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Positive Environmental Impact of Large Sized Dams in Maharashtra

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Abstract: Water is precious a natural resource. It is mainly used for agriculture, industrialization, domestic use, fisheries, power generation, water transportations and natural balance. In our country, 83 percent of water is used for agriculture, 12 percent for industrialization and only 5 percent for domestic use. In developed countries, water is used extensively for industrialization. India needs 167 liters of water per person per day by 2050 for increasing industrialization and urbanization. The dams are built on rivers for the purposes of irrigation, hydropower generation, drinking water supply, creation of recreational areas and specific improvements in the environment. The dams create reservoirs. With the increasing demand for water and energy in the world, the number and size of reservoirs are constantly increasing. Today, more than 4 million square kilometers of land have been submerged on the Earth. As a result, the rate of evaporation has increased and greenhouse gas emissions have increased. Although the dam is useful in many ways, the construction of the dam has caused environmental changes. The study concludes that the large sized dams in Maharashtra have reduced the intensity and frequency of floods. The research study found that 78.5 per cent of respondents said that the large dams had reduced the intensity and frequency of floods.

Keywords: Dams, Large Sized Dams, Impact, Environmental Impact, Positive Impact

I. INTRODUCTION

Today, we experience the truth that 'Water is Life'. All living things, humans, animals, plants need water in their daily processes. Water provides basic human needs such as food, clothing, and shelter. Water is essential for food, industrialization and maintaining the balance of nature. Water is available only on the planet Earth. About 70 percent of the earth's surface is covered by water. However, 97.5 percent of the water is alkaline and the remaining 2.5 percent is sweet or good. 69 percent of it is in the form of ice, 0.3 percent of good water is on the surface of the earth and 98 percent of that water is in lakes, ponds, dams and only 2 percent is in rivers. This shows that the availability of good water very is low.

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Water is precious natural resources. It is mainly used for agriculture, industrialization, domestic use, fisheries, power generation, water transportations and natural balance. In our country, 83 percent of water is used for agriculture, 12 percent for industrialization and only 5 percent for domestic use. In developed countries, water is used extensively for industrialization. India needs 167 liters of water per person per day by 2050 for increasing industrialization and urbanization. The dams are built on rivers for the purposes of irrigation, hydropower generation, drinking water supply, creation of recreational areas and specific improvements in the environment. The dams create reservoirs. With the increasing demand for water and energy in the world, the number and size of reservoirs are constantly increasing. Today, more than 4 million square kilometers of land have been submerged on the Earth. As a result, the rate of evaporation has increased and greenhouse gas emissions have increased. Although the dam is useful in many ways, the construction of the dam has caused environmental changes. The controversy is that whether dams and their reservoirs are good or bad for the environment and the people living in them have been going on since the 1960s or earlier. There is the controversy over the Sardar Sarovar Project on the Narmda River in India. In the present paper the positive impact of the large sized dams on the environment in Maharashtra have been studied.

II. REVIEW OF RESEARCH LITERATURE

A review of research studies in the present topic of the research is as under.

Israelsen O. W. and Hansen V. E. (1962) in his book, 'Irrigation Principles and Practices', focused on history and importance of irrigation projects. Authors also studied future growth of irrigation with different countries. In their book authors studied salinity problem of irrigation, different methods of irrigation and canals with given different counter example and images, they are also given details of soil-water relation, salinity problem, causes of water-logging and other problems of soil. **Joshi B. L. (1982)** in his book, 'Displacement and Rehabilitation' in the Marathwada region, studied the socio-psychological aspects of rehabilitation problems of a village community situated in the reservoir belt of Jayakwadi (Godavari) Irrigation Project near Paithan in Aurangabad district. The area of submergence consisted of 118 villages of which Pimpalwadi was selected. The total number of families in the village was 598 out of which 150 families were selected for further study. The study dealt with the changing social relations and resulting stresses and strains involved in the rehabilitation of the people prior to and after rehabilitation. **Irawati Karve and Jai Nimbalkar (1989)** carried out A Survey of the people Displaced through the Koyana Dam in Western Maharashtra. The sample was taken from two groups of villages-those that were moved out of the valley and those, which settled on the upper contour of the valley and were not moved. The study covered

602 families in all. The information was obtained on different aspects like land, caste, family, education, occupation, housing compensation, amenities, religious and social life etc. The study shows that the chief reason for failure of rehabilitation lies in the lack of planning on the part of the State Government. **Iyer R. R. (1989)** in his research paper entitled, 'Large Dams: The Right Perspective' published in 1989. In the researcher view on environmental grounds we cannot say 'No' to large dams and reservoirs; nor can we, having considered to projections of demand and availability, accept the view that there is no need for such projects. According to the researcher we should awfully unanimously priority to the utilisation of the potential already created, the reclamation of the potential which has been lost through abused, and a gigantic improvement in water management. **Pawar S. N. and Patil R. B. (1989)** report titled 'The Study of Environmental and Socio-economic Problem of Displacement and Rehabilitation in Koyana Project', Ministry of Environment and Forests, Government of India, has conducted a study during 1984-87 of Koyana project. The study covered 615 families in Satara, Sangli, Raigad and Thane districts. Their findings show that the people expressed their total dissatisfaction over the process of rehabilitation because of the following reasons: no proper compensation was given to the agricultural land, no adequate civic amenities, children deprived of educational and employment opportunities, discrimination and isolation from native villagers. **Singh S. K. (1990)** in his research article entitled, 'Evaluating Large Dams in India' published in 1990. According to the researcher, three positions may be identified in the controversy around large dams in India: firstly the huge social costs are paid by one section while the benefits increase to others; secondly while the concept of large dams is admissible, there ought to be appropriate treatment meted out to the environment; thirdly there is nothing wrong with large dams. The researcher examines these three positions using cost-benefit methodology but including environmental and social consequences and touches upon 'alternatives' to large dams. **Edmonds, Richard Louis (1992)** in his research article entitled, 'The Sanxia Project, The Environment agreement Surrounding China's Super Dam' presented environmental problems of large sized dams, people's emotional opinions about dams and compact history of Sanxia dam and lastly the benefits of dam like pollution free hydropower electricity, flood control, navigation, increase irrigation potential and agricultural production etc. He shows that irreparable ecological loss and the economic hazard of dam etc. **Gurjar R. K. (1994)** in his book, 'Irrigational Environment' he has given important information of history of irrigation of the world and in the period of 1983 and also studied the various aspects of development prospects of irrigation, management of irrigation system and suggested how to control water logging, salt problem in submerging area. He has studied environmental impacts assessment of water resource projects. **Bhat, G. K., Aronear, Revi (1995)** in their research article entitled, 'Earthquakes Affected Area

of Marathwada' researcher focused on the earthquakes of 30th September 1993 of 6.4 magnitude of the Richter scale in Osmanabad and Latur district. In that disaster 8000 people were killed and about 14,000 injured and enormous economic losses took place. The researchers have collected the primary data in the year 1994-95 from the various government offices and department and they have used different statistical techniques of data analysis. Researchers studied that earthquake problems in Maharashtra and also studied the problems of water related diseases and they also focused on the quality of water and ground water problem. **Flood L. U. (1997)** published his article entitled, 'Sardar Sarovar Dam: A Case Study of Development- induced Environmental Displacement', in 1997 where he discussed, how the Sardar Sarovar Dam in India is a case of a development project which causes environmental displacement on magnificent scale. This occurs through eviction and indirectly through the weakness of livelihood by environmental changes. The difficulties in resettlements and rehabilitation have emphasized in the article.

RESEARCH GAP: The aforementioned review of the research studies gives us the following research gap, which is the focus area of the present study. Considering the development of nation there are so many positive impacts of the large scale dams. However there are also some negative impacts of the large scale dames on the environment. These negative environmental impacts of large scale dams may convert this positive growth rate of economy into negative growth rate in long term. Hence, the study to large scale dams with its impacts on environmental issues became essential for India as well as nations across the world. The present research work is one of the efforts to cover the positive environmental impacts of large scale dams. At the same time study makes some suggestions to maximize the benefits with optimum use of large dams. In short, the present study is an attempt to observe the positive impacts of the large dams on the environment and also try to find out some solutions of the environmental problems which were raised by the large dams.

III. RESEARCH METHODOLOGY

The major objectives of the present research study are as below:

- To assess the positive environmental impact of large sized dams in Maharashtra. To reveal the conclusions and give suggestions as the solutions on problems.
- The present study endeavours to test the following hypotheses
- Large sized dams have significant positive environmental impact in Maharashtra.

The present research study is an analytical and quantitative type of study. The study uses all the necessary methods useful for data collection, analysis and testing accuracy or significance of the data results. The period of the present study especially for the

secondary data will be from 2001-02 to 2016-17, but updated wherever necessary up to 2019-20. The primary data has been collected by administering a questionnaire in the year 2020.

The present research study is in the area of economics of environment. Hence, it requires collecting both the secondary as well as primary data. It is therefore, the present study relies on the primary as well as secondary data. The study period of the present study is from 2001-02 to 2016-17, especially for the secondary data but it is updated. The necessary secondary data relating to the profiles of study area has been collected from publications and official records of Public Works Department, Irrigation Department, Forest Department, and Agricultural Department of Government of Maharashtra of all dams with emphasis on selected large dams. Likewise, the necessary primary data concerning land salinity, water logging, water pollution, crop yield, water level, water borne diseases, loss of wildlife habitats, soil nutrients, loss of land etc, is collected by administering a well-structured questionnaire and holding interviews, group discussions and observations.

In Maharashtra total numbers of large sized dams or major irrigation projects are 137. These total number of large sized dams are divided into six regions. The purposive sample of 10% of the universe has been taken to collect the primary data so to assess impact of large sized dams with emphasis on the environmental impact. The large sized dam is one having culturable command area more than 10000 hectares.

Selection of Study Area is as follows

Table 1: Major/Large Projects in Maharashtra (18-08-2017)

Sr. No.	*Names of Regions*	*Total No. of Projects*	*Selected Projects*
1.	Amravati	10	01 (10%)
2.	Kokan	11	01
3.	Nagpur	16	02
4.	Nashik	21	02
5.	Pune	35	03
6.	Marathwada	44	04
Total Projects		**137**	13 (10%)

Source: Irrigation Dept, Government of Maharashtra

From each region sample is selected by adopting non-random sample method with purposive sample category / method. Only from Pune region three dams will be selected because it is more rainfall and watered dam area. Total thirteen large sized dams have been selected from the universe of entire Maharashtra state. Researcher has collected the primary data about socio-economic and environmental impact of large sized dams through administering a well-designed questionnaire among the people or respondents

who are beneficiaries, victims or residents in the command area of the dams. The actual large sized dams have been selected for the study consist of I) Amravati Region: Upper Wardha, II) Kokan Region: Bhatsa, III) Nagpur Region; Itiadoh, Totladoh, IV) Nashik Region: Gangapur, Bhandardara, V) Pune Region: Koyana, Radhanagari, Panshet, VI) Marathwada Region: Jayakwadi, Manjra, Lower Terna, Dudhana. The primary data has been collected by administering a questionnaire among 50 respondents from each dam catchment area which comes at total of 650 respondents by adopting purposive sampling method.

The important and suitable statistical software's namely SPSS and Excel have been used for the data processing and analysis purpose. The necessary and appropriate statistical tools are used for the data analysis, which consisted of coefficient of variation, mean, simple and compound growth rate, ratio analysis etc.

The present study assesses social, economic and environmental impacts of the selected large sized dams in Maharashtra with emphasis on environmental impacts. The indicators study will consider and capture both positive as well negative impacts consisting of villages displaced, land submerged, housing, deforestation, land use pattern, land salinity, water logging, desertification of land, landslides, water & air pollution soil erosion, water borne diseases , irrigation facilities, agricultural production and productivity, employment, loss of wild life, birds & animals, Water Supply for Domestic and Industrial Use, Meeting the Agriculture Demand for Food Supply, Flood Control, Recreation, Hydropower, Inland Navigation as well as Resettlement and Relocation, Earth's Crust, Aquatic Life, Disappearance of Historical Places, Scouring of River, Generation of New Species, Human Health, natural calamities.

IV. POSITIVE ENVIRONMENTAL IMPACT OF LARGE SIZED DAMS IN MAHARASHTRA

The positive effects of dams include factors that will not have adverse effects on the surrounding human life as well as aquatic animals and plants.

1. Flood Control

As per the CWC, in 1996, 1,271 persons lost their life due to floods and crops worth Rs.3,839 million were damaged. These floods affected an area of 7.36 million ha and 39 million people. It has been known that large storage dams help in managing floods effectively and reducing the sufferings of millions.

The annual floods inundate the surrounding areas, causing huge loss of life and property. The Sudden infiltration of water into human settlements causes many deaths, houses collapse, animals are displaced, crops are damaged, plants and trees are destroyed, and many epidemics spread, causing socio-economic and environmental problems. The

only solution to all these problems is to create large dams to properly control the flow of rainwater from the river. As a result, large scale environmental damage as well as socio-economic damage can be brought under the control.

The only example in the world of building dams for flood control is the flood control scheme on the Miani River in the Western part of the US state of Ohio. The five dams in the scheme are built for flood control only, they temporarily store flood water and at other times they are empty. More than 30 dams have been built on Tennessee and its tributaries, and the water has been used for a variety of purposes. The examples of this in India are the four dams at Maithan, Konar, Tilaiya, Panchet on the Damodar river and its tributaries, and the Darwaza dam at Durgapur. Due to this project, floods in Damodar river basin have been brought under control.

Many multipurpose dams have been built in the twentieth century. These include Hoover Dam in the US, grand Cooley Dam, Fort Peck Dam, Bhakra in India, Hirakud, Rana Pratap Sagar, Nagarjuna Sagar, and Aswan in Egypt. The dams have helped in controlling the floods in their area.

If we think of Maharashtra, a big river like Krishna, Koyna, and Panchganga flood comes every year. The result is massive environmental damage. The flood controls as well as multi-purpose dams have been constructed on these rivers. Almatti dam has been constructed on Krishna river, Koyna dam on Koyna river and Radhanagari dam on Bhogawati, a tributary of Panchganga. The recent period flood in Sangli and Kolhapur has caused a lot of damage. The government has appointed various committees to look into the cause of the floods. According to his report, the dam does not create flood situation but due to improper management of water in the dam and increase in encroachment of human settlements in the river basin, flood situation occurs every year.

2. Hydropower Generation

Renewable and pollution free hydel power is environmentally preferable as compared to thermal power, another power source implemented in India. Besides the factor that thermal power stations cause pollution, much more than hydel power, it also has certain technical limitations. In 25 years, therefore, from 1954 to 1979, the installed hydroelectric energy generating capacity rose 12 times, from 3.24 billion KW to 39.4 billion KW perhaps a right march for pollution free power sources. In many countries, hydroelectric power provides nearly all of the electrical power. In 1998, the hydroelectric plants of Norway and the Democratic Republic of the Congo provided 99 percent of each country's power; and hydroelectric plants in Brazil provided 91 percent of total used electricity[1].

Electricity generated from dams is by very far the largest renewable energy source in the world. More than 90% of the world's renewable electricity comes from the dams.

The hydropower also offers unique possibilities to manage the power network by its ability to quickly respond to peak demands. Pumping-storage plants, using power produced during the night, while the demand is low, is used to pump water up to the higher reservoir. That water is then used during the peak demand period to produce electricity. This system today constitutes the only economic mass storage available for electricity.

India's hydroelectric power potential is estimated at 148,700 MW. In the fiscal year 2019-20, the total hydroelectric power generated in India was 156 TWh (excluding small hydro) with an average capacity factor of 38.71%. India currently has 197 hydropower plants above 25 MW, plus nine pumped storage stations and ranked fifth in the world for potential hydropower capacity[2].

In Maharashtra too, hydropower is generated through large dams. The electricity is generated by the Government of Maharashtra as well as on a private basis. With the help of the following tables, we understand the potential of hydroelectric power generation by the government and on a private basis.

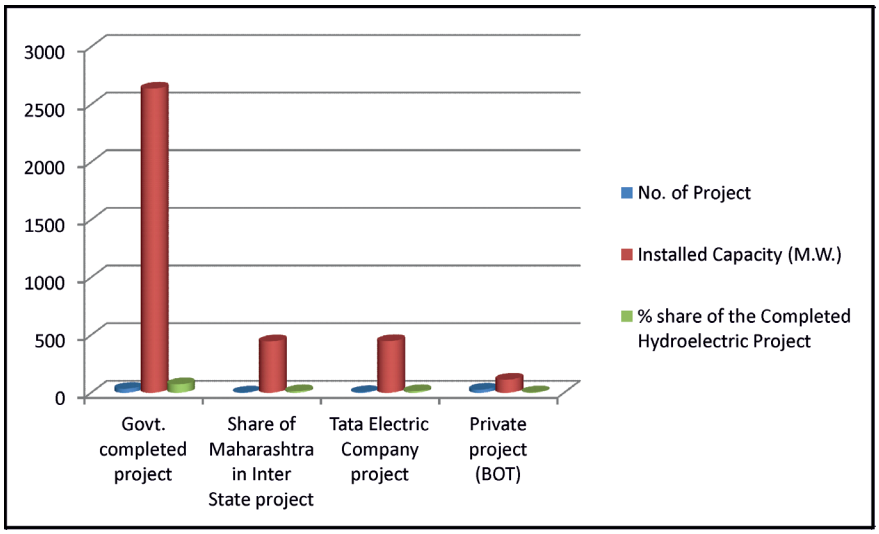
Table 2: Completed Hydroelectric Project in Maharashtra (2018-19)

Sr. No	*Project Name*	*No. of Project*	*Installed Capacity (M.W.)*	*% share of the Completed Hydroelectric Project*
1.	Govt. completed project	34	2636.325	72.408
2.	Share of Maharashtra in Inter State project	02	444.50	12.208
3.	Tata Electric Company Project	05	447.00	12.277
4.	Private Project (BOT)	27	113.10	3.107
	Total	68	3640.925	100

Source: Irrigation Status Report 2018-19 Govt. of Maharashtra

The above table and graph 2 shows that considering Maharashtra as a whole, a total of 68 hydropower projects have been completed. Their installed capacity is 3640.925 MW. Of these, 34 projects have been completed by the government and their maximum installed capacity is 2636.325 MW. The government accounts for 72 percent of the completed hydropower projects. The Maharashtra state also has a stake in the completion of two projects in hydropower generation of other states. They have an installed capacity of 444.50 MW and a share of 12.208 percent in total hydropower. The Tata Electric Company and Private sector have completed 5 and 27 projects respectively, with installed capacity of 447 and 113.10 MW respectively. Their share in the total hydropower generation is 12.27 percent and 3.10 percent respectively.

In the case of Maharashtra, the Koyna Dam in Satara district generates a large amount of hydropower. Koyna dam supplies electricity to almost the whole of



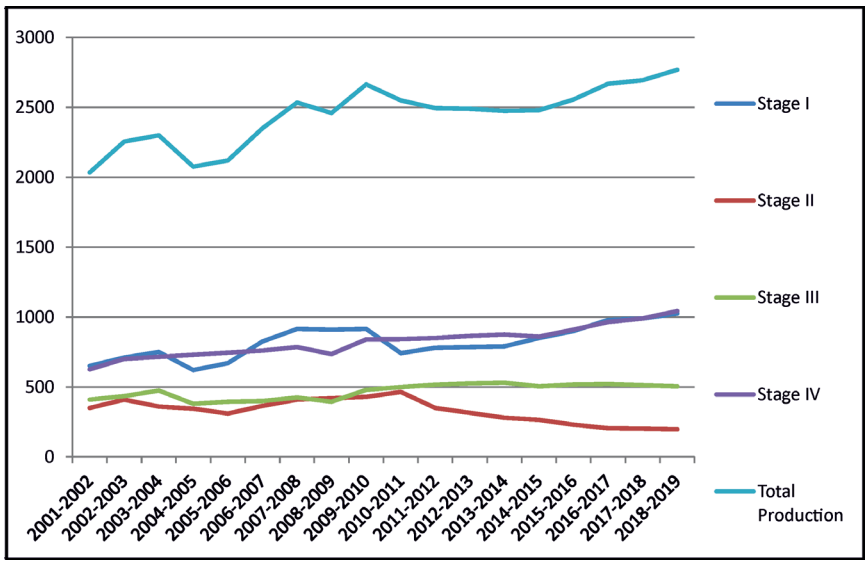
Graph 1: Completed Hydroelectric Project in Maharashtra

Table 3: Koyna Hydroelectricity Production

(Million Units)

Sr. No	*Year*	*Stage I*	*Stage II*	***Stage III***	***Stage IV***	***Total Production***
1.	2001-2002	650	350	410	625	2035
2.	2002-2003	710	410	435	700	2255
3.	2003-2004	750	360	475	715	2300
4.	2004-2005	620	345	380	730	2075
5.	2005-2006	671	310	395	745	2121
6.	2006-2007	825	365	400	760	2350
7.	2007-2008	915	410	425	785	2535
8.	2008-2009	910	420	395	735	2460
9.	2009-2010	915	430	480	840	2665
10.	2010-2011	742	465	500	842	2549
11.	2011-2012	780	350	515	850	2495
12.	2012-2013	785	315	525	865	2490
13.	2013-2014	790	280	530	875	2475
14.	2014-2015	850	265	505	860	2480
15.	2015-2016	900	230	517	910	2557
16.	2016-2017	980	205	520	965	2670
17.	2017-2018	990	202	512	990	2694
18.	2018-2019	1025	196	505	1043	2769
	CGR	2.16	-3.78	1.73	2.45	1.44
	CV	0.15	0.26	0.12	0.13	0.09
	SD	120.73	83.85	54.03	109.84	214.26
	AVERAGE	822.67	328.22	468.00	824.17	2443.06

Source: Koyna Hydroelectric Project Office, Humbarli, Maharashtra 2018-19



Graph 3: Koyna Hydroelectricity Production

Maharashtra. Therefore, Koyna dam is called the 'Line of Destiny of Maharashtra'. About two thousand megawatts of hydropower is generated through the Koyna dam.

The above table and graph no.3 shows the year-wise and stage-wise production of the hydroelectricity in Koyna Dam Project. Table also indicates the growth of the production of electricity of Koyna Dam Project in last 19 years. In 2001-2002, Koyna Dam produced total 2035 MU of hydroelectricity which increased up to 2769 MU in 2018-2019. During the same time at stage I, Stage II, Stage III and Stage IV Koyna Dam produced 650 MU, 350 MU, 410 MU, 625 MU of hydroelectricity respectively which was increased up to 1025 MU, 196 MU, 505 MU, 1043 MU in 2018-19. The CGR of total production of hydroelectricity during 2001-02 to 2018-19 was 1.44 per cent with average of 2443.06 MU. The Standard Deviation (SD) was 214.26 MU with 0.09 per cent of Coefficient Variance (CV).

In short the table shows that the dam produced maximum electricity at the Stage I and stage IV which is approximately in the same proportion while the Stage II is season of lowest production of electricity through the dam and day by its ratio is decreasing.

3. Increase Irrigation Facilities

The dams and reservoirs are constructed to store surplus waters during rainy season, which can be used for irrigating arid lands. One of the major benefits of the dams and reservoirs is that water flows can be regulated as per agricultural requirements of the various regions over the year. The dams and reservoirs render unforgettable services to the mankind for meeting irrigation requirements on a gigantic scale. It is estimated

that 80% of additional food production by the year 2025 would be available from the irrigation made possible by the dams and reservoirs[3].

Water is one of the basic necessities of life for all living things on the earth. Water is essential to keep the food chain intact. The lack of water will destroy all this and it has adverse effects on the environment. The large dams provide abundant water for living animals and plants. It can also produce food grains that are needed for living things to survive. The abundant food supply keeps the food chain intact and poses no threat to the environment.

There were a total of 3267 projects in the state of Maharashtra with 141 large, 258 medium and 2868 small projects with partial and full irrigation capacity by the end of June 30, 2020. Large, medium and small scale projects have created 59.620 million hectares of irrigation capacity in the state till the end of June 30, 2020. It is compared to other states in India; Maharashtra has a large human population and biodiversity. This is due to the fact that Maharashtra has the highest number of dams and these dams have large water reserves.

4. Water for Drinking and Industrial Use

Due to the large variations in hydrological cycle, dams and reservoirs are required to be constructed to store water during periods of surplus water availability and conserve the same for utilization during lean periods when the water availability is scarce. The properly designed and well-constructed dams play a great role in optimally meeting the drinking water requirements of the people. Water stored in reservoirs is also used vastly for meeting industrial needs. Regulated flow of water from reservoirs helps in diluting harmful dissolved substances in river waters during lean periods by supplementing low inflows and thus in maintaining and preserving quality of water within safe limits[4].

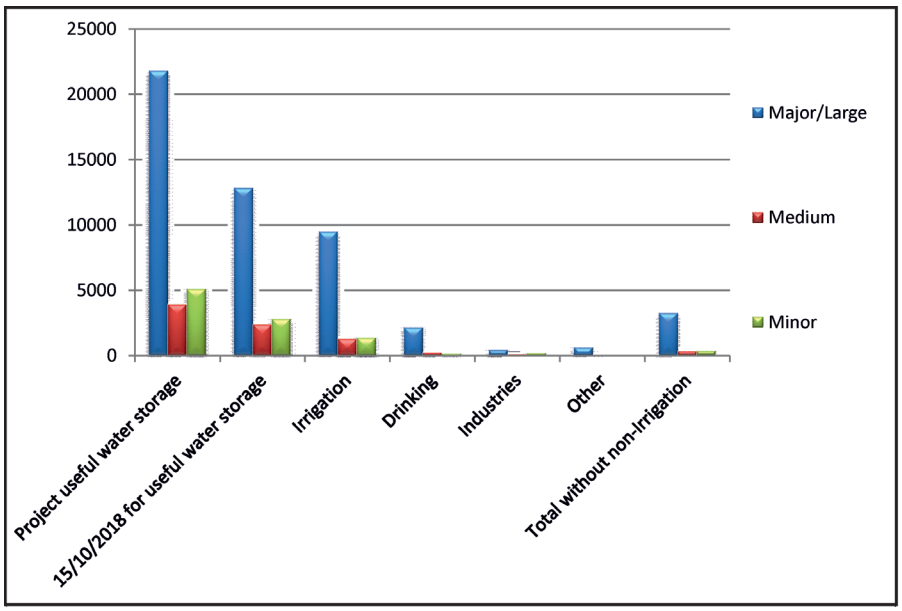
The following table shows the project type wise water supply in Maharashtra in the year 2018-19.

Table 4: Year 2018-19 for Project Type Wise Water Supply in Maharashtra

(Million Cubic Meters)

Sr. No	*Types of Project*	*Project useful water storage*	*15/10/2018 for useful water storage*	*Irrigation*	*Drinking*	*Industries*	*Other*	*Total without non-Irrigation*
1.	Major/Large	21825.30	12836.30	9496.85	2181.15	445.50	642.05	3268.70
2.	Medium	3944.63	2401.40	1312.57	222.86	84.82	45.22	352.90
3.	Minor	5117.26	2809.21	1385.56	153.96	176.86	28.15	358.97
	Total	30887.43	18046.91	12194.98	2557.97	707.42	715.42	3980.57

Source: Irrigation Status Report 2018-19 Maharashtra Govt.



Graph 4: Project Type wise Water supply in Maharashtra

The above table and graph 4.3 shows that in the year 2018, all the dams had combined storage capacity of 18046.91 million cubic meters. Out of these, water was supplied to 12194.98(67.57%) million cubic meters for agriculture as well as 2557.97(14.17%) million cubic meters for drinking and 707.42 (3.91%) million cubic meter for industrial area. 715.42 (3.96%) million cubic meters of water was supplied for electricity generation and other purposes, that is 3980.57 (22.05) million cubic meters for non-irrigation purposes.

5. Inland Navigation

Shipping is seen as very cheap, safe and fast transportation. Water transport is known as a means of reducing environmental pollution rather than road transport, rail transport and air transport. Even though water is not being transported through dams in Maharashtra, the Koyna Dam administration has received a proposal for water transportation.

The enhanced inland navigation is a result of comprehensive basin planning and development, utilizing dams, locks and reservoirs that are regulated to play a vital role in realizing large economic benefits of national importance. The advantages of inland navigation, however, when compared with highway and rail are the large load carrying capacity of each barge, the ability to handle cargo with large-dimensions and fuel savings. The enhanced inland navigation is a result of comprehensive basin

planning and development utilizing dams, locks and reservoirs which are regulated to provide a vital role in realizing regional and national economic benefits. In addition to the economic benefits, a river that has been developed with dams and reservoirs for navigation may also provide additional benefits of flood control, reduced erosion, stabilized groundwater levels throughout the system and recreation[5].

6. Reserve Forest Places

It is generally observed that the dam is constructed in a forest area far from human habitation i.e. in areas with high rainfall and large hills. The construction of the dam has submerged much of the forest. Also deforestation is done extensively for farming around the dam. The large-scale deforestation threatens the biodiversity of the area. The different types of pollution are generated and adversely affect the environment. But even if all this is true, in recent times it appears that the government of the place has declared the area around the dam as a protected area considering all these consequences in the dam area. As a result, there is a lot of forest growth in the area and a different kind of biodiversity is being added.

In the case of Maharashtra, the area around the largest dam, Koyna, has been declared a protected area by the government as a Koyna Wildlife Sanctuary. The Koyna Sanctuary is located in Satara district of Maharashtra. The Koyna Sanctuary is one of the densest forests in Western Maharashtra. This sanctuary is spread along the side of Shivajisagar behind the walls of Koyna Dam. The total area of the sanctuary is 426 sq. km and it got the status of sanctuary in 1985. Similarly, the Radhanagari Sanctuary is a sanctuary in Radhanagari taluka of Kolhapur district in Maharashtra. It is the first sanctuary in Maharashtra. It was established in 1958 and at that time it was renamed as Dajipur Sanctuary. The sanctuary has a total of 135 species of wild animals and 235 species of birds. The total area of Radhanagari Sanctuary is 351.16 sq. km.

V. MAJOR CONCLUSIONS AND POLICY SUGGESTIONS

The major conclusions of the study are; The large dams in Maharashtra have reduced the intensity and frequency of floods. The research study found that 78.5 per cent of respondents said that the large dams had reduced the intensity and frequency of floods. The reduction in the intensity and frequency of the annual floods appears to have greatly reduced the environmental damage. The crops that have been submerged for many days under the floodwater rotted and appeared to have caused extensive damage to the crops. The research study shows that the construction of the large dams in Maharashtra has helped to control the floods and have reduced the agricultural losses. More than the 75 per cent of respondents appear to agree with this view. The large dams have increased the irrigation area and the agricultural productivity, because the crops get

water at the right time and in the right amount. As a result, the agricultural productivity has been increased. The research study found that the 82.2 per cent of respondents feel that the dams had improved the agricultural productivity. The large dams seem that they have provided permanent water to the agriculture area throughout the year. Due to the availability of adequate amount of water for agriculture area, its fertility has been maintained. The soil fertility is good in Pune and Nashik divisions of Maharashtra, because the dams in these divisions have reserved sufficient water, but the situation is very different in Marathwada and Vidarbha divisions. After the construction of the large dams, farmers seem to have shifted from conventional crops to cash crops. The result was an increase in the area under cash crops. Water is available in the dams, in the large quantity for the cash crops like sugarcane.

The research study shows that more than 90 per cent of farmers agree with the view that dams have increased the area under cash crops. The waste lands have come under the large scale cultivation due to the dam water. Their productive intentions have increased. Similarly, the industrial development has taken place due to the availability of water required for the industries. The research study shows that 80.3 per cent of respondents agree with the view that the productive purpose of the land has increased after the constructions of the dams. The large dams have improved surface water resources. The water level of rivers, lakes, streams and creeks has been increased. The research studies show that 80.9 per cent respondents agree that the dams have improved the surface water resources. The groundwater levels have improved after the construction of the large dams. The water level of borewells and wells has increased, because the dams cause a large amount of water to absorb into the ground, which in turn increase the groundwater level. The research study has found that 86.9 per cent of respondents agree with the view that groundwater levels have risen since the constructions of the dams. In Pune, Nashik and Kokan Divisions of Maharashtra, the ground water level has increased. Water constantly release from the dam into the river basin reduces the risk of water pollution; the flow of water in the river basin reduces the formation of water hyacinths and algae, the stagnant water due to the accumulation of damaged water, the pollution due to the accumulation of plastics in the river basin, etc. The result is the greater protection of the environment.

If we consider the large dams in Maharashtra from an environmental point of view, there are both positive and negative consequences. When we think of the positive aspects of the dam include elements such as flood control, hydroelectric power, irrigation, water transportation, water for drinking and industrial use, protected forest area, etc. The importance of dams does not diminish as large dams have negative consequences. You can see that the surrounding area has become very prosperous due to the dams. Some people have to make sacrifices while implementing any development

project from the point of view of the country. The projects will not create any major problems in the concerned government agencies work with due diligence. For this, a kind of 'Sustainable Development' can be created in the country and state the concerned government agencies pays attention to how to minimize the negative effects caused by dams and increase the positive results.

The policy useful suggestions can be; The dam management board should properly plan the discharge of water from the dam. As a result, floods will not cause environmental, social and economic damages. The dam management board is required to inspect and maintain the dam every year. As a result, the dam will not burst and unexpected floods will not occur. The leaks in the dams need to be removed in time. Removal of leakage in time will reduce the amount of wetland in the dam area. The proper planning of water supply to the agricultural sector is essential. This will reduce the amount of saline soils that grow due to excess water. Contaminated water mixing in the rivers and the dams must be controlled. This will reduce the incidence of epidemics. The economic as well as environmental impact assessment frequently should be carried out and necessary remedies should be implemented.

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