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THE ENVIRONMENTAL AND SOCIAL IMPACTS OF DAMS IN NASHIK DISTRICT

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ABSTRACT

This review paper critically examines the multifaceted environmental and social repercussions of dam construction in Nashik, considering the region's unique geographical, ecological, and socio-economic contexts. Through an interdisciplinary lens, we analyze the consequences of dam projects on the local ecosystems, biodiversity, water quality, and land use patterns. Additionally, we delve into the social dimensions, evaluating the impact on communities, livelihoods, and cultural heritage. Drawing on a comprehensive synthesis of existing literature, case studies, and empirical evidence, this review aims to provide a nuanced understanding of the interconnected environmental and social challenges posed by dams in Nashik. By highlighting both positive and adverse effects, we contribute to informed decision-making and sustainable development practices in the region.

Keywords: Environment Protection, Social Impact, Constructional Aspects to Environment and Society.

INTRODUCTION

Dams, monumental structures designed to harness water resources, have played a pivotal role in shaping landscapes, meeting energy demands, and facilitating agricultural development. While their benefits in providing water storage, flood control, and hydropower are undeniable, the construction and operation of dams also impose significant environmental impacts that require careful consideration. This introduction delves into the multifaceted environmental consequences associated with dam projects, exploring alterations in river ecosystems, sedimentation issues, water quality concerns, effects on biodiversity, and broader ecological transformations. One of the most profound environmental impacts stems from the alteration of river ecosystems. Dams regulate the natural flow of rivers, disrupting established patterns that are vital for the migration of fish, sediment transport, and nutrient cycling. These changes can lead to habitat modification as reservoirs form, creating new ecosystems that may not fully support the diversity of species found in natural riverine environments. The impoundment created by dams alters water temperature, substrate composition, and sediment transport, influencing the availability of suitable habitats for aquatic organisms. This, in turn, can impact the biodiversity of both plant and animal species dependent on the river ecosystem.Sedimentation and siltation emerge as critical concerns during dam construction. Various activities, including excavation works, quarrying operations, and the creation of spoil areas, contribute to the discharge of sediment into the water. The altered sediment load released into rivers can lead to downstream erosion, habitat degradation, and changes in the physical characteristics of river channels. Carefully managing sedimentation is crucial to maintaining the ecological balance of river systems and preventing adverse effects on

downstream habitats. Water quality concerns represent another facet of environmental impact associated with dam projects. Construction sites can serve as sources of water pollution due to inadequately managed activities, potentially releasing excessive sediment loads and various chemicals into nearby water bodies. Storage and processing of substances like gasoline, lubricants, explosives, and construction-related chemicals pose risks of leakage or accidental discharge.

Effluents from concrete truck cleaning, containing elevated pH levels and contaminants, can further compromise downstream water quality if released directly into rivers. Ensuring preventive management procedures, including proper storage practices and contingency plans, is essential to mitigate the risk of water pollution. Dams also exert significant effects on biodiversity, especially concerning fish migration. The construction of dams can impede the natural migration routes of fish, disrupting their life cycles and leading to declines in fish populations. Species relying on migratory patterns for spawning or feeding face challenges in reaching their preferred habitats, impacting both aquatic ecosystems and the communities dependent on these fishery resources.

The environmental impacts extend beyond the construction phase into the reservoir filling process. The flooding caused by reservoir filling can result in out-migration and drowning of terrestrial fauna, with implications for public health and crop pests. The displacement of rodents and carnivores may disturb the human health environment, while crop pests could become more problematic for fields near the reservoir. Drowning of animals, especially small flightless terrestrial mammals and immature or injured animals, contributes to the biomass decomposition in the reservoir. In navigating the complex landscape of dam-related environmental impacts, it becomes imperative to adopt sustainable practices, implement effective management measures, and carefully assess the policies and regulations governing dam construction. The subsequent sections of this exploration will delve into each aspect of environmental impact in greater detail, providing a comprehensive understanding of the challenges and considerations associated with the development and operation of dams.

PROFILE OF THE REGION

Nashik city serves as the capital of Khandesh and is the headquarters of the Nashik revenue division. Additionally, it houses the Regional office of the Maharashtra Pollution Control Board. Nashik is a significant and renowned historic city in Maharashtra. Situated on the banks of the Godavari River, this district headquarters is positioned at an elevation of 565 metres above mean sea level (MSL). There are two possible interpretations for the origin of the word 'NASHIK'. The first is related to the town being situated on nine peaks (Navshikhar), and the second is related to an incident in the Ramayana when Lakshmana is supposed to have chopped off the nose (Nashik) of Shurpanakha, a sister of LankadhipatiRavan. This location boasts a wealth of historical and cultural significance, and has since evolved into a bustling metropolis with a population of almost 1.1 million. The banks or Ghats of the river Godavari has religious significance as people perform sacred rituals by taking a holy dip in the "Kundas" (Ponds) built along the river banks. The Godavari river is known as the "DakshinVahini" and Ramkund is a significant holy site, particularly during the Kumbhamela. Nashik is a significant industrial town in Northern Maharashtra, situated at Latitude 19° 0' - 33' and 20° 53' North, and Longitude 73° 0' - 16' and 75° 6' East. It is located at an elevation of 565 metres above mean sea level, approximately 180 kilometres away from Mumbai (Bombay), 210 kilometres from Pune, 165 kilometres from Ahmednagar, and 180 kilometres from Aurangabad.

The overall area measures 259.13 square kilometres, making it the second largest in Maharashtra, surpassed only by Mumbai. The city has a population of 1.5 million and a transportation network spanning 850 kilometres. Furthermore, there is the Mumbai Agra National Highway No.3, spanning a distance of 1000 kilometres, and the NashikPune

National Highway No.50, which covers a distance of 210 km. The primary rivers coursing through the district include Godavari, Kashyapi, Darna, Girna, Kadwa, and Nasardi (Nandini). There are two industrial estates: Satpur, which covers an area of 1600 acres and has 750 units, and Ambad, which spans 1400 acres and has 850 units. The city has garnered attention due to its picturesque surroundings and refreshing temperature. Nashik possesses a distinctiveness stemming from its mythical, historical, social, and cultural significance. The city, characterised by its dynamism and engagement in the industrial, political, social, and cultural spheres, has exerted a profound influence on the lives of numerous eminent individuals. The city is traversed by the river Godavari. Nashik has become a highly revered destination for Hindus worldwide due to the presence of temples and ghats along the banks of the Godavari River. Religious sites like Trimbakeshwar, Panchavati, and Tapovan are renowned throughout India.

The establishment of Nashik Municipality took place in 1864, coinciding with the elevation of Nashik to a fully-fledged district including 13 Talukas. Currently, there are a total of 15 Talukas in Nashik district, namely Nashik, Peth, Dindori, Surgana, Kalvan, Baglan (Satana), Devla, Trimbakeshwar, Malegaon, Chandwad, Nandgaon, Yeola, Niphad, Sinnar, and Igatpuri. Nashik District is a prominent agricultural hub renowned for its cultivation of grapes, onions, flowers, sugar cane, rice, and famous vegetables. Grapes, onions, and flowers are globally exported. The proportion of land that is used for cultivation is around 56% of the total land area. Nashik is rich in forest resources. The forest is located in the western region of the District. The Surgana, Kalwan, Peth, Dindori, Nashik, and Igatpuri Talukas possess a significant amount of forested areas. The forests contain a significant abundance of teak and sissoo trees. In addition to this, one can also find trees and plants such as anjan, agave, and bamboo in this area. The jungles are inhabited by several animal species, including wolves, hyenas, sambars, foxes, as well as avian species such as koels, kingfishers, and peacocks.

BACKGROUND OF DAMS IN NASHIK DISTRICT

Table 1: Dam Profile of Nashik district of Maharashtra

Sr. No	Dam	Type of dam (Medium, Major)	Source of River
1	Gangapur Dam	Major	Godavari River
2	Kashyapi Dam	Medium	Godavari River
4	Gautami Godavari DAM	Medium	Godavari River
5	Alandi Dam	Medium	Alandi River
6	Palkhed Dam	Medium	Kadva River
7	Karanjwan Dam	Major	Kadva River
8	Waghad Dam	Medium	Kolwan River
9	Ozarkhed Dam	Medium	Unanda River
10	Punegaon Dam	Medium	Unanda River
11	Tisgaon Dam	Medium	Parashri River
12	Darna Dam	Major	Darna River
13	Bhavali Dam	Medium	Bham River
14	Mukane Dam	Major	Aundha River
15	Waldevi Dam	Medium	Waldevi River
16	Kadwa Dam	Major	Kadwa River
17	Nandur Madhmeshwer Dam	Medium	Bandara River
18	Khojapur Dam	Medium	Maha lungi River
19	Chankapur Dam	Major	Girna River
20	Haranbari Dam	Medium	Mosam River
21	Kelzar Dam	Medium	Aram River

22	Nagysakya Dam	Medium	Panzan River
23	Girna Dam	Major	Girna River
24	Punad Dam	Medium	Punad River
25	Manik Punj Dam	Medium	Manyad River

The table catalogs a series of dams, distinguishing between medium and major types, along with their associated rivers. Notable examples include the Gangapur Dam, a major structure on the Godavari River, and the Chankapur Dam, classified as major and situated on the Girna River. This compilation highlights the strategic utilization of different water sources for dam construction in the region.

EVOLUTION OF DAM CONSTRUCTION IN NASHIK

The evolution of dam construction in Nashik reflects a journey intertwined with the region's historical, cultural, and economic developments. Over the years, the construction of dams in Nashik has played a pivotal role in shaping the landscape, fostering agricultural growth, and addressing the water needs of the local communities. Nashik, situated on the banks of the Godavari River, has a rich history dating back to ancient times. The people of this region, primarily dependent on agriculture, recognized the vital importance of water for their existence. Early inhabitants developed ingenious water harvesting methods to conserve water from precipitation, ensuring a steady supply during dry months (Anandakrishnan, 2012). This ancient wisdom laid the foundation for the later, more sophisticated dam construction endeavors. In Nashik, the construction of dams gained momentum as a means to harness the abundant water resources of the region. Gangapur Dam, a major structure on the Godavari River, became a key milestone in this evolution. It served multifaceted purposes, including irrigation, flood control, and water storage. As Nashik developed into an industrial hub, the demand for water increased, prompting the construction of medium-sized dams like Kashyapi Dam and Gautami Godavari Dam, both situated on the Godavari River.

The Alandi Dam, strategically located on the Alandi River, exemplifies the region's commitment to comprehensive water resource management. Its construction aimed at addressing the specific needs of the local geography. Similarly, dams like Palkhed on the Kadva River and Karanjwan on the same river contributed significantly to the irrigation and water supply infrastructure. While Nashik embraced the idea of dams for economic development, it faced challenges in adapting models from developed countries like the TVA. The DVC in India, despite its ambitious goals of multipurpose benefits, encountered obstacles due to the transfer of technology between nations with distinct physical, technical, social, cultural, economic, and institutional conditions. The repercussions of these challenges continue to affect the people in the DVC area. The late twentieth century witnessed a global shift in dam construction trends. Developed countries completed their large dam programs by 1975, while developing nations like Brazil, China, India, Indonesia, Malaysia, Thailand, Turkey, and others initiated their dam projects in subsequent years. Nashik, with its rich agricultural heritage, actively participated in this global movement. India's first Prime Minister, Jawaharlal Nehru, articulated a vision where dams were considered the new temples of modern India. Iconic dams like Bhakra and Hirakud were celebrated as symbols of progress. Nashik, aligning with this vision, continued to invest in dam construction projects that addressed the region's growing water demands. The journey of dam construction in Nashik has not been without challenges. As the region developed, so did the complexities associated with water management. Environmental concerns, technological advancements, and evolving socio-economic landscapes influenced the design and execution of dams. Nashik, however, demonstrated resilience in adapting to these changes, ensuring a sustainable approach to water resource development.

In recent times, Nashik has witnessed the completion of dam projects, each contributing to the overall socio-economic development of the region. The comprehensive network of dams on rivers such as Girna, Darna, Kadwa, and Nasardi (Nandini) showcases Nashik's

commitment to holistic water management. The impact of dam construction on the environment and the surrounding areas is a subject of increasing importance. Nashik's experience with dam construction provides valuable insights into the challenges and benefits associated with large-scale water infrastructure projects. The ecological balance, water conservation, and the welfare of local communities are integral aspects that demand careful consideration in the evolution of future dam projects. As Nashik looks toward the future, the evolution of dam construction will likely continue to be shaped by technological advancements, environmental consciousness, and the evolving needs of the region.

ENVIRONMENTAL IMPACTS OF DAMS

There are many potential impacts of dams on the physical and biological environment at the construction site, reservoir area and downs stream areas. These impacts were summarized.

Fig 2: An Overview of Different Environmental Impact

ALTERATION OF RIVER ECOSYSTEMS

The alteration of river ecosystems due to the construction of dams is a multifaceted and significant environmental impact that has both immediate and long-term consequences. Dams, while serving various purposes such as water storage, flood control, and hydroelectric power generation, can profoundly influence the natural balance of river ecosystems. This section explores the key alterations observed in river ecosystems as a result of dam construction.

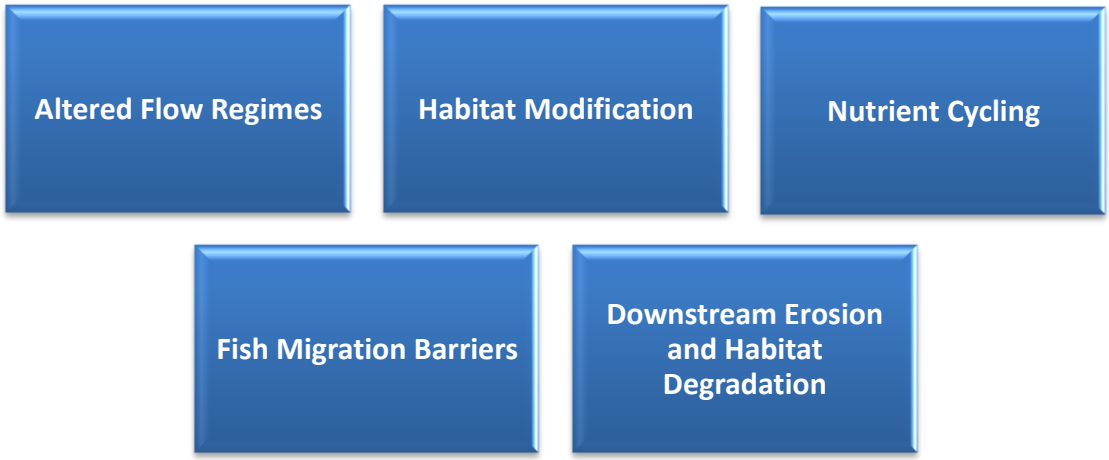

Fig 3: Different Components of River Alteration

The impact of dams on river ecosystems is a complex and multifaceted issue that involves both ecological and hydrological changes. While dams provide various benefits, such as water storage, flood control, and electricity generation, they also bring about significant alterations to the natural flow of rivers, water quality, and the habitats that rivers support. Understanding these impacts is crucial for sustainable water resource management and conservation of river ecosystems.

a) Altered Flow Regimes:

Dams regulate the flow of rivers by controlling water release. This alteration in natural flow regimes can have profound effects on the downstream ecosystems. Changes in flow patterns can disrupt the seasonal cues that trigger fish migration, affect sediment transport, and impact the natural flushing of nutrients downstream.

1. **Habitat Modification:**The impoundment created by dams leads to the formation of reservoirs, altering the river's physical structure and creating new habitats. While some species may thrive in reservoirs, others that depend on the natural riverine environment may face challenges. Changes in water temperature, sediment transport, and substrate composition can affect the availability of suitable habitats for aquatic organisms.
2. **Nutrient Cycling:**The natural flow of rivers contributes to nutrient cycling by transporting organic matter downstream. Dams can alter nutrient dynamics by trapping sediments and organic material within reservoirs. This disruption affects nutrient availability downstream, potentially impacting the productivity of aquatic ecosystems.
3. **Fish Migration Barriers:**Dams can impede the natural migration of fish, disrupting their life cycles and impacting fish populations. Species that rely on migratory patterns for spawning, feeding, or completing their life cycle may face challenges in reaching their desired habitats.
4. **Downstream Erosion and Habitat Degradation:**The altered sediment transport downstream can lead to increased erosion, habitat degradation, and changes in the physical characteristics of river channels. This can affect not only aquatic habitats but also the surrounding riparian ecosystems.

SEDIMENTATION AND SILTATION ISSUES

The discharge of a substantial sediment load into the water is likely to occur primarily during activities conducted within or in close proximity to the riverbed. These activities include the construction of diversion channels, excavation works at the dam site, the erection of protection dikes and coffer-dams, quarrying operations, sand borrowing from the riverbed, and the creation of spoil areas either too close to the riverbank or with unstable slopes. Each of these activities holds the potential for significant impacts on the sediment load released into the river. Most of these construction activities are scheduled during the dry season when river flows are at their lowest. During these works, water that infiltrates from the alluvial aquifer into the excavation needs to be pumped out. Frequently, water pumped out carries a heavy sediment load and is discharged into the nearby stream, typically consisting of a low flow of very clean water drained from superficial aquifers. The period when the high sediment loads may enter the river coincides with the onset of the rainy season.

During the initial heavy storms of this season, unstable slopes of spoils or bare soils in construction sites, camps, or along access roads may be washed out, contributing to increased sedimentation in the river. However, the impact during this period is somewhat mitigated due to the significantly higher flows in the river, which already carry a substantial sediment content. To address these challenges and minimize environmental impact, it is crucial to implement effective measures and management practices. This includes adopting construction techniques that reduce soil erosion, establishing proper sedimentation ponds or

basins to capture sediment-laden water before discharge, and carefully planning the location of spoil areas to prevent instability. Additionally, during the pumping of water from excavations, employing proper sediment control measures can help prevent the discharge of water with heavy sediment loads into nearby streams. Regular monitoring and adherence to environmental regulations are essential components of responsible construction practices near riverbeds to safeguard aquatic ecosystems and downstream water quality.

WATER QUALITY CONCERNS

The construction of dams has become imperative in response to the rising needs for water and energy. However, despite their undeniable benefits, dams also give rise to adverse environmental impacts. Throughout the construction phase, the sites may serve as sources of water pollution due to inadequately managed and monitored activities, subsequently impacting downstream water quality. Commonly observed consequences in such situations involve the excessive release of sediment loads into the river stream and the discharge of chemicals. Furthermore, the distribution and cycling of chemical compounds within water bodies, including dams, are intricately linked to water movement in the landscape and are subject to alterations influenced by shifts in hydrological and biological cycles.

During the construction of dams, substantial quantities of gasoline, lubricant products, explosives, and various chemicals (such as concrete topping, solvents, paints, thinners, and acids) are stored and processed at the construction site, posing a potential risk of leakage or accidental discharge into the surroundings. This risk can be effectively mitigated through the implementation of preventive management procedures by the contractor. This includes selecting appropriate locations for storage areas in accordance with international best practices (utilizing bonded storage), implementing the collection and recycling of used oils, and closely monitoring all hazardous products with specific handling procedures and contingency plans. Another potential source of pollution arises from batching plants, particularly the effluent generated during the cleaning of concrete trucks.

EFFECTS ON BIODIVERSITY

The primary sources of noise and dust along construction paths, roads, and transmission lines are the vehicles transporting materials, people, and equipment. Construction site activities, including the operation of vehicles, earth-moving equipment, lifting equipment, cutting and blasting equipment, as well as sirens, contribute to noise and dust emissions. In borrowing areas, where materials are sourced, additional noise and dust arise from vehicles, earth-moving equipment, sirens, and occasional explosive detonations.

These paths intersect various land habitats where a variety of mammals, including sand foxes, porcupines, rattlesnakes, civets, porpoises, hedgehogs, and wild cats, may be present. While none of these mammals are endangered or of significant environmental importance, the construction activities can still impact their habitats. In the dam construction and borrowing areas within riverine habitats, the wildlife primarily consists of birds, but other species such as pigs, green monkeys, crocodiles, and snakes may also be present. The inundation event during reservoir filling has complex impacts on terrestrial fauna, leading to reactions such as out-migration and drowning. Timber and biomass clearance may disturb larger animals, prompting them to leave the area. Even without such activities, larger and highly mobile small animals tend to evacuate as the water level rises. The 24-hour inundation process presents challenges for strictly nocturnal and diurnal animals. Displaced animals may survive drowning in some cases, but the rapid displacement often leads to high mortality rates. Even animals successfully establishing themselves post-displacement may face higher mortality rates until population pressures decrease through natural regulation processes.

1. Drowning of Animals: Rapidly moving fauna often leave the inundation area during biomass destruction. Those that remain or return may become trapped on temporary islands formed during reservoir filling. Due to the absence of permanent islands, animals trapped on these temporary landmasses will eventually drown unless they can swim to the shore.

The animals most vulnerable to drowning include small flightless terrestrial mammals, immature and injured animals unable to move, and soil fauna. The bodies of drowned animals contribute to the total biomass decomposition in the reservoir.

2. Social Impacts of Dams: The construction and operation of dams in the Nashik region have multifaceted social impacts, influencing various aspects of the local communities' lives and the broader sociocultural fabric. One significant aspect is the transformative effect on livelihoods, particularly in areas where agriculture is prevalent. The regulation of water flow through dams enables better irrigation practices, positively affecting crop yields and promoting agricultural productivity. This, in turn, contributes to economic growth within the farming communities, providing them with a reliable water source for cultivation. Additionally, the availability of water for irrigation supports diversification into cash crops, enhancing income opportunities for farmers. The establishment of dams often leads to the creation of reservoirs, introducing new opportunities for fisheries and aquaculture. Local communities can benefit from increased fish stocks, contributing to both dietary and economic aspects. The fishing industry becomes a source of employment and income, offering a sustainable livelihood for those engaged in this activity. Moreover, the reservoirs may become recreational spaces, attracting tourists and fostering the growth of local businesses catering to tourism-related needs. Dams also play a crucial role in addressing water scarcity, a persistent challenge in many regions. The regulated release of water from dams ensures a more consistent water supply for domestic use, reducing dependency on seasonal variations. This, in turn, enhances the quality of life for residents who now have improved access to clean and reliable water for daily needs. Additionally, the availability of water facilitates the growth of urban areas, promoting infrastructural development and contributing to the overall urbanization of Nashik.

On the flip side, the construction of dams can result in the displacement of communities living in the dam's catchment area. Resettlement programs become imperative, aiming to address the social and economic challenges faced by those forced to relocate. Proper rehabilitation measures, including the provision of alternative housing, livelihood support, and community infrastructure, are essential to mitigate the adverse effects of displacement. The impact of dams on local cultures and traditions is noteworthy. In areas where dam construction alters the physical landscape, there may be a loss of culturally significant sites or changes in the local ecology that impact traditional practices. Additionally, the influx of diverse populations drawn to the economic opportunities created by dam-related activities can lead to cultural exchange and adaptation.However, the social impacts are not uniform across all segments of society. Vulnerable groups, such as indigenous communities or marginalized populations, may face disproportionately negative effects. Their access to resources, land, and livelihoods may be compromised, necessitating targeted interventions and inclusive policies to ensure equitable outcomes.

Furthermore, the development of dams necessitates the establishment of governance structures and regulatory frameworks to manage water resources effectively. This may involve the creation of local water management committees or engagement with existing local governance structures to ensure that the benefits and responsibilities associated with water use are distributed equitably among different sections of society.

The social impacts of dams in Nashik are dynamic and multifaceted, influencing livelihoods, culture, and community dynamics. While dams contribute significantly to agricultural productivity, water availability, and economic growth, they also pose challenges related to displacement, cultural changes, and potential inequalities. Strategic planning, inclusive policies, and community participation are crucial in navigating these complexities and ensuring that the benefits of dam development are shared equitably among all members of the society.

LEGISLATIVE FRAMEWORK

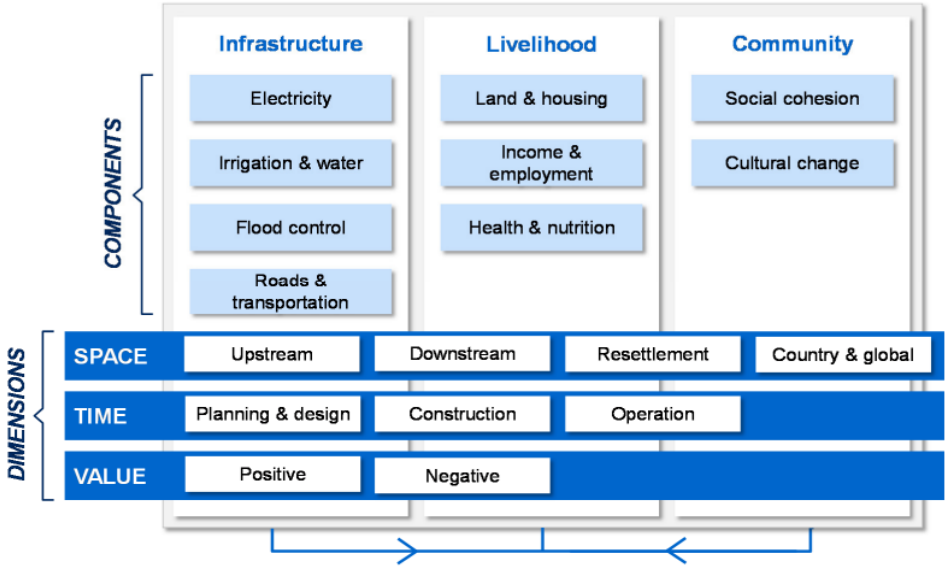

Fig 4: An Overview of different dimensions of Environmental and Social Impact (Juilian et al.,2016)

CONCLUSION

In conclusion, our review underscores the intricate relationship between dam construction and its far-reaching consequences on the environment and society in Nashik. The environmental impact assessment reveals that dams have significantly altered local ecosystems, affecting biodiversity, water quality, and land use. Simultaneously, the social dimensions of dam projects expose a spectrum of effects on communities, livelihoods, and cultural heritage, both positive and negative. The synthesis of diverse studies and empirical evidence emphasizes the need for a balanced approach in dam development, considering the delicate equilibrium between ecological preservation and socio-economic progress.

While dams offer essential benefits such as water supply, irrigation, and power generation, our review advocates for an integrated and sustainable management strategy. Future dam projects in Nashik should prioritize ecological restoration, community engagement, and participatory decision-making processes to mitigate adverse impacts. Additionally, the incorporation of modern technologies and innovative solutions can enhance the efficiency of dam operations while minimizing negative consequences. As Nashik continues to evolve, policymakers, environmentalists, and local communities must collaborate to formulate and implement policies that prioritize the preservation of the region's unique environment and the well-being of its inhabitants. By recognizing the interconnectedness of environmental and social factors, Nashik can strive for a harmonious coexistence between dam infrastructure and sustainable development. Ultimately, this review serves as a foundation for informed decision-making, fostering a future where the benefits of dam projects are maximized, and their adverse impacts are minimized for the collective welfare of Nashik's environment and society.

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