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Research Paper

Usages of Reservoirs in Gwalior Region Madhya Pradesh India

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Abstract: Dams and reservoirs the water bodies that is very important for us and for whole universe. At present, more than 45,000 large dams and an estimated 800,000 small dams regulate the world's River; some have been built to supply water including irrigation, control floods, provide for navigation, fishing and recreation, and importantly to generate electricity. The reservoirs have played a powerful role in economic development; however, there has been growing controversy about the failure of these projects to address environment and social concerns. These dams extend major contribution in fish culture and drinking water supply. Dams, large and small, are planned, constructed and operated to meet human needs in the generation of energy, irrigation for agricultural production, flood control, supply of drinking water, and various other purposes.
Keywords: Irrigation, Reservoirs

INTRODUCTION

Dams, wetlands and aquatic ecosystems are the biological machine of the earth. They are the basis for life and the livelihoods of local communities. Understanding, protecting, and restoring ecosystems at River basin level is essential to foster equitable human development and the welfare of all species. Dams transform landscapes and create risk irreversible impacts. The International Commission of Large Dams (ICOLD) defines large dams as dams with a height of 15 meter or more from foundation to crest.

Dams between 10 and 15 meter also fall into this category if: crest length is over 500 m or spillway discharge over $2000 m^3 s^{-1}$ or reservoir capacity is more than one million cubic meters. Dams have one of the most important roles in utilizing water resources. These were constructed long years before gaining present information about hydrology and hydromechanics. They are not ordinary engineering buildings. Dam projects which are useful in meeting the demand for water in desired times and in regulating stream regimes have undertaken an important function in the development of civilization

(J. Manatunga).Modern dam construction began during the second half of 19th century, even though they had been built since ancient times. At the turn of twentieth century (1900), there were 42 dams in India. During 1901 to 1950, about 250 dams were added. That is, at the time of the beginning of plan period (1950-51), after India gained independence in 1947, there were about 300 dams. During the next twenty years, there has been a spurt in the dam construction activity in which 695 dams were added bringing the total number of dams to nearly 1000 up to the year 1970. The dam building activity intensified during the next two decades and at the end of 1990, the total number of dams constructed by India stood at 3,244 without accounting for 236 numbers of dams for which the year of construction is not available. Due to dwindling economy, only 115 dams could be added after 1990 and today about 695 dams are at various stages of construction. As per the National Register of Large dams, India has as on today 4,291 large dams including the 695 dams under construction (World Commission on Dams, IV.5, Options Assessment- Large Dams in India-1999). Nearly 700 dams were built every 10 years up to 1950s. This number grew rapidly after 1950s. While the dams were built and completed, it was observed that there was something missing and detrimental. Although the effects of water on human life and the development of civilizations are well known all over the world, it is claimed that the economic benefits expected from the projects designed to utilize water resources could not be gained and also necessary precautions to decrease the environmental, economic and social losses were not taken. Even some studies aiming to block these water supply projects (like dams and reservoirs) of the developing countries are approved by some international organizations. Because of this, in the sustainable management of the water, taking into account the economic and social development and the environmental impacts, which came out because of the mentioned studies, has gained an increasing importance (Sait, M., 2008). The more than 45,000 dams around the world helped many communities and countries' economies in utilizing and harnessing water resources from half of the world has dammed Rivers primarily for food production, energy generation, flood control and other domestic use.

Dams supported 30-40% of the entire irrigated area of the world and thus supported 12-16% global food production. Hydropower provides about 19% (2,650 TWh43/yr.) to more than half of 63 countries' electricity supply. Around 12% of all dams supplies water for drinking and sanitation (WCD Report, 2000). In India, recent research shows that development-caused displacements over the last five decades affected over 50-55 million people (Fernandes, 2005); by sector, India's dam construction alone accounts for the single largest displacements. In China, recent research shows at least 45 million people displaced; dams (for power, irrigation and drinking water) account alone for over half of this number (Shi and Chen, 2004). The WCD report estimates dam-triggered displacements worldwide as between 40-80 million people, even without counting those losing their common lands but not also evicted from houses (WCD, 2000). In 2005, at least 62 Hindu pilgrims were killed when the water from the Indira Sagar dam of the state-run Narmada Hydroelectric Development Corporation was released without warning during a religious ceremony (Bhootdi Amavasya or Moonless Night) appeared by an estimated 300,000 Hindus who congregated to bathe downstream from the dam on the banks of Narmada River near Dewas. The Indira

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Sagar has a full reservoir level of 262.13m and is part of more than 3,000 dams being built across Narmada River and its tributaries as part of the Narmada Valley hydro project. In August 1917, around 1500 peoples were killed when the Tigra dam was breached at the level of 744.65 ft. and the inflow was probably 13500 cusecs (Given Information by Irrigation and Dam department of Tigra Reservoir) One another case is that, in June 2014about 26 Students were washed away when the Larji Hydropower Project (on Byas River, Mandi Himachal Pradesh) authorities suddenly released water from the dam (www.wekipedia.org/wiki/2014_Beas_River_Tragedy). Water has been used as an energy source for generations, first in mills to grind flour and later, after the innovation of the electric generator, to produce electricity. After the industrial revolution, the need for electricity became more and the use of hydroelectricity increased. "By 1920, hydroelectric plants accounted for 40 percent of the electric power produced in the United States." This number has since been reduced to about 12% in the United State as the focus shifted to other types of fuel that were able to meet electricity demands easier and economical (Atkins, 2011).

STUDY AREA

Gwalior region is a subdivision of Madhya Pradesh state in central India. The historic city of Gwalior is the administrative headquarters of the Gwalior division. Gwalior region corresponds to the gird region of Madhya Pradesh, which is mostly agricultural plain, dotted with ranges of low hills. Gwalior is located to the 119 kilometers south of Agra, 319 kilometers south of Delhi, the capital city of India, and 423 kilometers north of Bhopal, the state capital. Before Independence Gwalior remained a princely state of British Raj with Scindias as the local ruler. The high rocky hills surroundings the city from all sides, on the north border of Gwalior is formed by Ganga – Yamuna Drainage Basin. The city still situated on the valley between the hills of Plateau.

Demography

As of 2011's census of India, Gwalior had a population of 1,564,981; Males constitute 53% of the population and females 47%. Gwalior has an average literacy rate of 87.20%, higher than the national average of 74%: male literacy is 90.85%, and female literacy is 78.82%. In Gwalior, 13% of the population is under 6 years of age.

Geography

Gwalior positioned at 26°22.N 78°18.E in northern Madhya Pradesh 319 km (186 miles) from Delhi. It has an average altitude of 197 meters (646 feet). Most part of it comes under Bundelkhand area.

Climate

Table 1: Climate Information of Gwalior Region
(Data Source– www.accuweather.com)

Climate of Gwalior in 2015												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min. (^{0}C)	07^{0}C	10^{0}C	16^{0}C	22^{0}C	27^{0}C	29^{0}C	26^{0}C	25^{0}C	24^{0}C	18^{0}C	11^{0}C	07^{0}C
Max. (^{0}C)	23^{0}C	26^{0}C	32^{0}C	38^{0}C	42^{0}C	40^{0}C	34^{0}C	32^{0}C	32^{0}C	33^{0}C	29^{0}C	24^{0}C

This study conducted on the usages of dams and reservoirs of Gwalior region. Details of these dams and reservoirs are as follows–

TIGRA RESERVOIR

Tigra is a stored water reservoir. It is a major drinking water project situated on Sank River, a tributary of Chambal River in Gwalior district. Tigra reservoir is located at a distance of around 20 km from Gwalior. It provides good service without interruption from ancient years. This dam covered on three sides so it is called Tigra. This place is home village of the Queen Merg Nayni. Construction of the Tigra reservoir started in 1909 on Sank River by Jiwaji Rao Scindia, after that, reconstruction has been performed four times; first reconstruction was done in 1918, second in 1929, third time it was reconstructed in 2002 and fourth reconstruction started in 2013. Tigra reservoir have 64 gates (well system) for supplying water for drinking and irrigation purposes, but all gates are manual working rather than automatic. In 2002, 7 new automatic gates were installed in Tigra reservoir. The extension of Tigra reservoir lies at latitude $26^0$12'0" North and longitude $78^0$30'0" East.

The reservoir was assembled with stone masonry in lime mortar and bases were resting on the massive sandstone. It was breached on 4 August 1917 at 7:45 PM. At that time, the water level was 744.65 ft., the inflow was probably 13,500 cusecs, and therefore the Government of Madhya Pradesh again rebuilt the reservoir in 1929. The catchment area of the reservoir is 414.24 Km^2. The Maximum height of the reservoir is 79 ft. (27.70 M) and the maximum level of the reservoir is 740 ft. (225.52 M). The reservoir was mainly constructed for irrigation and aquaculture. At present, it is used only for supplying drinking water to the Gwalior city.

Salient Features of Tigra Reservoir

Location – On Sank River, Village Tigra Gwalior.
Latitude – 26^o 12' N
Longitude –78^o 30' E
Latitude – 218.58 m (M.S.L)
Catchments Area – 414.25 Km^2
Average Rainfall – About 600 mm
Maximum Length – 5.8 km
Maximum Width – 3.8 km
Maximum Depth – 18 m

Reservoir Capacity

Gross – 130.80 m3 (4622 m Cft)
Live – 124.23 m3 (4390 m Cft)
Dead – 6.56 m3 (232 m Cft)

Principle levels

L.B.L. – 202.5 m
Lower Sill – 211.8 m
Crest – 202 .2 m
Full Tank Level – 225.5 m (F.T.L)

Particulars of Reservoir

Reservoir Type – Masonry Reservoir
Length – 1524.2 m
(Masonry 1342.4 m Earthen 182.8 m)
Maximum Height – 24 m
Year of Starting of Construction – 1909
Year of Completion – 1917
Estimated Cost – 52.57 Lakhs

Sub Details

No. of Over Flow – 64 gates (10'x8' each)
Sluice gates and their area No. of fitting Gates – 16 gates
Size and Area – 10'x 4' each 620 sq. ft

Discharge Capacity of Each Gate

(a) Tilling Gate – 260 cusecs each
(b) Vertical Gate – 734 cusecs each

Irrigation

Canals and Their Length

(1) Jigsoli Minor – 6.4 km
(2) Nirouli Minor – 4.8 km (Water supply to Gwalior city – 66.37 MLD)

HARSI RESERVOIR

Harsi is one of the most important and big reservoirs. It is stored water reservoir. The Harsi reservoir is a major irrigation project situated on Parwati River, a tributary of Sindh River, in Dabra, Bhitarwar, and Tehsil of Gwalior District. The project is located at a distance of around 95 km from Gwalior

and 55 km from Dabra. Harsi reservoir is a homogeneous earthen dam, 2134 m long with a maximum height of 29.26 m. The extension of Harsi reservoir project lies at latitude $25^0$45'487" N and longitude $77^0$55'286" E and distance is 277 meter. Harsi reservoir has a water spread area of 2523-hectare total catchment area of 1960 Km^2. It was starting in 1925 and complete in 1935. The reservoir is primarily use for irrigation, fisheries and domestic purposes. Districts benefited from this dam are Gwalior, Shivpuri and Datia. The importance of this reservoir becomes important because Mohini Sagar, Kaketo and Takanpur reservoir make a system, which joins this dam together. The Harsi reservoir gets feeding from Kaketo and Mohini Sagar through a canal, which has been termed as a pickup weir. From Harsi reservoir, a canal joins the Takanpur reservoir. Apart from storage of the dam, a feeder canal taking off from Mohini pick–up weir of Sindh project also feeds to the irrigation system of Harsi project. The canal system consists of 65 km long main canal and 33 no. of distributaries, covering a total length of 483.3 km. Harsi canal system, which was build in the year 1935 with irrigation potential of 30,223 hectares. In year 2011– 12, the actual Rabi irrigation area has been extending to 62,500 hectares. The CCA of the project is 68,392 hectares.

Salient Features of Harsi Reservoir

Name Project–Harsi Major Irrigation Project
Name of the Reservoir – Harsi Reservoir
Nearest City –Gwalior
Type of Project – Major
District – Gwalior
State – Madhya Pradesh
Engineering Type of Project–Diversion, Storage
International Sharing–No (State and National)
Basin Name – Ganga
River – Parwati
Reservoir Type – Earthen
Reservoir Status – Completed
Year of Start Project – 1925
Completion Year – 1937
Plan Start (Five Year) – Pre-plan
Purpose of Reservoir – Irrigation
Length of Reservoir – 2138.00 m
Reservoir Area – 25230.00 10^3 m^2
Design Flood – 4918 cumec
Spillway Capacity – 4918 cumec
District Benefited – Gwalior
Seismic Zone – Seismic Zone II
Reservoir Height – 29.28 m
Gross Storage Capacity – 192670.00 10^3m^3
Effective Storage Capacity–179020.00 10^3m^3
Potential Utilized (Th. Ha.) – 40.5
Project Covered Under ERM Scheme–No
Project Covered Under CADA Scheme–Yes
Project Covered Under AIBP Scheme – No
Ultimate Irrigation Potential (Th. Ha.)– 30.2

KAKETO RESERVOIR

Kaketo is a stored water reservoir for providing the drinking water to whole Gwalior city. It constructed on Parvati River in Mohana, a sub–district of Gwalior. Its construction was complete in 1934. It is located at latitude $25^0$54' N and longitude $77^0$44'E. It is use for irrigation, drinking purpose and aquaculture. Kaketo and Devera villages are situating near to Kake to reservoir but there is no connection between Kaketo reservoir and the villages owing to the long distance. When Tigra reservoir is at low level, then supply of water is providing by Kaketo reservoir through canal system and it fulfills the water requirement of Gwalior. It works as a complementary reservoir of Tigra reservoir.

Salient Features of Kaketo Reservoir

Project Name – Kaketo Reservoir
Nearest City – Mohana
District – Gwalior
State –Madhya Pradesh
Basin Name – Ganga
River – Parwati River

Reservoir Type – Gravity/Masonry
Reservoir Status – Completed
Completion Year – 1934
Purpose of Reservoir – Irrigation/Drinking
Length of Reservoir – 1,047 m
Reservoir Area – 8,906.90 10^3 m^2
Design Flood – 1,811 cumec
Spillway Capacity – 1,811 cumec
Seismic Zone – Seismic zone II
Reservoir Height – 37.64 m
Length of Spillway – 190.5 m
Crest level of Spillway – 64.5
Gross Storage Capacity – 80,510.0010^3m^3
Effective Storage Capacity–79,180.00 $10^3$$m^3$

RAMOVA RESERVOIR

Ramova is a reservoir, which is best habitat for migratory birds. Ramova reservoir is silent water body. At present, it is use only for domestic purposes and for aquaculture. It is about 8 km away from Jiwaji University near to Ramova village. Ramova reservoir was completed in 1931 and it built with latitude $26^0$09.22' N and longitude $78^0$13'21"E.

Salient Features of Ramova Reservoir

Project Name – Ramova Reservoir
City & District – Gwalior
State – Madhya Pradesh
Basin Name – Ganga
River – Morar River
Reservoir type – Earthen
Reservoir Status – Completed
Completion Year – 1931
Purpose of Reservoir – Irrigation
Length of Reservoir – 384 m
Reservoir Area – 8533.00 10^3 m^2
Reservoir Height – 21.33 m
Design Flood – 707.75 cumec
Spillway Capacity – 707.75 cumec
Seismic Zone – Seismic zone II
Effective Storage Capacity– 12827.00 $10^3$$m^3$
Gross Storage Capacity – 12960.00 10^3m

Materials and Methodology

The study is based upon the collection of primary data, which were gathered through household level survey near dam-affected areas. For household survey, questionnaire and schedule were framed and affected people and government employees were interviewed.

The sources of the collected data are:

- GPS positions of villages and socio-economic infrastructures.
- Socio-Economic data obtained by field interviews of affected people.
- Photograph of interviewed people.

Data from Irrigation departments.

Instruments Used in Research Work

- **GIS Mapping**

Maps of dams and reservoirs were prepared with the help of GIS application Arc GIS 9.1 version. The same application was use to calculate the area of Dams and reservoirs. To map the locations of the Dams and reservoirs, GIS Software, Arc GIS was use. Arc GIS consists of Arc Catalog, Arc Editor and Arc view.

- **Photography**

Canon D 600 camera was use for taking photographs during field surveys of reservoirs and dams. These photographs were use for the interpretation.

Questionnaire

Socio-economic impact analysis can be complete with a variety of tools. In this case, the socio-economic impact analysis is retroactive, and the research aimed to quantify impact that has already occurred across a broad population. A questionnaire is the most efficient option and examines the potential socio-economic outcomes.

RESULTS

Gwalior region in Madhya Pradesh is rich in water resources and have approximately 54,839-hectare water area falling under the reservoirs. These reservoirs are having multipurpose usages (Table – 2)

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Table 2: Usage of Reservoirs in Gwalior Region

S. No.	Reservoirs	Usage	District
1	Tigra	Drinking, Irrigation, Bird Habitat, Fish Culture, Ecotourism	Gwalior
2	Harsi	Irrigation, Fish Culture,	Gwalior
3	Ramova	Irrigation, Bird Habitat, Domestic Use	Gwalior
4	Kaketo	Drinking water	Gwalior

TIGRA RESERVOIR

Tigra is located in Tigra village and this area is home village of the Queen Merg Nayni. Before reservoir construction, Rayi, Ghamandipura, and Tigra villages were located on this place but after the construction of reservoir, the residents migrated to other nearby places. Tigra is an only such reservoir in Gwalior-

Chambal region work with eco-tourism board of Madhya Pradesh in India. Tigra reservoir is constructed on Sank River a tributary of the Chambal River. About 15 villages are situated near to Tigra reservoir but 9 villages affected by Tigra reservoir are as Sujwaya, Pava, Nagdaa, Mircha Bhoreshwar, Mandka, Tigra (Rai, Bandha, PTS, and Tigra), Khaidha, Kaiytha and Kuleth. About 5,200 people live in 9 villages and approximately 2,442 acre area is available for cropping (Table 3).

In this area, the villagers surrounding Tigra reservoir grow different types of crops such as Wheat, Mustard, Pea, Gram, Millet, and Arhar Dal. The source of drinking water for the nearby villages is Tigra but the villages do not get water directly from Tigra reservoir and use the hand pumps, tube wells and wells as source of drinking and domestic use. Some villagers have used catchment area of Tigra as a field for cropping and in that area, they have used fertilizer and pesticides. These chemicals produce detrimental effect on Tigra reservoir. According to villagers much water is required in summer season compared to winter season for cropping. Though there are different types of fertilizers available in market, only particular types of fertilizers are used for better cropping. These are Urea, Di ammonium phosphate, and Natural fertilizer. Cymbush (Cypermethrin) is an organ chlorine compound used as pesticide for cropping.

Some health problems are observing nearby Tigra reservoir like Malaria, Diarrhea, Fever and Typhoid. These health problems are especially seasonal. In festive seasons, such as Durga Worship and Ganesh worship, immersion of statues was allowed earlier but now the local authority has restricted it. All villages live near Tigra reservoir run a programmed called Nirmal Bharat Abhiyaan. From this program, funds have been granted to make toilets to avoid open defecation near Tigra reservoir. Tigra reservoir is constructed in Ghati Goan. After the construction of the reservoir, the area became a suitable habitat for several birds and this area was later declared as a Ghati Goan Bird Sanctuary (Figure 2).

Uses of Tigra Reservoir

Drinking Water

Water is basic need of every one. Tigra is a stored water reservoir. It is the main source of drinking water for Gwalior city. Tigra reservoir was only use for drinking water initially, but recently by the order of Honorable High court, it is also use for the irrigation purposes

Ecotourism

Tigra reservoir has huge potential for ecotourism. The Madhya Pradesh State Tourism Development Corporation has initiated its activities in this direction and Tigra reservoir was declare as ecotourism spot in 2007. Ecotourism activities propose a unique opportunity to manipulate conservation of nearby communities positively. Where local residents are

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occupied and gain economic profits from conservation efforts, ecotourism provides crucial link in environmental management. Tigra reservoir is a good place for recreational purpose (Figure 1).

Irrigation

Irrigation is primary need of Farmers for cropping. Its command area is 22000 acre (8903 ha.). Tigra reservoir serves the water to whole 22000-acre area so it has important role to play in irrigation for cropping in Gwalior District. The crop area serves by Tigra reservoir is 5000 acre (2223 ha).

Table 3: Villages around Tigra reservoir in Gwalior

S. No.	Village Name	Population	Reservoir	Land for crops (Acre)
1	Sujwaya	600	Tigra	360
2	Pava	700	Tigra	200
3	Nagdaa	100	Tigra	-
4	Mircha Bhoreshwar	300	Tigra	120
5	Mandka	400	Tigra	80
6	Tigra (Rai, Bandha PTS,Tigra)	2500	Tigra	1602
7	Khaidha	200	Tigra	40
8	Kaiytha	150	Tigra	-
9	Kuleth	250	Tigra	40
Total		**5200**		**2442**

(A): Boat Platform

(B): Main Gate

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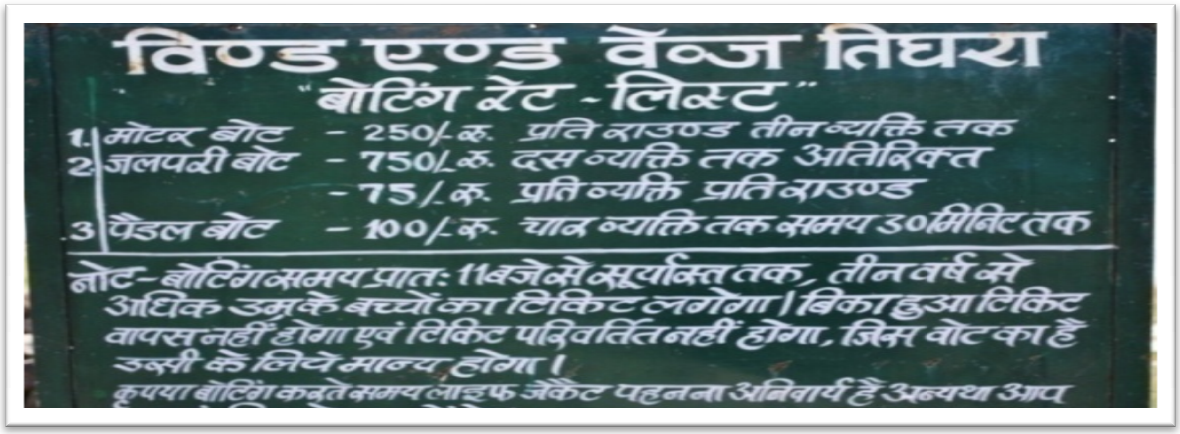

(C): Rate list

(D): Boat

Figure: 01 (A, B, C & D) Ecotourism in Tigra

Fish culture: Water is a significant ingredient of all living organism and basic needs of human beings. Fishes are important, edible, pretentious food for humankind. It is significant to note that, India is at the threshold of blue revolution. It has made notable progress in the field of Inland fisheries. Most of the Indian reservoirs are utilize for the fish culture. Fish play an important role in present and future from diet of human beings. Total 33 fish species were identify from Tigra reservoir.

Bird Habitat: Tigra reservoir attracts to migratory birds. Migratory birds come during winter season so Tigra reservoir is best habitat for migratory birds. Large numbers of birds visit the Tigra reservoir (Figure 2).

Figure 2: Son Chirraiya Bird Sanctuary in Tigra Reservoir, Gwalior

HARSI RESERVOIR

Harsi, one of the most important reservoirs in the state, situated about 100 km from Gwalior. The reservoir was build over the Parvati River, a tributary of Sindh River during 1925-1937. The reservoir covered by hills and small hill by its three sides.

Measuring 2,133 meters in length with 29.26 meters height and having a full collection capacity of 06.30 million cubic meters, the reservoir has been a big supplier to the prosperity of the farmers in the Gwalior-Chambal region. Due to reservoir construction, Basota, Kodan, Manki, Pirikothi, Sidai, Bodh ka pura, Pipalkhadi, Kheydo, Narwai-1, Narwai-2, Jadhoi and Pava villages were relocate to another place. In these villages, about 8000 people relocated due to the Harsi reservoir. In this area, 4 villages are located near Harsi reservoir. Names are Khodan, Harsi, Harsi camp and Karuya (Table 4). In the area, villagers who live near Harsi reservoir grow different types of crops such as Sugarcane, Wheat, Mustard, Pea, Gram, Millet, and Arhar Dal and many types of cereals. Nearby the Harsi reservoir, villager's source of domestic water is Harsi water. According to villagers, much water is required in summer season compare to winter season for cropping. There are different types of fertilizers available in market, in which fertilizers only these fertilizers used for better cropping. These mainly are Urea, Di ammonium phosphate, Natural fertilizer. Pesticides are those chemicals, which are use in cropping for, kill the pest of fields. These chemicals produce harmful effect on human by food chain. Dhanzyme, Zink, Uttam, Super and Pursuit pesticides use in area nearby Harsi reservoir. Statue immersion in Harsi reservoir is totally bane. These health problems are observed nearby Harsi reservoir like malaria, diarrhea, and typhoid. These health problems are very seasonal. In this area, about 5% peoples are infected by Tuberculosis.

Table 4: Villages Near Around Harsi Reservoir

S. No.	Village Name	Population	Reservoir	Land for crops (acre)
1	Harsi Camp	800	Harsi	60
2	Karuya	2000	Harsi	1602
3	Harsi	500	Harsi	40
4	Khodan	250	Harsi	-
Total		**3550**		**1702**

(A): Start Point of Canal

(B): Main Canal

Figure 03: (A & B): Main Canal of Harsi Reservoir, Gwalior

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Uses of Harsi Reservoir

Irrigation: Harsi is large reservoir, which is use for irrigation. It has huge capacity of water. Harsi is a major project of Madhya Pradesh which is very important role-play canal with length of 65 km provide water to Gwalior for irrigation purpose. Tigra is also reservoir in Gwalior but it is not fulfil the irrigation requirement of Gwalior. So Harsi fulfils the irrigation requirement of Gwalior. Harsi reservoir has supply 37.13 cumec water as irrigation by canal system

Fish culture: Harsi reservoir is a major project of Madhya Pradesh. The Harsi reservoir is also use for fish farming and provide job to local peoples. Recently by 5 years, Harsi gives government tender for fish farming who does the fish farming in Harsi reservoir

KAKETO RESERVOIR Kaketo is a store water reservoir constructed on Parwati River a tributary of Sindh River. It is located in Mohana a Tehsil of Gwalior**.** Kaketo and Devera, two villages situated near to Kaketo reservoir but there are no connections between Kaketo reservoir and villages because these villages located outside from Kaketo reservoir (Table – 5). Kaketo reservoir is the store water reservoir for providing the drinking water phosphate, Natural fertilizer in this area in improves the economy of Madhya Pradesh. It has larger potential irrigation area. The area 30.2 thousand hectare feed by Harsi reservoir. Harsi has a long main to whole Gwalior city and it is complementary reservoir of Tigra reservoir because whole water of Kaketo reservoir provided by Tigra reservoir by Pehshari canal. This old reservoir was constructing in 1934 in stone masonry in lime mortar. It has 855 M long non-overflow section, which has been leaking at many points on downstream face. Over the period due to ageing, lime mortar had washed away from the masonry joints leaving voids in the body of reservoir, causing water to seep through. In this area, many types of crops such as Wheat, Mustard, Pea, Gram, Arhar Dal and Millet crop by villagers. Source of drinking and domestic use is hand pump, tube well and well system in this area. According to villagers, much water is required in summer season compare to winter season for cropping. There are different types of fertilizers available in market, in which fertilizers only these fertilizers used for better cropping. These are Urea, Di ammonium

Uses of Kaketo Reservoir

Drinking: Kaketo is medium sized reservoir, which constructed on the Parwati River 35 km away from Gwalior. Kaketo reservoir primary use for provide drinking water to Gwalior by Tigra. By the way, it is 35 km away from Gwalior but connected to Tigra Reservoir by Pehshari canal (13.10 km). Recently it provided the water as irrigation but arise the water crisis in Gwalior so at this time it mainly uses for provide drinking water to Gwalior city.

Table 5: Village around Kaketo Reservoir, Gwalior

S. No.	Village Name	Population	Reservoir	Land for crops (Acre)
1	Kaketo	500	Kaketo	160
2	Devra	200	Kaketo	100
Total		**700**		**260**

RAMOVA RESERVOIR

Ramova is a store water reservoir constructed over River Morar in Gwalior. Ramova is not a big reservoir but it stocks by Morar River and mainly stock by rainfall. It is best habitat for migratory birds, which comes in winter season. It is very old reservoir of Gwalior-Chambal region so its construction work was completed in 1931 according to local

villagers and Irrigation department. Moreover the reservoir provides the water to local villagers that live with Ramova reservoir. In this area 3 villages are located near to Ramova reservoir these villages names are Ramova, Naingiri, and habibpur (Table 6). In 3 villages around 2000 peoples are live with Ramova reservoir. In the area, different cultivated of crops such as Wheat, Mustard, Gram, and Arhar Dal and many types of cereals are cropping by local farmers. Some local peoples who live with reservoir cropping the cereals and other crops in the catchment area, they have used the Dhanzyme, Pursuit pesticides and Urea, DAP and Natural fertilizers for increase crops. These chemicals are very noxious produce toxic effects on human being and wetland biodiversity. Statues immersion prohibited in Ramova reservoir.

Uses of Ramova Reservoir

Domestic Uses: Ramova reservoir is secondary use for domestic purpose. The peoples that live nearby reservoir, they used the water of Ramova reservoir for domestic purpose (like animal bathing, daily needs).

Irrigation

Ramova reservoir was mainly use for irrigation from Ramova reservoir is located in Gwalior so it was serve the water to Gwalior but at this time, Ramova reservoir condition is vary dreadful. Ramova reservoir depth is about 740 feet but the reservoir has least full filled by silt formation so it does not provide the water for their service. At this time reservoir does not have water so the local peoples doing cropping in the outlet area of Ramova reservoir.

Bird Habitat: Ramova reservoir is located 9 km away from Gwalior that mean it situated outside from city of Gwalior. Ramova is a silent water body in Gwalior so it attracts the migratory birds in winter season and a best habitat for migratory birds. It helps in study of migratory birds to research students, which want study on migratory birds.

Table 6: Village around Ramova Reservior, Gwalior

S. No	Village Name	Population	Reservoir	Land for Crops (acre)
1	Ramova	689	Ramova	400
2	Habibpur	**1200**	Ramova	**600**
3	Naingiri	**250**	Ramova	**50**
Total		**1889**		**1050**

DISCUSSION

The multi-purpose dam and reservoir projects in worldwide have extremely improved the entire development processes of the region and most of the countries having developed stage of their economy only after successfully completion of these reservoir projects. Water is important for sustenance of all forms living organism on the earth. It is not evenly distributed all over the world and even its availability at the same locations is not uniform over the years.

According to the World Commission on Dams (WCD 2010), today there are over 50,000 large dams and reservoirs. It is estimated that 472 million people are affected downstream of a major dams because of the environmental changes caused by dams and reservoirs construction.

Gwalior regions hilly type area in Madhya Pradesh, which constructed too many dams and reservoirs so this area was also affect like Harsi reservoir in Gwalior region, affect to surrounding area. Adams

(1992) argues that, although water borne diseases are wide spread in floodplains, dam construction can increase their prevalence. Water borne disease like typhoid, skin problems, Malaria, Diarrhea, and Fever have been observe in surrounding area of Dams and reservoirs. Sedimentation due to build-up of River carried material behind the dam (especially in glacial Rivers) can quickly reduce the dam's lifetime, and significantly affect the amount of power produced. Most dams and reservoirs do not last their predicted lifetime and many considerably less (Besant Jones, 1993). Siltation issues were also observing in most of the dams and reservoir under study. However, Ramova reservoir was significantly affected by siltation leaving the reservoir in operational. Transportation difficulties were also seen in the areas around most of the dams and reservoirs whenever there was a heavy release from the spillway, which leads to the flooding of the low-lying roads around the surrounding villages. As the release of water from the spillway is an occasional event bridge construction across the streams is also difficult.

The major dams and reservoirs in India have been responsible for 12 percent of the forestland losses during the period 1951 to 1985 (Shah, 1990). Singh (1990) reported that big River valley projects have consumed 0.5 m ha of forestland between 1951 and 1976- roughly one-tenth of the area, which has benefited from irrigation. The direct impacts of construction activity for any dam and reservoir projects are generally limited approximately the construction station only during the construction phase. Water logging is also a threat, which disturbed to local people who live nearby the dams and reservoirs. This can be observed in the areas lying downstream to the dams and reservoirs.

Sharma and Rana (2014) studied in Chamba district of Himachal Pradesh; state that People living in and around the project area needed resettlement due to submergence of land because of construction of project. A number of families affected due to acquisition of land for project construction and several became homeless or landless and needed resettlement. Besides this, there were other environmental Impacts like submergence, deforestation, loss of flora/fauna, soil erosion etc.

After the natural calamity in Uttarakhand in 2013, Supreme Court of India directed to Government (Central and State) that no more hydropower projects construction in the hilly states. Similarly, in Gwalior region is also hilly area, which has dams and reservoirs. Due to the reservoirs and dams, impacts have been observed like loss of flora/fauna, deforestation issue of resettlement.

The reservoir and dams made possible by constructing a dam presents a beautiful view of a lake**.** In the areas where natural surface water is scarce or non-existent, the reservoirs are a great source of recreation. A long with other objectives, recreational benefits such as boating, swimming and fishing linked with lakes are also given due consideration at the planning stage to achieve all the benefits of an ideal multipurpose project.

Large dams and reservoir have enjoyed a very positive status as industrial powerhouses in assessment to fossil fuel equivalents. The dam and reservoir lobby claims that they produce negligible greenhouse gases, little disturbance to River systems and labels them 'renewable and green technology'. In reality, studies have shown that dams and reservoirs can be more polluting, emit more greenhouses gases and be less sustainable than even fossil fuel alternatives.

Conclusion: The study has revealed that all reservoirs and dams have both positive and negative impact in Gwalior-Chambal Region of Madhya Pradesh State.

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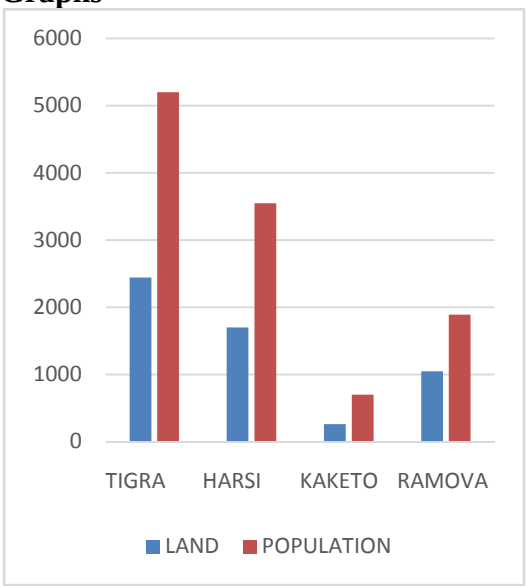
However, there is a need to enhance the beneficial impacts and minimize the adverse impacts of the dam.

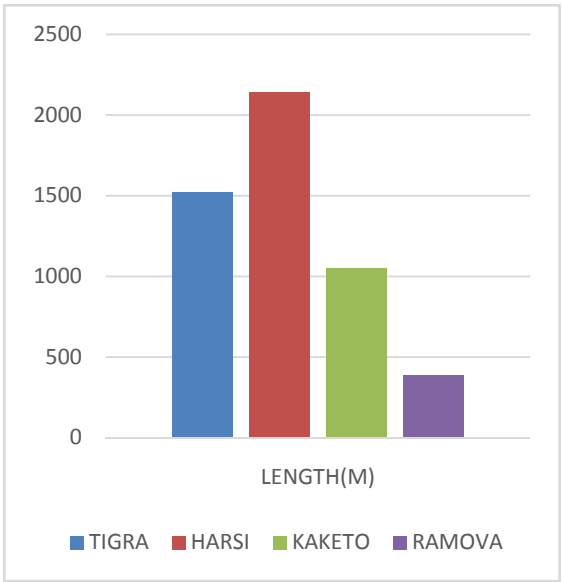
The beneficial economic impacts of the reservoirs and dams are the development of the irrigation scheme and the supply of water to the area near to Reservoirs and other villages. Lack of proper management and funding will possibly be the major obstruction to the development of the irrigation scheme; funds should be made available for this purpose. Irrigation has the potential to boost local agricultural income through ensuring constant supply of water for crops throughout the year. The development of irrigation scheme is also an important mitigation measure against climate change.

The benefit of Dams can be improved by using its water resources for the development of the hydroelectric power plant project. The hydroelectric power plant project would supplement the national power grid and contribute to the production of clean energy. The project could be beneficial from carbon trading, as this will be one of the alternatives to achieving net carbon sink status. This will be a plus for combating global climate change and achieving sustainable development. Local communities should also participate in water resources development planning. This empowers local people so that they regard the development projects as their own. The people of Gwalior-Chambal region did not actively participate in the development planning of the dams and reservoirs. It has largely contributed to failure by authorities to ensure the local communities reap maximum benefit from the dam. Public involvement in the dam construction also reduces the impact of uncertainties and stress caused by uprooting and resettlement. Thus, bottom up planning is necessary for the achievement of sustainable development. In summary, the environmental changes coming out of dams and reservoirs are in various amounts and in different significance degrees. It is difficult to consider the relations between these effects beforehand and determine which positive and negative effects will come up. This evaluation should be made one by one for each dam and reservoir. On the other hand, it is false to comprehend the effects extremely negatively. The important point is who will do the assessments and from whose point of view.

Graphs



Total land and Population Density



Length of Reservoirs

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