From divergence to convergence: Navigating the water-energy-food nexus in case of the Teesta

Abstract

The Teesta River dispute between India and Bangladesh has been a matter of debate and criticism, particularly due to the failure on the part of the government to negotiate an agreement on sharing the waters of the Teesta. The river considered as vital for both the countries, and hence coming to a consensus is a major challenge given the diverse interest, and benefits, arising out of it. Considering the depth of the issue, the paper makes an attempt to analyze the issue from a holistic water-energy-food nexus to try and investigate the issue more closely. The paper is qualitative in nature, where inferences have been drawn from the various literature on the nexus and attempt has been made to provide a more holistic approach towards the issue. The study contends that adopting the nexus approach would provide a solution in arriving at a consensus, and resolving the underlying issues between the two, through an integrative policy.

Keywords: Water-energy-food nexus, Resource security, Resource efficiency, Teesta, India-Bangladesh

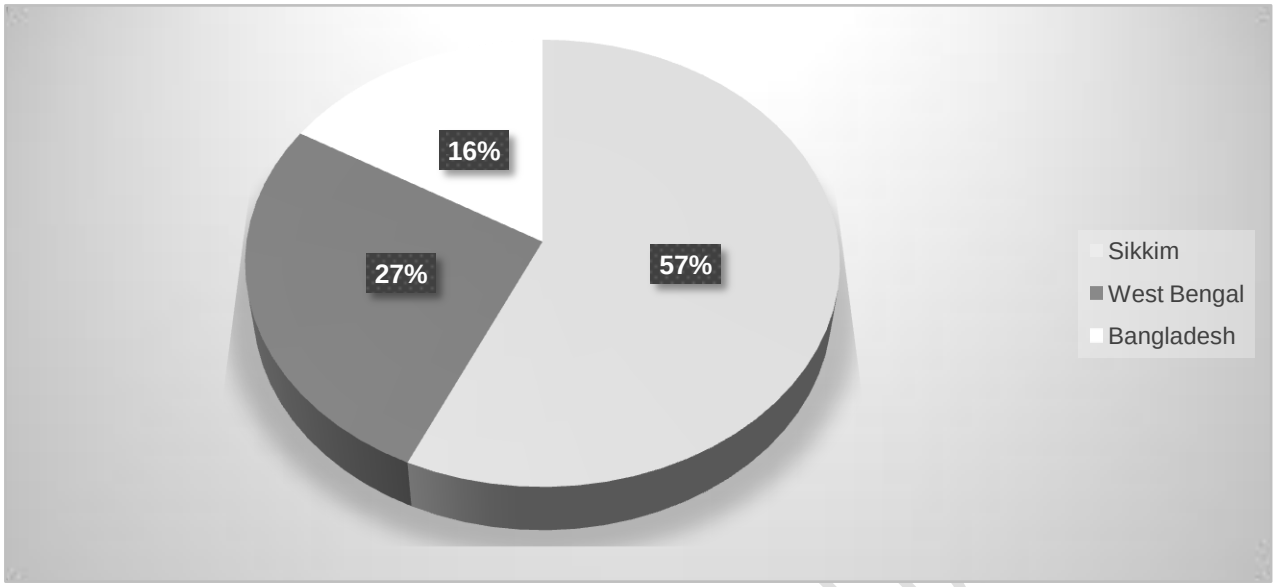
Introduction

Management of the water resources, becomes crucial in the light of water becoming a scarce, and limited resource. Since water is linked with various aspects like social, economic, political, ecological, as well as strategic, therefore, there is competition between the states to secure their own interest, considering the increased demands for it. These demands can range from basic drinking and sanitation, to food, energy, economic, and development. So, when water is to be shared, the decision related to its use, and distribution, brings in complexities due to the different values attached to it, which can lead to contestation, conflict, and at times cooperation. Cooperation becomes obligatory for the nations here, due to the interdependency brought through the transboundary water sharing. The situation becomes more and more complex, as

water scarcity and dependency intensify, as it further widens the gap between demand and supply. It becomes all the more difficult for the nations around the world to secure the resource, posing a threat to the global security, which in turn is linked to the areas of water-energy-food sectors (WEF) (Bazilian et al 2011). Often the decisions and policies formulated with regard to water sharing and management, fails to highlight the issue concerned, due to the ignorance of the interlinkages that exist between the three sectors. It therefore, becomes pertinent to understand the nexus which are interrelated yet distinct, as decision in one sector is bound to have its implications upon the others. Not only that even ignorance and too much attention or emphasis on one sector can have serious repercussions upon the others. Since the three sectors are interconnected and water being a finite resource is central to it, it affects the policy formulation and policy choices. Therefore, it becomes all the more significant for nations particularly those sharing the water resources to consider the linkages that exist, making the study of the nexus even more crucial. It not only helps in resolving the environmental issues but also in reaping optimum benefits.

In the light of the above arguments, the water sharing between India and Bangladesh on the Teesta River has been taken as a reference point which has primarily attracted the attention of the policymakers, academicians and the researchers alike. The river which has its source in the Indian state of Sikkim at an elevation of 5280m, flows through the state of West Bengal to Bangladesh before meeting the Brahmaputra River in Kurigram (Suryanarayanan 2010). The Basin has a catchment area of 12,159 sq km, of which 16 percent of the area lies in Bangladesh whereas the rest lies with India (see Fig. 1 below) (Khawas 2016).

Figure 1. Teesta Catchment Basin



Source: Based on the study

It has been a matter of concern for both the countries, where despite several attempts at negotiation, arriving at a consensus and concluding a treaty has been a challenge since 2011. Since then, the Agreement has not seen the light and various attempts at negotiations has desperately met with disappointments raising serious questions about the credibility and effectiveness of both the governments as well as the policy makers. The factor of Domestic Politics has and still continues to play a dominant role in both the countries but the inability to come to a consensus and negotiate on Teesta water sharing requires an in-depth and a holistic approach to be adopted to analyze the issue more remotely in identifying the priority interconnectedness.

Therefore, based on the said arguments the paper aims to

1. Analyze the issue from the nexus perspective.
2. Navigate whether adopting the approach can help resolve the issue and create opportunities for both.

Review of literature

The water-energy-food nexus is relatively a new approach as an academic discipline, that has come into light where researcher and academicians have been probing into the approach to find a viable solution to the problems related with water sharing and management.

With an emphasis on integration and interdependence of the three sectors- water, energy and food, the approach focuses on the synergies and tradeoffs that exists between them (Bazilian et al 2011; Larson 2014; Wolf et al 2016). This approach is seen as crucial in understanding not only the interrelationship between the sectors, but also in determining the policy choices. Developed in the 1990's and 2000's particularly with regard to the Bonn 2011 conference and in the wake of the world-wide food and economic crisis. The nexus aims at looking into the water issue from a holistic approach and accordingly tends to find a sustainable solution.

But as pointed out by Bazilian et al (2011), the nexus primarily depends upon the perspective of the policy makers, and their relative priorities. If it is water perspective, then food and energy happen to be the user of the resource where water is needed to

produce, transport and use all forms of energy and produce food. If it is food, then water and energy are the inputs, while in energy perspective the others happen to be the output which is required for extraction, utilisation, distribution as well as treatment of waters. In the nexus, water is regarded as central as it is an irreplaceable resource. Factors like increased population, urbanisation, industrialisation along with climate change has further accelerated the dependence upon the resource thereby pushing the demand for it leading to its over extraction.

In case of ensuring food security, the resource is essential for irrigation and increased productivity, hence majority of the water resources tends to be consumed by the agricultural sector. The situation is more crucial when a nation thrives on an agrarian economy. This is collaborated by the report of the Food and Agriculture Organisation (FAO), Aquastat, where agriculture accounts for 69 percent of annual water withdrawals, while industry 19 percent and household 12 percent. But if we view it regionally, then the figure somewhat varies like the case of Asia, wherein, agriculture accounts for more than 80 percent, while, industry is 10 percent and household a mere 9 percent. This figure tends to tilt upwards as the world population grows. It is further estimated that the demand for food, water and energy will increase by 35, 40 and 50 percent respectively by 2030 (NIC, 2012). This in turn is bound to have its implications, and put additional stress upon the water resources. As increased population would lead to increased demand, which would also lead to an increased water withdrawn capacity, as there will be greater pressure to ensure food security. To provide food at an affordable price would eventually lead to increased productivity. This would not only lead to greater use of fertilisers, pesticides, farm machinery, long distance channeling of water, modern food processing and packaging, rapid transport but in turn would transform agriculture into more and more water intensive (Chellaney 2014). Food security also requires equitable access but disagreements related with policies and access to water, mismanagement impedes it (Scott et al 2018).

Again, to ensure food security, energy is required and water is regarded as vital for energy production. According to Malik (2009), 85 percent of the electricity is used in most farms to pump groundwater for crop production. In fact, energy is regarded as the backbone of the economy and hence there is a greater emphasis amongst the nations towards its development particularly in terms of hydropower generation. Roughly 75 percent of the industrial withdrawals are used for energy production and 90 percent of global power generation is water intensive (UNESCO, 2014). As per the IEA, this water withdrawal for energy consumption is likely to increase 20 percent by 2035 which in turn will increase stress on water resources. Thus, there is a competition amongst the nation towards the drive for energy which by 2035 is going to increase by 87 percent (Hoff 2011) leading to further exploitation of the water resources. Complexities arises because the world would look for an alternative source of energy, which in turn leads to another issue of equity, related to access as pointed by Scott et al (2018). This is because the alternative sources that exist makes the true price of energy more internalized, thereby making energy less affordable. Hence making access restricted and limited and thereby impacting the vulnerable, the poor and especially the developing countries.

The water security comes third in the nexus, but is the central focus of both food and energy security. It is defined as the ‘reliable access to safe drinking water and sanitation’ together with ecological protection (UNDP, 2007), a basic human right (Hoff, 2011); ‘reliable availability of an acceptable quality and quantity of water’ along with addressing the water-related risks and issues of ‘environmental protection

and mismanagement of water resources' (Rashid, 2014). According to the World Water Council (2000) & the UN Water (2013), water security entails meeting the basic needs; securing food supply; protecting the ecosystem; managing the risks; protection of the livelihoods, human rights, culture and recreational values; adequate water supply for socio-economic development and activities; collaborative approach to Transboundary water resource management to promote freshwater sustainability and cooperation; good governance and accountability. The failure to do so leads to water insecurity, which makes nations to undertake various measures often leading to conflicts and confrontations**.**

It is also to be noted here that each and every sector is bound to affect as well as complement one another. If we talk about water for food, then it though helps in securing food security and increase production thereby improving the livelihood and economy, yet it also can affect the water resources. This is due to the dependency upon water resources for agriculture hence increased productivity means increased use of water resources more so in water intensive food products. This in turn implies over extraction of groundwater and thereby exhaustion of the resources leading to water scarcity. Similar is the case with water for energy. It is significant in generation of electricity through development of power plants/hydros, cooling of plants etc. Yet one cannot ignore the fact that it also has the tendency of affecting the quality and quantity of the water resource to a larger extent creating an unsustainable pressure. So, although these sectors seem independent yet a closer analysis would reveal their growing interconnectedness and dependency making proper management of the resources significant. It also brings to the fore that a neglect in one and over emphasis on the other can have serious implications like social and political instability, geopolitical conflict and environmental damages which makes it all the more significant for policy makers to give adherent push towards it (Hoff 2011; Bizilova 2013). Therefore, understanding the nexus is important to develop an integrated approach towards water management which in turn would facilitate social stability and economic growth. Understanding the nexus is seen as significant in maximizing the benefits and minimize the tradeoffs, improve resource use efficiency and lower the social and environmental impacts () thereby emphasizing on sustainability.

Methodology

The study is analytical, therefore qualitative, where inferences have been drawn from the existing literatures, which includes reports and publications to gain insights on the issue.

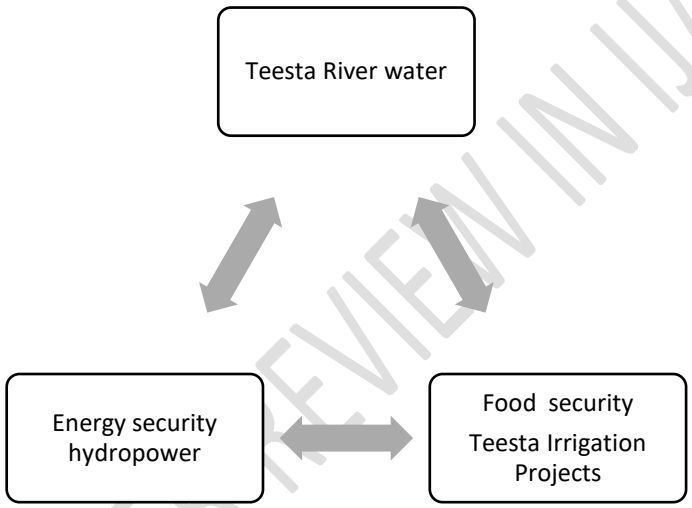
Discussion

The rising demand for water, food and energy has emerged as a nonconventional security threat around the world. Among the various reasons cited, one that can explain the failure of the policy/decision is the lack of nexus approach in understanding the core of the issue which in turn has also led to undermining of the interests of the various stakeholders concerned. The Teesta River basin is a transboundary river shared between India and Bangladesh which has its source in the Indian state of Sikkim. The basin is home to 30m people with 29 percent in India, and 71 percent in Bangladesh (Sardar 2021). The river is rain-fed so there is seasonal variation where 90 percent i.e. 54BCM of the volume falls in the monsoon (June-September), whereas a mere 6BCM is found during the lean season (October-May)

making the ratio 1:10 (Raj, 2013). Complexities arise due to increased scarcity and dependency upon the river, together with different values attached to water, leading to lack of consensus.

So where and how the nexus is related?In the case of Teesta, the issue lies in the fact that there is a greater dependency upon the river for securing not just food, but also energy security, and hence it affects and implicates the policy choices of both the countries. An informal trade off does exist between the country where water is essentially viewed as a 'peace deal' whereby in lieu of sharing waters by India during the lean season, Bangladesh cooperates on tackling various security concerns of the former (Raj 2013).

Figure 2. W-E-F nexus in Teesta



Source: Based on the study

It becomes imperative to note that both the countries, depend upon the Teesta particularly the northern parts of West Bengal and northwestern Bangladesh as the region economy is particularly agrarian. The agricultural production accounts to 19 percent for Bangladesh (Bangladesh Bureau of Statistics, 2012) and 14.2 percent for India (Central statistical organisation, India, 2011). Therefore, to sustain food security both the sides undertook the Teesta Irrigation projects in Dalia (Bangladesh), and Gajaldoba (India). Both the projects aims at irrigating around 540,000 hectares, and 922,000 hectares of land respectively, along with other integrated functions like flood control, recreation, increase cropping intensity, agricultural productivity, fisheries development, hydropower, tourism (https://en.banglapedia.org/index.php/Barrage; Strategic foresight group 2013; Mukherjee and Saha 2016; Rahaman and Abdullah 2020). But to ensure its goal an adequate amount of water from the Teesta is required which if not maintained would lead to food insecurity. In fact, as per the study conducted by Syed et al (2017), a total of 93,523 cusses of water is required to facilitate irrigation, whereas the flow of the river is 6,984, 51,966 and 27,987 cusses in dry, wet and lean seasons respectively. Therefore, the supply is limited while the demand is higher which has further intensified due to increased use of water intensive agriculture and industrialization. Further as the population increases so also the

pressure over food security, and thereby on water availability (Sambou et al 2023). Therefore, issue of water availability or lack of it has sown the seed of mistrust between the two countries. To elucidate it further, there was a study conducted by Zannah et al (2020) which suggest that from 1967-1990, the annual runoff of the river ranged between 3674 cusecs in high flood seasons to 139 cusecs to mean monthly minimum flow which has drastically reduced. The reason being anthropogenic i.e., construction of dams and the barrage upstream by India, which has led to diversion of the flow of the waters of the Teesta via side canals. Further studies aimed at making an assessment of the mean annual outflow discharge at Gajaldoba barrage also pointed out to the same. Since the freshwater resources is limited and getting exhausted in the Teesta catchment hence there is a greater dependence on groundwater and monsoonal rains (Wahid et al 2007). So, there is less availability of water in the region thereby affecting its agriculture. The river is rain fed so it is dependent upon the monsoonal discharge however, as the river descends downstream due to seasonal variation the volume of the water gets affected together with the problem of climate change factor which adds further to the water woes.

Therefore, decreased water flow is the concern of both upstream and downstream countries, and one of the reasons why the state of West Bengal emphasizing on 'state first priority'. Since the region relies heavily on the flow of the Teesta for its livelihood keeping the interest of the farmers in concern, the state government wants to secure the water first and foremost for its people. Therefore, water security issues can lead to insecurity among the riparian nations.According to Mondal and Saleh, (2003) due to its over extraction coupled by poor management, and land use change, the level of groundwater is drastically getting reduced by 1.2m/year in various parts of the area. Not to forget the impact it has on lowering the aquifer levels. Since there is a greater demand for food grains to meet the needs of the population thriving there, hence attainment of food security becomes all the more pertinent. And since the ground water discharge is getting exhausted therefore there calls for a greater attention to find an alternate source of freshwater and groundwater particularly during the dry season.

Likewise, the concerns related with food security is also related with the energy security, particularly in terms of the construction of dams for the generation of hydroelectricity. Hydropower is regarded as synonymous to development, economic growth and considered as the source of clean, cheap and renewable source of energy. Hence nations are emphasizing on its development. The state of Sikkim alone has a hydro potential of 8000 MW peak with a firm base of 3000 MW and around 39.15 percent of the capacity is yet to be developed (Government of Sikkim, Energy and Power department). The rapid elevation of the Teesta that makes it very suitable for hydro ranging from 8598 meters to 213 meters (The Asia Foundation, 2013). These cascades of dams even though have ecological as well social implications yet they are furthered in the region particularly in the state due to the developmental notion. Along the Teesta Basin, six Hydro projects -Teesta Stage I, Teesta Stage II, Teesta Stage III, Teesta Stage IV, Teesta Stage V and Teesta Stage VI of 3635 MW was awarded to NHPC, NTPC and private developers. The Government of Sikkim sells the hydro-electricity of Teesta III HEP (1200 MW) to Punjab, Haryana, Rajasthan, Uttar Pradesh at a very cheap rate of 3 INR/unit (CFA, 2019). These projects are seen as a source of revenue, employment, development and assuring energy security for all. However, the same cannot be said for downstream Bangladesh as it has not been able to exploit the waters of the Teesta for hydro. Though time and again, the country claims of furnishing the same in the near future.

Therefore, the upstream of the river is used for energy security and as the river discharge downstream it is used for food security. There are arguments and counter arguments that it is bound to have its implications downstream as the flow of river gradually decreases. It in turn is said to have further heightened the issue of water scarcity for the lower riparian having its repercussions for securing food and energy security.

However, it needs to be realized here that whatever maybe the priorities energy or food security, the fact remains that both are dependent on the availability of the water from the Teesta River. Water is needed for sustaining energy security, as well as food, and both are deemed crucial for livelihood, and development. As we have already seen above, how there is an interconnectedness between the three sectors, hence any action and decision taken on one is going to have its impact upon the other. If India is achieving its energy security, through construction of hydro projects upstream then it needs adequate water which though countered do affect the quality and quantity of the water downstream. Then it also has its own Irrigation project at Gazaldoba for ensuring food security and the same applies for Bangladesh. Therefore, for India waters of the Teesta is vital for energy and food security and the latter for Bangladesh. Hence, in order to maintain a balance, both nations would undertake decisions which might not be favorable to one other and that is exactly what is happening with regard to the Teesta. Bangladesh wanting an equal share of the waters means India particularly West Bengal losing out most of its waters which it would not want as it affects the food security and same is the dilemma with the case of Bangladesh. In order to ensure adequate waters, it has been adamant in shipping out more waters from India and that is exactly what is leading to the deadlock.

These priorities seem independent but a closer analysis would indicate its interconnectedness. The upstream emphasis is on energy security but one cannot deny the fact that even for securing food one needs energy. Like lower region of the Teesta basin along Bangladesh lacks access to energy hence it also will impact the food security. Swain (2004) in this regard attributes to the differences of perception as leading to conflicts between states and its internal groupings. He pointed out how state's developmental projects which is undertaken to secure the water resources at times are viewed as countering the interest of the local people leading to conflicts within and between the states. Not only that each stakeholder here including the state parties concerned have set their own priorities over the use of the waters of the Teesta. Sikkim interms of hydro power and West Bengal and Bangladesh related with food. But one does not understand the interconnectedness that exists and how these priorities need to be seen in an integrated manner. The waters of the Teesta are significant for Boro cultivation in case of India and Kharif and Rabi crops for Bangladesh. The situation becomes critical during the lean season where kharif crop demand for water significantly increases, while that of the Boro crop is tripled while the supply is limited due to decreased flow of the river.

Another issue which is generally kept at the back-burner, is related with water scarcity and its impact on basic human rights i.e., safe and clean water for drinking and sanitation. It is also recognized by the UNGA (2010) and also falls within the Sustainable Development Goals no 6, as Water Sanitation and Hygiene (WASH). The issue of arsenic contamination in ground water is common in Siliguri-Jalpaiguri region in India (Bhattacharyya & Mukherjee, 2009), and Bengal basin region of Bangladesh (Sarkar et al, 2022). This situation is worrisome considering the level of water decreasing, and people in the region compelled to be dependent upon the

groundwater extraction for drinking purpose. The arsenic contamination therefore, exposes the vulnerability of the people living along the basin.

Results

Adopting the nexus is vital here as it aims at balancing the trade offs and facilitating more synergies for sustainable development (Wu et al, 2021). Since water is critical aspect in the nexus and given the water availability issues both countries can think in terms of adopting mechanism towards it.

Water and food security

It becomes significant to think about maintaining the flow of the water in this case of Teesta River before its utilization. Both the countries should emphasize on conservation and protection of water resources, and shift to less water intensive farming methods and crops thereby improvement in the irrigation system. This would help significantly in maintaining a balance and also ensure sustainability. The nexus approach focusses on 'creating more with less'. With water scarcity evident along the basin, countries can adopt the approach in addressing the dwindling water flow of the Teesta collectively, first and foremost, and then think in terms of using the available water resources for food production, and also in locating the alternate source of water. Because the river is monsoon fed, both countries can come together in storing the excess waters during the monsoon and using it during the lean period.

Water and energy security

Energy security is vital for the economy of both the countries. In order to facilitate it, steps should be taken more towards the development of renewable sources of energy like wind, solar which has less implications on the ecosystem. Further, emphasis should be taken on reducing energy consumption and more on energy recovery. Since geographically, India as an upper riparian has the advantage of utilizing the waters of the Teesta, as per the International Water Law, and technically has been doing so through furthering of numerous projects upstream in Sikkim, the same cannot be applied for Bangladesh. Therefore, both can identify the benefits that they can share out of it, where India can help the latter, through providing electricity at a low and affordable cost, to mitigate their energy deficit.

Energy and food security

Since ensuring food security, energy is required therefore adaption of solar pumping for irrigation is seen effective. Which would not only reduce the cost but also stress on the use of resources for the generation of energy.

Therefore, it calls for understanding of the issue from the broader nexus approach to understand the intricacies related to the issue, so that an integrated approach can be adopted. In fact, various countries like United States and European Union have already started adopting smart tools for water supply networks (Helmbrecht et al, 2017) which can be furthered by India and Bangladesh at a regional level for integrated water management of the Teesta Basin. Nexus solution and nexus investment is seen essential in reducing pressure on the ecosystem, and thereby producing sustainable transboundary benefits (unece.org). It again to a large extent depends upon the transboundary cooperation mechanism including the governance system as follows;

- Strong cooperation among the transboundary nations in this case India and Bangladesh, identifying the multiple benefits including the trade offs and the synergies. Which can range from sharing the revenues as well as sharing the electricity developed through hydros.
- Innovative and integrative infrastructure to facilitate cooperation and benefits out of the nexus including financing.

- Development of transparent mechanism to share data and minimize the social and ecological impacts.
- Cross sectoral coordination and institutional arrangements supporting integrated approach.
- Integrated policy approach towards sustainable use of the water, its treatment, and protection.

Therefore, instead of physically attributing the waters of the Teesta, it is very much pertinent to understand this nexus and whatever be the vested interest of the concerned state parties be it food or energy security, the centrality or the crux of the issue happens to be the availability of the water resources. Many claims anthropogenic reasons as affecting the water flow but they fail to identify the climate change factor (natural reason) which has been a major source contributing to the decreased flow. In fact, the factor of climate change was highlighted by the Paris Agreement and the Sustainable Development Goals (SDG's). Emphasis should be taken to understand the intricacies involved and adopt policies aimed at integration and proper coordination of sector-based policies. One of the major issues that seems neglected is the very incorporation of the stakeholders which not only include the state parties or the private sectors but also the people living along the basin. Incorporating them within the domain of decision making can further understanding of the nexus and the issues concerned. Participation of the stakeholders also happens to be one of the indicators of SDG 6. The nexus not only help in addressing the water issues along the basin but also seen as vital in promoting intersectoral and transboundary cooperation, better resilience, improving ecosystem services, increased transparency, improved resource security and furthering regional peace and stability.

Conclusion

Until and unless a sort of balance is maintained with regard to maintaining food and energy security which in turn involves proper management of the water resources. Hence it calls for adoption of a more holistic and integrative approach which would take the nexus into consideration as well as the various stakeholders' involvement in the policy formulation. With regard to Teesta, one needs to focus upon the question of who actually is making the decisions? And the decisions for whom? Water is a vital resource for both the countries. Water Scarcity issues related with mismanagement, topographical constraints, dependency factors make securing the waters of the Teesta all the more vital. However, lack of knowledge and emphasis upon the nexus and the interconnectedness impacts the decision making as the focus tends to be more on the 'Rights' issues rather than the 'Needs'. Thus, strengthening the nexus perspective becomes all the more pertinent. The issue of Teesta needs to be understood from the nexus perspective to understand the complexities associated with the use, distribution of resources and its implication on the policy formulation. Both India and Bangladesh can follow on the lines of the Mekong River Commission in implementing the nexus approach as a solution to their long-time water issue over the Teesta Basin.

Statement and Declarations

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Availability of data and material: The data used in the study is collected from the government sources which includes Bangladesh Bureau of Statistics; Ministry of Agriculture, Government of Bangladesh; Central Statistic Organisation, Government of India; Energy and Power department, Government of Sikkim; FAO, IEA, UNESCO, UNDP report.

Code availability Not Applicable

Authors' contributions: The data were collected form the primary and secondary sources some enlisted above and analyzed by the author. The manuscript has been read and approved by the author.

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