# The Analysis of Dam Induced Risk at its Upstream and Downstream Side

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**Abstract**
Dams not only affect human beings but also affect the flora and fauna. The suitable site for dam is bowl shape in between hills, which are geographically rich in flora and fauna. As shelter, food, water are easily available in such location, historically, these have been sites for human settlements. Before constructing of a dam, the areas has to be first cleared of human settlements and vegetation, an enormous intrusion into and invasion of the human, aquatic, and eco-system of the entire region. With the construction of a barrier such as a dam, the water is collected in a huge lake or reservoir that results in submersion of local surrounding area in upstream. Along with that it also decreases the fertility of soil due to regular soil salinity. Since dams are long term projects, this also result in the increase in the flood level of river basin due to deposition of silt carried by the river. This also increases the risk of flood in river basin area. There is also chance of landslide near the water reservoir due to slope failure along the edges of the reservoir.
Standing on a dam, and looking upstream and downstream presents two divergent scenarios. Upstream, the dammed up river is full of water, standing in a static lake while downstream, the river is reduced to a few streams, hungry for water. In many cases, due to low water levels downstream, the channel shrinks and fertile river islands are created, providing attractive settings for new settlements. The settlers are often unaware of the risks of living in such fragile environments, which are vulnerable to inundation at times of excessive rainfall when the discharge from the dam cannot be regulated to protect these settlements downstream. This causes tremendous damages to human life and property, causing untold suffering.

**KEYWORDS:** Dam, Reservoir, Risk, Displaced, Deforestation and Aquatic System.

## 1. Introduction

This article is based on visual observation and technical analysis. We are generally working on understand dams induce risk by displacement of existing living community near river bank and reservoir area, way of degrading of soil near the reservoir due to rise of water table, chances of getting flood during monsoon period and heavy rainfall, aquatic life spoliation or disturbing of aquatic life.
For this analysis, I am selected a small dam in Bokaro district named “GARGA DAM”. So that it is easier for me to observe periodic as well as collect data for analysis. It is situated at one of the tributary rivers of Damodar river geographical location 86.084400 east.
The major information about the dam is as follows:-

**Table 1 Dam Description Chart**

| Descriptions of Garga dam feature | Value with unit |
|---|---|
| Catchment area | 55 sq mills |
| Submerged area | 1120 acres |
| Maximum flood discharge | 79 cusecs / cubic feet per second |
| Deepest foundation level | RL 712.50 ft |
| Top level of dam | RL 776.00 ft |
| Full reservoir level | RL 770.00 ft |
| Dead storage | 1845.0 ac.ft ~80 million cft |
| Total storage | 15771.7 ac.ft ~ 606.5 million cft |
| Total length of dam | 4440 ft |
| Born date of dam | 28/02/1968 |

Under these objectives I am conducing my article,

1. Identifying Problems among people living in dam coverage area.
2. Environmental issues generated by dam.
3. Spatial analysis of the study area.
4. Making one hypothetical geometrical model.

## 2. Literature review

***Disaster Mitigation Experiences and Reflections***
Pardeep Sahni, Alka Dhameja, Uma Medury PHI Learning Private Limited 2016
As per writers Disasters, whether natural or human-made, play havoc with the lives of millions of people very year around the globe. Their aftermath is nothing but a grim picture of death, destruction and suffering. The impact of hazards is mainly

time and location dependent. While vulnerability is dependent on exposure to the hazard, the magnitude of risk is directly proportional to vulnerability, duration and intensity of the hazard.
This book contains wide field of Disaster related terms and issues but some of them are-Managing Disaster in Urban Areas, Disaster Management: Analyzing Vulnerability, Community capacity Building on Disaster Preparedness, Role of Media in Disaster Preparedness, Role of Police in Disaster Management, Vulnerability Reduction at Community level: The new Global Paradigm. Along with this one important chapter of it is "Floods, Embankments and Dams" by S.M.Kulshrestha. Under this section, writing is done in a very decorative manner. There is some historical discussion of dam following emerging problem due to dam and working of world commission and some emerging debates[4].

***Role of Doyang Dam in bringing unprecedented floods in Golaghat***
https://sandrp.in/2018/08/07/role-of-doyang-dam-in-bringing-unprecedented-floods-in-golaghat/#more-30351 August7,2018
Under this report, the highest flood level of Dhansiri River at Numaligarh was sudden increases 80.18 m i.e. 31 cm above the actual HFL. At that time Dhansiri catchment area is declared as rain-deficient by IMD that time. The reason behind that there was the high rainfall in Doyang project catchment area, so it discharges excess water due to rainfall. There is no option for NEEPCO to open the sluice gate which cause flood in Golaghat. There is mismanagement of dam which causes huge loss of life and property in Golaghat area[2].

## 3. Methodology

This section shows the detail of the method on which we are working on the article. The steps involve while writing of the article are as follows: -
Under information collected by secondary source, information is taken from different book/journal and internet sources. For information collection in primary source, I did site visit and interviewing local people.

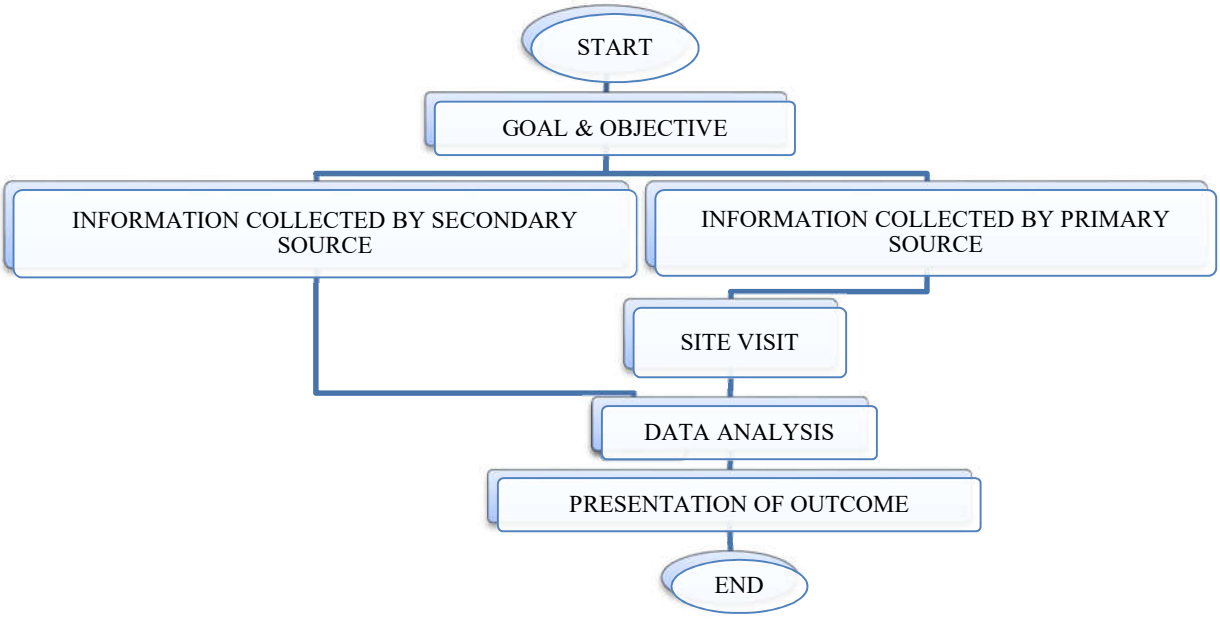


**Figure 1 Methodology Chart**

### Finding during site visit

During my study, I have found that these are some problems rise by dam at local level.
**Environmental issues:** In this study we have found generation of greenhouse gasses i.e. water vapour depends upon the surface area of reservoir. Due to forming dam on earth surface, there will be effect on earth axis and rotation. Approximately 10000 $km^3$ of water is stored in large dam and reservoir, which is five times the total water in the rivers (Chao 1995) [1]. In case of dam water gets contaminated by Methyl mercury which results in contamination in food web.

**Drought condition:** As our geometrical model analysis, it shows that due to construction of dam on river, it disturbs total surface area of water expose to air. Therefore, it results in changes of rainfall pattern. It is also responsible for decrease in groundwater table. Socially, in overall aspect it shows that it denied right to equality.

**Resettlement / rehabilitation issues:** There is provision of resettlement in India, but it is only for those persons who are sufferer of land and house due to submerge. There is no provision for this settlement who live on bank of same river, because they also sufferer of lack of water. This shows the discrimination among common people.

**Unemployment issues:** Under various types of problems, economical issue is unemployment which leads to another social issues i.e. poverty. In upstream side the issues are temporal, but in downstream these issues are permanent and in regular seasonal variant[3]. This also leads to migration toward safer side (in terms of regional location, livelihood, etc.).

**Flooding issues:** Flood issues are common while discussing on dam. As it is a bowl full of water in case of any addition in it, it has two affects either it will submerge or make overload on dam. Later one is more serious case so releasing that overload, dam opens and over flooded its downstream basin. This also sows inequality between both sides of dam.

**Reduction of mining output:** Mainly dams are situated in hilly or plateau region. As our knowledge, plateau is rich of minerals. So geographically those areas have numbers of mines. If it is close to any dam that also reduces mines production and increases chance of mines accidents.

## 4. Analysis and Results

### 4.1. Spatial analysis using acrmap

Here we use satellite data and processing it using ArcMAP software for its spatial analysis. We have considered the region from reservoir upto point of meeting to the Damodar River in figure 2. And in figure 3, we have designated different colour for different landuse.

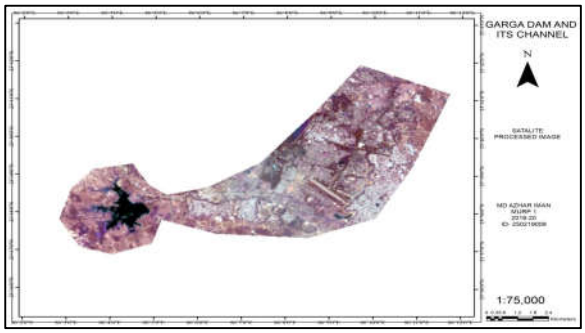


**Figure 2 Mask image of satellite land sat 8 using band (R:G:B=7:4:3)**

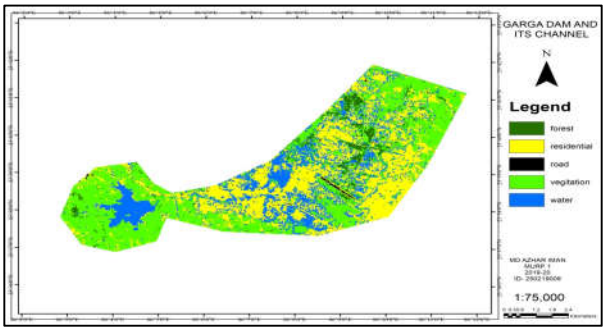


**Figure 3 Map of ground cove**

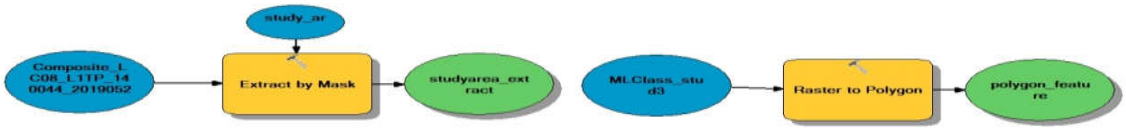


**Figure 4 Model of working**

### 4.2. Geometrical model and mathematical calculation

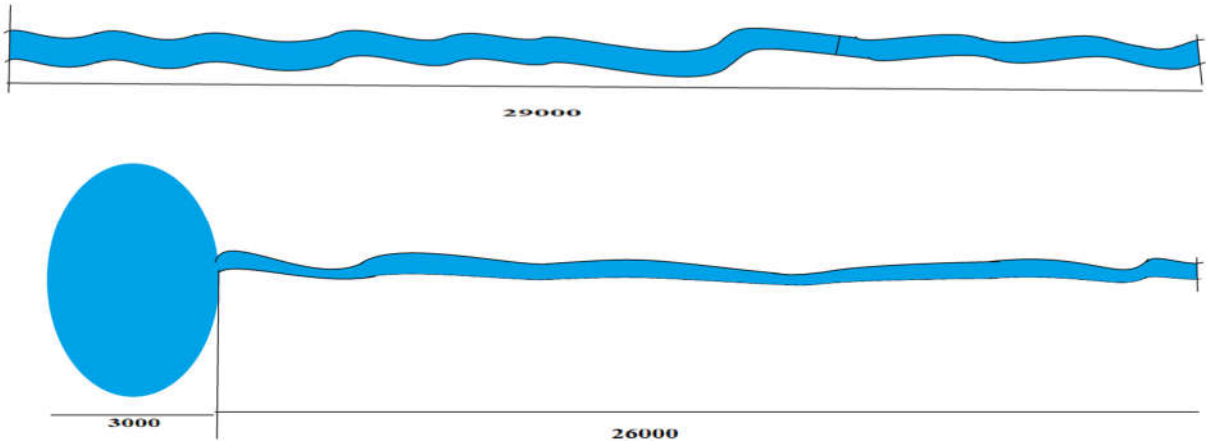


**Figure 5 Geometrical Modal**

As per given data reservoir stores 17174167 cubic meters of water and assuming that initially depth of water in river channel may be 3.5 meter. On observation present average depth of water in river is found to be 1.5 meter. In similar Faison, we assume that earlier width of river is six times present width. Present width of river is 10 meters based on eye observation. Assuming reservoir is nearly circular having area of 1945076sqm (area of actual reservoir calculated by AcrMap).
CASE 1: When there was no dam on Garga River.
Then, Total volume of water in Garga River= 6*10*3.5*29000=6090000 cubic meter.
This amount of water is distributed uniformly, somehow, throughout the river channel.

CASE 2: when there is dam on Garga River.
Now, Total volume of water in reservoir and river channel=17174167+1.5*10*(29000-1574)

= 17585557cubic meter.

But in CASE 2, concentration of large amount of water is at reservoir and along the channel the amount of water get reduced, which shows inequality of water distribution among the settlement living surrounding the river channel as well as in river channel.

At the reservoir region approximately 14293747 cubic meters of water is stored as surplus, while downstream has facing deficient of 195 cubic meters per meter of Garga River channel.

It is not enough, due to disturbance in water distribution, it also rises various other issues related to livestock, employment and environmental.

## 5. Result

i. It shows that due to construction of dam on river, it disturbs rainfall pattern and decrease in groundwater table. Socially, it denied right to equality.
ii. Discrimination among all people regarding proper compensation.
iii. Unemployment which leads to another social issue i.e. poverty in the upstream side and downstream side.
iv. Flooding is common for both upstream and downstream sides in different conditions of control on the dam.
v. It also hampers the production of mines, if nearby present.

## 6. Conclusion

The extra concession in jobs should be provided for the affected community. The proper land with household should be allocated in terms of compensation for the displaced people. So that the social equitability will be maintained. To overcome from environment issues, small check dams and a large pond should be constructed in and along the river. Such that, GWT and surface water of river can be maintained throughout year-round. Ensuring proper security, maintenance and checking of dam as well as river line that why, the public residing there will be safe. Authority should rise jobs opportunity for local people by introducing tourist activity, fishing and boating.

## 7. Reference

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[4] **“**Disaster Mitigation Experiences and Reflections” - Pardeep Sahni, Alka Dhameja, Uma Medury; PHI Learning Private Limited; 2016