali
1	Community Fishing		X	X		X	XXX	X	X	X	XXX
2	Drinking Water and Irrigation	X	X	X	X	X	XX	XXX	X	XXX	XXX
3	Ecology in Riparian Zone		X	XX	X	XXX	XX	X	X	X	
4	Sand and Gravel	XX	X		X	X	XXX	XX	X		X
5	Religion/Cremation Sites		XX	X	XX	XX	XXX	XX	X	X	XXX
6	Marginal Community			X	XX	XX	XXX	X	X	X	XXX
7	Share		X	X	XX	XX	XXX	XXX	XXX	XX	
8	Miscellaneous				XXX		X	X	X	X	X

Note: Interaction: XXX = High, XX = Moderate, X = Low

Source: Field Survey 2014 and 2015

The major theme of the above interactions is presented below.

Product resources

The FGD from the Charange downstream showed the main importance on this aspect. However, people from Lamabagar also know its importance but use of the resource is very limited over here due to unaware and lack of transportation. People have idea that the sand and gravel is the function of river flow and it is highly correlated with flow regime. Higher the flow more the deposit and vice versa. The people of Charnge say that about 50 family members of the marginal group are depended upon the river flow.

The flow of river water is the basis of livelihood of marginal community. Major Communities are Majhi, Bhujel. Surel, and Sunuwar. Among them Majhi are one whose cultural activities and livelihood are more dependent on it than other. Most of the other have good and productive and but these groups have only marginal Land. The Majhi people specially from Malepu to Tribeniare employed partly or permanently in river flow pattern. This trend is more live as one move downwards from Karambote. Even other caste people in locality of Brange of Tamakoshi, Charange, are dependent on it. However, the people of the Manthaliare depend upon the fishing activities than the exploitation of the sand and gravel activities.

Share

Share capital is the money a company raises by issuing common or preferred stock. The amount of share capital or equity financing a company may change over time with additional public offering.

The hydropower project in the study area was constructed by the company in order to arrange the fund for such project. They issue different types Initial Public Offering (IPO) shares. To find out the stakeholder support in the project implementation, the government directed company to issue the IPO. In FGD majority of people expect the share from alternate use of flow regime. The people from middle parts (Singait to Devitaar) want share of river flow from hydropower production. The people of Devitaar sought 10 per cent share from flow used for development activity, while people from Malu ask for reduced rate of energy generation with share. Charange FGD raised for free share. This phenomenon is less in Lamabagar and Manthali. The flow velocity and local idea also correlate with this aspect, in both places the river flows in flat land and with low velocity.

Miscellaneous

The miscellaneous refers to drift woods, water mills, boating, animal yellowing, grazing etc. The people relate the water flow with industrial activities (ghatta) operating throughout the basin. But the number is about 30 inin the middle part (Singati) than south and north. Singati FGU related this with electrification of hydropower and diesel plants in several places. Water from tributaries of Tamakoshi River has also been diverted at some places to run mills. Similarly, a grinding mill at Nagdaha and Devitar utilizes water from tributaries. This type of mills is observed in locations is Malu Devitaar, Karambote. Chisapani Bhatauli etc.

In addition to other FGDs, participants in this group also associated the river flow with various aspects such as livestock grazing, agricultural practices, and farming. They highlighted the cohesion among local people due to working together during the summer flow regime, the aesthetic value of the river basin, and the opportunity for free swimming and greenery in the area. The discussion also brought out positive aspects related to employment opportunities and increasing royalties from the use of the river's flow, particularly concerning the production of more than 2,000 MW of electricity from the basin. Another interesting point raised was the upstream-downstream interaction, which is notably low in the case of the Khimiti Project.

Fuelwood collection was also linked to the river's flow. The wood carried downstream by the river is the primary source of firewood for people living in Pikhuti and further downstream. Field observations indicated that residents in Manthali and the confluence areas rely heavily on this source. FGDs revealed that about one-third of the yearly fuelwood supply in Malu comes from this driftwood, with the percentage being even higher in Manthali, where this source is sufficient for almost the entire year.

Everything over here is possible due to Koshi and its flow. Paddy field for food grain, forest for fuel and wild animals and water and fish from Tamakoshi, grinding mill from Dolti and plain land with deposited silt were possible due to Tamakoshi flow. However sometimes they must spend labour to sort out the boulders. Tamakoshi Stakeholders Committee needs to form local governance of flow regulation from any development projects.

The flow and low area is related with tropical vegetation and moisture regime as a result the area is becoming part of mango, ginger, and other things too. The FGD focused on relation of flow with lifting water from flood during monsoon. Furthermore, local people representing from Janajati also relates the flow with making beer and Rakshit (local alcohol). People of Manthali aren't fully aware about the share and they want to use the water only for pumping. The area was once dry but now they have water flow by lifting system. So, they are interest in other activities than diversion of water. The physical feature of the area also shows this kind of phenomena. Even the higher stakeholders are also focused on the basic requirement and water distribution rather than its exploitation of flow.

Fishing

The FGD from all the location revealed the importance of fishing except Lamabagar upwards. The people of Lamabagar are mostly Buddhist and they do not make any kind of fishing and those activities are prohibited religiously in the Lamabagar and upwards. Spatial interaction shows that the number of fishing household (15 HH) increased downstream from Singati and highest in Manthali

(more than 300 HH). The entire Majhi people of Manthali and southern part depend partly and fully dependent upon the fishing activities. The people view the flow regime as species differences of fishes. The Majhi are aware about the types of fishes and its flow regime spatially and temporarily. The image of flow regime is well acquainted with Majhi community than other communities.

According to the total house hold survey (412 HH) more than 50 percent of the people (56.44%) are in favor of diversion of flow and less than one fourth (23.46%) are against it, no idea (7.5%), dry in downstream (4.75%), Dry spring (13.33%) and drowning (0.76%).

The similar result was found in the study of Chitwan valley. The augmented flow of East Rapti River was not enough to support the ecology of Chitwan National Park (Khadka &Joshi, 1992; Primack, 2013), Ganga and Yamuna River (Dutta, 2014, Yangauli River, New Zealand (THT, Aug, 12, 2018), Kaligandaki (THT, August 8, 201) and Marshyangdi (Shrestha, 2000).

Owusauet al., (2023) found that construction of hydropower not only raises the energy, rather it equally raises the problems of downstream area like changes in livelihood, disappearing of aquatic diversity and so on. Litnov and Golonov (2004) concluded that decline of ecological diversity (flora and fauna) due to dam construction, Leasure and Magulick (2011) viewed that the e-flow is still doubt in fulfilling the ecological systems of the river, Mishra, Tripathi and Babel (2014) discover that the changes in flow regime with respect to the temperature changes and ecological system of Gandaki river and Sada (2017) detected that 10 per cent flow as a ecological system may raise problem of water user in the downstream and does not fulfill the requirement of ecological system and water uses problem between downstream and upstream; CDG (2015) raised the question of changing geomorphological system of downstream area following dam construction.

Conclusion

The observations made by local people regarding the flow regime and interactions vary spatially and temporally. While local experiences differ based on time and scale, some observations align with scientific perspectives. Geographically, these claims hold validity as many people have noted significant changes in flow regimes and interactions over the past three decades. The flow of the river is a key factor affecting the livelihoods of communities downstream from Chanange, including those involved in fishing, ecology, sand and gravel mining, and religious activities. Focus Group Discussions (FGDs) and Key Informant Surveys (KISs) revealed that many residents are directly or indirectly dependent on the river's flow regimes. Additionally, many believe that rising temperatures over the past two decades have contributed to increased flow regimes, a fact supported by discharge measurements at the Busty station.

In the upper and middle regions, most people correlate the flow regime with share ownership, a new concept where they seek investment in water resources from donor agencies rather than utilizing their own resources. This highlights the need for the government to establish proper regulations concerning the interaction between settlements and changing river flow regimes. Furthermore, more scientific studies are necessary to address the challenges that may arise soon due to the extensive use of river flow (10%) for development activities.

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