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MAHARASHTRA'S DAMS AND THEIR EFFECTS ON THE ENVIRONMENT

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Introduction :

A dam is a vital multipurpose structure constructed across rivers or streams to store and regulate the flow of water. It plays a significant role in ensuring the sustainable management of water resources for various human and environmental needs. In a tropical Bar. Ramrao Deshmukh Arts, Smt. Indiraji Kapadiya Commerce and Ny. Krushnarao Deshmukh Science College, Badnera Dist. Amravati (Maharashtra) ountry like India, rainfall is highly seasonal, with the majority of precipitation occurring during the monsoon period from June to September. For the remaining eight months, most regions experience water scarcity, affecting agriculture, domestic consumption, and industrial activities. Hence, the construction of dams and reservoirs becomes essential to store excess monsoon water for use during the dry season.

Dams have historically contributed to agricultural development, hydroelectric power generation, flood control, and industrial growth. By storing large quantities of water, dams help maintain a steady supply for irrigation, enabling multiple cropping and improving agricultural productivity, especially in drought-prone regions of Maharashtra. They also play a crucial role in controlling floods during heavy rainfall, thereby protecting human settlements, agricultural lands, and infrastructure from damage. Moreover, hydroelectric projects associated with dams contribute to the production of renewable energy, reducing dependence on fossil fuels and supporting sustainable development.

Maharashtra holds a prominent position in India in terms of dam construction and water resource management. The state ranks first in the number of dams, with nearly 1,821 large and small dams spread across its varied geographical landscape. These structures have been built to meet the state's growing demand for water and electricity and to support agriculture in semi-arid regions. The Koyna Dam, located in the Satara district, is the largest and tallest dam in Maharashtra and a major source of hydroelectric power. Following it are the Bhatsa and Vaitarna Dams, which supply water to urban areas such as Mumbai and Thane. The Ujjani Dam, situated on the Bhima River, holds the distinction of having the largest water storage capacity in Maharashtra, amounting to 3,140 million cubic meters.

Despite these benefits, dam construction also brings forth several environmental and social challenges. The submergence of vast land areas for reservoir formation leads to the loss of forests, agricultural fields, and wildlife habitats. This results in significant biodiversity decline and alteration of local ecosystems. Moreover, the displacement of people due to dam construction gives rise to rehabilitation and resettlement issues, often leading to socio-economic hardship for affected communities. In addition, dams influence local climate conditions by modifying humidity, temperature, and rainfall patterns in the surrounding regions, which in turn affect local agriculture and vegetation.

Therefore, while dams are indispensable for regional development and water management, it is equally important to assess their ecological and social consequences. Sustainable dam management practices must focus on minimizing environmental degradation, ensuring proper rehabilitation of displaced populations, and maintaining the ecological balance of surrounding ecosystems.

The present study focuses on analyzing both the positive and negative impacts of dam construction in Maharashtra. It highlights the relationship between dams and agricultural progress, flood control, climate change, and local area development, while also examining the biodiversity loss and rehabilitation issues arising from such large-scale projects. The findings aim to provide insights into achieving a balanced approach between development and environmental conservation.

Aims and Objectives

The construction of dams has played a crucial role in shaping Maharashtra's socio-economic and environmental landscape. This study is designed to understand the multifaceted importance of dams in the state, their contribution to development, and the associated challenges. The key aims and objectives of the present study Article are outlined below:

1. **To analyze the status and distribution of large dams in Maharashtra** — Maharashtra ranks first in India in terms of the number of large dams. The study aims to identify how many major and minor dams are constructed across different regions of the state and to evaluate their importance in regional water management, agriculture, and industrial growth.

2. **To examine the impact of dams in drought-prone regions** — The research seeks to explore how dams have transformed agricultural systems, improved irrigation facilities, and contributed to environmental and socio-economic development in the drought-prone areas of Maharashtra.
3. **To identify and discuss the operational and maintenance issues related to large dams** — This includes examining challenges in water distribution, sedimentation, reservoir management, and long-term sustainability of dam structures, along with their influence on local water supply systems.
4. **To study the problems of rehabilitation and resettlement** — The project investigates the social impacts of dam construction, including displacement of rural populations, loss of agricultural lands, and the effectiveness of rehabilitation policies implemented by the government.
5. **To assess environmental changes after the construction of dams** — The study focuses on understanding how large dams alter the local environment, including changes in microclimate, biodiversity, soil characteristics, and landscape features, and how these transformations affect the ecological balance of surrounding areas.

Dams in Maharashtra and Their Environmental Effects:

Maharashtra holds a unique position in India as the state with the highest number of dams. There are approximately **1,821 large and small dams** constructed across various river basins, which serve multiple purposes such as irrigation, hydroelectric power generation, flood control, and water supply for domestic and industrial use. These structures have significantly contributed to the socio-economic development of the state by ensuring water availability in drought-prone regions and by supporting agricultural expansion. However, the environmental impacts of dam construction are equally notable, influencing local biodiversity, microclimatic conditions, and socio-ecological balance.

Koyna Dam

The **Koyna Dam**, constructed on the **Koyna River** in the Western Ghats, is the largest and tallest dam in Maharashtra. It also hosts India's largest hydroelectric power station with a total installed capacity of **1,960 MW**. The dam was primarily designed for hydroelectric power generation, although it also supports irrigation in nearby areas. The Koyna Hydroelectric Project is often regarded as the *"Lifeline of Maharashtra"* due to its significant contribution to the state's electricity supply.

Environmentally, however, the project has led to the submergence of vast forest areas in the Western Ghats—one of the world's biodiversity hotspots—resulting in habitat loss, soil erosion, and minor seismic activities due to reservoir-induced stress.

Bhatsa Dam

The **Bhatsa Dam**, located near **Shahapur in Thane district**, is an earthfill and gravity dam with a height of **88.5 meters** and a length of **959 meters**, making it the second tallest dam in Maharashtra. The dam's hydroelectric power station has a generation capacity of **15 MW**. Bhatsa Dam also supplies drinking water to the Mumbai metropolitan region and supports irrigation in surrounding rural areas.

The large water spread area of the Bhatsa reservoir has altered the natural landscape and aquatic ecosystem, affecting native fish populations and local vegetation due to changes in water flow and nutrient distribution.

Middle and Upper Vaitarna Dams

The **Middle Vaitarna Dam (84 m)**, built on the **Vaitarna River**, ranks as the third tallest dam in Maharashtra. Along with the **Vaitarna (82 m)** and **Upper Vaitarna Dams**, it forms a series of interconnected reservoirs supplying water to major urban centers, including Mumbai and Thane. These dams have substantially improved the region's water security but have also resulted in the submergence of large forest tracts and the displacement of several small tribal settlements. Reduced river flow downstream has affected aquatic biodiversity and the natural regeneration of riverine ecosystems.

Bhandardara (Wilson) Dam

The **Bhandardara Dam**, also known as the **Wilson Dam**, is constructed on the **Pravara River** near the scenic village of Bhandardara in Ahmednagar district. The reservoir formed by the dam is called **Arthur Lake**. This region has become a major tourist destination, surrounded by natural attractions such as **Mount Kalsubai**, **Randha Falls**, and **Amriteshwar Temple**.

While the dam contributes to irrigation and tourism, it has changed the local hydrology and microclimate, with increased humidity and reduced natural river flow downstream, impacting native species and riparian vegetation.

Totladoh Dam

The **Totladoh Dam** on the **Pench River** in **Nagpur district**, near the border with Madhya Pradesh, is a vital multipurpose project. With a height of **74.5 meters**, it supplies water to **Nagpur city**, the **Koradi Thermal Power Station**, and **NTPC Mauda Super Thermal Power Station**. Its canal systems irrigate several talukas including **Parseoni**, **Ramtek**, **Saoner**, and **Mauda**.

The creation of the reservoir has submerged forested areas of the Pench Tiger Reserve, affecting wildlife habitats, though the water body now supports migratory birds and enhances groundwater recharge in nearby regions.

Kalammawadi Dam

The **Kalammawadi Dam** in **Kolhapur district** is the largest dam in the region,built across the **Dudhaganga River**. Standing **73.08 meters** high, it primarily serves irrigation and water supply purposes. The dam area, surrounded by dense forests, is home to rich biodiversity, including endangered species like the **Indian bison (Gaur)**.

While it supports agriculture and tourism, the alteration of the river's natural flow and the flooding of forest habitats have led to ecological disturbances and loss of species diversity.

Ujjani (Bhima) Dam

The **Ujjani Dam**, also known as the **Bhima Dam**, is a large earthfill-cum-masonry gravity dam located in **Solapur district**. With a vast storage capacity of **3,140 million cubic meters**, it is the largest in Maharashtra in terms of total volume. The reservoir benefits agriculture, fisheries, and birdlife, particularly **flamingos**, making it a popular site for birdwatching near Pune.

However, eutrophication and sedimentation due to agricultural runoff have emerged as environmental concerns, impacting water quality and aquatic ecosystems.

Jayakwadi Dam

The **Jayakwadi Dam**, situated on the **Godavari River** near **Paithan in Aurangabad district**, is one of the largest earthen dams in Asia. It supplies water for irrigation, industrial use, and domestic consumption to **Aurangabad** and **Jalna** districts, playing a crucial role in the drought-prone **Marathwada region**. The area around the dam also hosts a bird sanctuary and a well-developed garden that attract tourists.

Nonetheless, the dam has caused extensive submergence of fertile land and forest areas, leading to the displacement of numerous villages and affecting the ecological dynamics of the Godavari River basin.

Sapan Dam (Paratwada, Amravati District)

The **Sapan Dam**, located near **Paratwada** in **Amravati district**, serves as a key source of irrigation and water storage for nearby agricultural areas. It supports local crop cultivation and aids in groundwater recharge. The surrounding region has seen improved vegetation and microclimatic conditions; however, minor ecological disturbances and changes in local biodiversity have also been observed due to reservoir formation.

Babulgaon Dam

The **Babulgaon Dam**, also situated in **Amravati district**, is a medium-scale irrigation dam constructed to supply water for agricultural and domestic purposes. It has improved crop productivity and provided water security to local farmers. Nevertheless, soil erosion along the reservoir margins and partial loss of vegetation are notable environmental side effects.

Naldamyanti Dam (Morshi)

The **Naldamyanti Dam**, located in **Morshi taluka** of **Amravati district**, plays an important role in supporting irrigation and maintaining water availability in nearby villages. It has promoted agricultural development and improved socio-economic conditions in the area. The reservoir also contributes to local climate moderation, but sediment deposition and minor waterlogging issues have emerged as environmental concerns.

Gosekhurd Dam (also spelled Gosikhurd)

Located on the Wainganga River near Pauni in Bhandara district, Maharashtra. It is an earth-fill dam, very large in length (11.35 km) though its height is modest. Purpose is irrigation, hydropower & water supply.

Environmental note: Given its large surface area and length, the submergence zone is extensive — so local habitat change, fisheries effects and altered river flows are relevant for your biodiversity/landscape discussion.

Siddheshwar Dam:

On the Purna River (tributary of Godavari), in Hingoli district of Maharashtra. It is an earth-fill dam with gross storage capacity (~0.251 km^3) and live (~0.081 km^3). Purpose isirrigation for surrounding tehsils, drinking water for nearby areas. Environmental note: As a smaller dam compared to the giants, its ecological footprint may be less dramatic, but still relevant for local landscape change, groundwater recharge, and possible change in micro-climate around the reservoir.

Bhatghar Dam :

Situated on the Velvandi (Yelwande) River near Bhor in Pune district. Gravity masonry dam: Height ~57.92 m, storage capacity ~666 million m³. Purpose: irrigation, hydropower (16 MW) and water supply.
Environmental note: Because it's relatively old (1927), its reservoir ecology, sedimentation levels, and long-term changes in catchment may provide interesting insights into older dam environmental dynamics.

Chankapur Dam:

Located on the Girna River near Abhona in Kalwan Tehsil of Nashik district. Earthfill dam: height ~41 m, length ~3705 m. Purpose: irrigation (historically built in the 19th century by British). Environmental note: As one of the earlier dams in the region, the long-term land use changes, sedimentation, and downstream river ecology alterations are worth noting.

Mula Dam:

On the Mula River at Rahuri, Ahmednagar district. LiquiSearch Although I don't have height/volume exactly in my source, it's listed among major dams in Maharashtra. Environmental note: Given its role in the drier central regions of Maharashtra, its effect on agriculture expansion, groundwater recharge, and local micro-climate could be significant and worth examining.

Middle Vaitarna Dam (84 m)

Middle Vaitarana Dam is the third tallest dam inharashtra by height built on the Vaitarna river. Vaitarna river. Vaitarna Dam (82 m) and Upper Vaitarna Dam are two more dams built on Middle Vaitarna Dam (84 m) Middle Vaitarana Dam is the third tallest dam in Maharashtra by height built on the Vaitarna river. Vaitarna river. Vaitarna Dam (82m) and Upper Vaitarna Dam are two more dams built on Bhandaradara Dam **(82.35) Bhandardara Dam** Wilson Dam is known as Bhandardara Dam and the reservoirs know as Arthur Lake, located near the holiday resort village called Bhandardara. Bhandardara is a famous tourist place of Maharashtra, home to Mount Kalsubai, Randha falls, Wilson Dam, Amriteshwar Temple, Ghatghar, Ratnagad fort, Arthur Lake, Sandhan valley and also popular place for angling in India.

Totladoh Dam (74.5m)

Totladoh Dam and reservoir built on Pench river in Nagpur district, also with adjoining state of Madhya Pradesh. The Pench right canal supplies water to Nagpur, the koradi Thermal Power Station, of the water is use for irrigation in Parseoni taluka, Kalmeshwar taluka, Saoner taluka, Kamthi taluka, and rural Nagpur The Pench left canal irrigates Parseoni taluka, Ramtek taluka, and Mauda taluka and provides water for the NTPC Mauda Super Thermal Power Jalnadistricts. The surrounding area of the dam has a garden and a bird sanctuary.

Major Dams in Maharashtra and Their Environmental Effects

Sr. No.	Name of Dam	River	District	Type	Height (m)	Gross Storage Capacity (million m³)	Major Purpose	Environmental Effects
1	**Koyna Dam**	Koyna	Satara	Concrete gravity	103	2,797	Hydroelectricity & irrigation	Submergence of forest, habitat loss, seismic activity due to reservoir stress
2	**Ujjani (Bhima) Dam**	Bhima	Solapur	Earthfill & masonry	56.4	3,140	Irrigation, water supply, fisheries	Eutrophication, sedimentation, bird habitat creation
3	**Jayakwadi Dam**	Godavari	Aurangabad	Earthen	41.3	2,171	Irrigation & water supply	Displacement, biodiversity loss, bird sanctuary formation
4	**Bhatsa Dam**	Bhatsa	Thane	Earthfill & gravity	88.5	942	Hydroelectricity, water supply	Forest submergence, aquatic ecosystem changes
5	**Middle Vaitarna Dam**	Vaitarna	Thane	Gravity	84	1,200	Drinking water supply	Submergence of forest, tribal displacement
6	**Bhandardara (Wilson) Dam**	Pravara	Ahmednagar	Masonry	82.35	303	Irrigation, tourism	Hydrological alteration, microclimate change
7	**Totladoh Dam**	Pench	Nagpur	Gravity	74.5	1,246	Irrigation, industrial use, power	Submergence of forest in Pench Tiger Reserve

Sr. No.	Name of Dam	River	District	Type	Height (m)	Gross Storage Capacity (million m³)	Major Purpose	Environmental Effects
8	**Kalammawadi Dam**	Dudhaganga	Kolhapur	Gravity	73.08	1,370	Irrigation, tourism	Loss of forest, impact on wildlife (Indian Bison)
9	**Gosekhurd (Gosikhurd) Dam**	Wainganga	Bhandara	Earthfill	38	1,148	Irrigation, hydropower	Large submergence area, aquatic habitat modification
10	**Siddheshwar Dam**	Purna (Godavari tributary)	Hingoli	Earthfill	38.26	251	Irrigation, water supply	Local habitat alteration, groundwater recharge
11	**Bhatghar Dam**	Velvandi (Yelwande)	Pune	Masonry	57.9	666	Irrigation, hydropower	Sedimentation, riparian vegetation loss
12	**Chankapur Dam**	Girna	Nashik	Earthfill	41	364	Irrigation	Old dam, sedimentation, downstream flow alteration
13	**Mula Dam**	Mula	Ahmednagar	Earthfill	48.17	736	Irrigation, water supply	Land use change, groundwater recharge
14	**Warasgaon (Varasgaon) Dam**	Mose	Pune	Gravity	54.86	331	Drinking water, power	Waterlogging, vegetation submergence
15	**Panshet Dam**	Ambi	Pune	Earthfill	63.56	303	Water supply	Soil erosion, fish habitat formation
16	**Mulshi Dam**	Mula	Pune	Gravity	48.8	635	Hydroelectricity	Microclimate alteration, forest loss
17	**Yeldari Dam**	Purna	Hingoli	Earthfill	51	932	Irrigation & hydropower	Habitat submergence, improved groundwater
18	**Sapan Dam**	Local stream	Amravati	Earthfill	35	—	Irrigation & water storage	Improved local climate, minor biodiversity loss
19	**Babulgaon Dam**	Local stream	Amravati	Earthfill	—	—	Irrigation & domestic use	Soil erosion, vegetation loss along reservoir
20	**Naldamyanti Dam**	Local river	Amravati (Morshi)	Earthfill	—	—	Irrigation & agriculture	Waterlogging, sedimentation, local ecology change

Positive and Negative Impacts of Dams in Maharashtra

Positive Impacts of Dams

1. Water Supply to Drought-Prone Areas

Maharashtra is one of the states frequently affected by drought conditions due to irregular monsoon rainfall. The construction of dams in such regions ensures the availability of water throughout the year for drinking, irrigation, and other domestic uses.

A study conducted across India's dryland districts—such as Dahod in Gujarat and Jhalawar and Banswara in Rajasthan—highlighted the significant benefits of small dams and check dams. Between 1990 and 2012, approximately 356 check dams were constructed at a cost of USD 17 million, benefiting more than one million farmers. These structures contributed to groundwater recharge, river revival during dry seasons, and increased vegetation along riverbanks, thus mitigating the adverse impacts of local climate change.

Check dams are simple, eco-friendly, and cost-effective structures. If adopted widely across Maharashtra's drought-prone districts like Beed, Osmanabad, Solapur, Ahmednagar, and Amravati, they can significantly enhance agricultural output, food security, and groundwater resources, while mitigating the effects of climate variability.

2. Hydroelectric Power Generation

Electricity is a key driver of economic growth, and hydroelectric power plays an important role in meeting energy demands sustainably. Although hydroelectricity contributes only about 5–10 gigawatts to India's total energy supply, it is a vital renewable source of clean energy.

The Koyna Hydroelectric Project is considered the lifeline of Maharashtra, with a total installed capacity of 1,960 MW. The project, divided into four power generation stages, supplies electricity to Navi Mumbai, Thane, Pune, and surrounding industrial zones. The powerhouses are ingeniously constructed underground within the Western Ghats, demonstrating advanced engineering. Hydroelectric projects like this reduce dependence on fossil fuels and promote regional industrialization.

3. Flood Control and Water Regulation

One of the essential purposes of dam construction is flood control. Dams help regulate river discharge during heavy rainfall, preventing downstream flooding and protecting human settlements, farmlands, and infrastructure.

While northern India faces major flood challenges in the Ganga and Yamuna basins, Maharashtra also experiences severe monsoon floods in regions like Konkan, Satara, Kolhapur, and Sangli due to heavy rainfall in the Krishna and Panchganga river basins. Proper dam management allows storage of excess water during monsoon and controlled release during dry periods, thus balancing the hydrological cycle and ensuring water availability for agriculture during lean months.

4. Soil Fertility and Agricultural Development

Dams play a vital role in enhancing soil fertility and agricultural productivity. The continuous availability of water through irrigation keeps the soil moist and fertile. The seepage from reservoirs recharges groundwater, improving the quality and fertility of agricultural lands in nearby areas.

Farmers benefit from multi-crop cultivation, producing two or even three crops per year. Regions surrounding major dams such as Jayakwadi, Ujjani, and Mula have transformed from drylands into agriculturally productive areas. This has strengthened food self-sufficiency and improved the socio-economic conditions of farmers.

5. Fisheries and Inland Transportation

Dams also contribute to the growth of inland fisheries and local transportation. Reservoirs provide a stable aquatic environment suitable for fish breeding and farming. Species like Rohu, Catla, and freshwater crabs are common in dam waters and serve as a major source of livelihood for local and tribal communities, especially the Koli and Katkari tribes.

Although not as commercially developed as marine fishing, inland fish farming in Maharashtra is expanding rapidly and contributes significantly to nutritional security and rural employment. Reservoirs also provide opportunities for eco-tourism and small-scale transport through boats.

Negative Impacts of Large Dams in Maharashtra

1. Flooding During Heavy Rainfall

Despite their flood-control function, dams sometimes contribute to overflooding during extreme rainfall events, particularly when reservoir management is inefficient. Rivers such as Krishna, Panchganga, and Godavari frequently overflow during July and August, causing widespread agricultural damage, livestock loss, and property destruction in nearby villages. Poor coordination among dam authorities often worsens these disasters.

2. Interstate Water Disputes

Maharashtra shares several rivers with neighboring states, leading to interstate disputes over dam water management. A notable example is the Krishna River dispute between Maharashtra and Karnataka, involving the Almatti Dam. Delayed release of water from upstream reservoirs in Karnataka has caused severe backwater flooding in Maharashtra, destroying crops such as sugarcane, rice, cotton, and oilseeds. Such disputes also create social unrest and affect interstate relations.

3. Disturbance of Biodiversity

Large dams significantly alter natural ecosystems by blocking fish migration routes and submerging terrestrial habitats. Many fish species that migrate upstream for spawning are unable to reach their breeding grounds, disrupting aquatic food chains. Submerged forests and wetlands lead to the loss of flora and fauna, while the altered water flow impacts wetland and riparian ecosystems downstream.

4. Greenhouse Gas Emissions

Contrary to popular belief, reservoirs also emit greenhouse gases. The submergence of vegetation and organic matter around reservoirs leads to decomposition under anaerobic conditions, producing methane (CH_4) and carbon dioxide (CO_2). These gases contribute to global warming. Slow-moving reservoir waters also promote eutrophication, which further intensifies methane emissions.

5. Downstream Sediment Depletion and Erosion

Dams trap sediments that would normally flow downstream, leading to sediment starvation. This causes riverbed erosion, loss of nutrients, and deterioration of downstream aquatic habitats. The absence of sediment also reduces oxygen levels and promotes the formation of "dead zones" incapable of supporting aquatic life. Such effects are well-documented in hydrological studies, including analyses by Drishti IAS (2019).

6. Rehabilitation and Resettlement Issues

One of the most severe socio-economic consequences of large dams is the displacement of people. Thousands of families lose their homes, farmland, and livelihoods due to submergence. For example, many affected by the Koyna Dam Project continue to struggle with inadequate compensation, loss of ancestral land, and delayed rehabilitation. Displacement often leads to social isolation, loss of cultural identity, and long-term mental distress among affected populations.

7. Maintenance and Cost Challenges

Large dams require continuous and costly maintenance to ensure structural safety and operational efficiency. Over time, siltation reduces storage capacity, and aging infrastructure poses safety risks. In contrast, small and medium-sized dams or check dams are more cost-effective and easier to maintain. Studies have shown that the net irrigated area from large dams in Maharashtra has declined in the past 25 years, questioning the long-term viability of such large-scale projects.

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