Flood Impacts of Araniyar River Basin

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Abstract-- Floods are the most common natural disaster and the leading cause of fatalities worldwide. Risk of catastrophic losses of flooding is significant due to deforestation and the increasing proximities of large populations to coastal areas, river basins and lakeshores. The objectives of this review are to describe the impact of flood events at Araniyar river basin on structural damages to the extent possible, human populations in terms of mortality, injury, and displacement, the risk factors associated with these outcomes are also identified.

Data on the impact of floods were compiled from various sources. Historical reviews of flood events from the past have been taken and the most intense impact is taken into consideration. Possible literature reviews are also referred. From these, analysis is made from the perspective such that it could be controlled more effectively in the future. The devastating floods that hit Chennai city and other parts of Tamil Nadu during November-December 2015 have claimed more than 400 lives and caused enormous economic damages. Araniyar, being a perennial river has experienced a maximum rainfall of 855.50mm and this has been a major cause for the disaster.

The impact study includes the atmospheric condition that caused such high intensity rainfall, the discharge occurred at river, the condition and characteristics of reservoir, check dams and other hydraulic structures associated with the river, the region of the place inundated and for how long, the immediate measures taken and the suggestions of steps to be taken so that the similar rainfall pattern repeating in future would not cause a devastating deluge. In preparing the report, a large body of information available through newspapers, news magazines, TV reports, government documents, web pages and other freely available sources were sifted through. A field visit was also undertaken by the team and a first-hand impression was reviewed in the flooded areas.

The report is prepared with a view to provide a rapid assessment of the flood impacts which is useful for more rigorous scientific studies that should be taken up in the affected regions, addressing the increasing urban flooding problems. The long, medium and short-term issues affecting urban floods are discussed in this report. Recommendations arising out of this assessment are summarised in the report to help policy makers, researchers and other stakeholders in expanded monitoring of floods, improved mitigation measures, and effective communication with civil authorities and potential to reduce loss of life in future flood events.

Keywords: flooding; analysis; mitigation; losses; reservoir; rainfall

I. INTRODUCTION

The climate of India comprises of wide range of weather conditions across vast differentiated topographies. The meteorological department of country has briefed up four types of climate based on the international standards with some local adjustments. They are winter (December, January, February), winter (March, April and May), monsoon rainfall (June to September) and a post monsoon period, but these seasonal climate have been irregular due to natural and manmade activities.

In Tamil Nadu, the irregularity has imposed its effect on the monsoon rainfall, creating a greater degree of impact in the recent years. Some years receive good rainfall while some are scarce. The seasonal period of monsoon is gradually shifting to the later months of the year. The intensity of rainfall has shown great deviation in every year. All these changes have caused great losses in life and property, damage in hydraulic structures and natural drainage system due to flooding. Because of the deviations, the impact of future years couldn’t be definitely predicted. Hence lack of Awareness and Preparedness has been increasing its impact over a period of time.

These impacts caused due to irregular monsoon cannot be controlled completely, but certain remedial measures can be taken to minimise its effect, by zoning different regions for more accuracy and gathering the data of impact of maximum rainfall in past years to avoid much disasters. Not following up of lessons from past floods have caused unavoidable damages in Mississippi (James P. Kahan et al.2006). Hence attending to history leads in mitigating the potential damage of flood and ignoring them leads to larger disaster. It also creates a better platform for other researchers to suggest better control measures, thus managing the flood. The flood risk zones are investigated by eye inspecting of Google earth and Landsat TM satellite images and rendition of 1:50000 aerial images (YounesDaneshbod, 2016). Thus flood risk maps are created helping authorities in comprehending inundation characteristics of flood plain.

Spatial rainfall distribution map can be generated in ArcGIS platform by applying interpolation techniques with the help of collected rainfall data and the study of flooding impact caused is made easier (R. Nagalakshmi et al, 2016).
HEC-RAS is an advanced software which is easy and powerful in determining water surface profile. (SaniaModa et al, 2015) It gives flood warning and prevent from flooding. Inundation maps can be created by HEC-RAS which serves for various emergency plan of action.

II. STUDY AREA

The study area selected is the Araniyar sub basin which lies in Thiruvallur district, Tamil Nadu, India.

Table 1
Study area in Araniyar sub basin

<table>
<thead>
<tr>
<th>Country</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Araniyar river and its basin, Tamil Nadu</td>
</tr>
<tr>
<td>Origin</td>
<td>Nagari hills</td>
</tr>
<tr>
<td>Confluent Point</td>
<td>Pulikat Lake</td>
</tr>
<tr>
<td>Total Length of River</td>
<td>131.60Km</td>
</tr>
<tr>
<td>Study area Length</td>
<td>LS 93.60Km to LS 131.60Km</td>
</tr>
</tbody>
</table>

The Araniyar River is a stretch of 131.60Km, in which 65.2Km lies in Tamil Nadu and 66.40Km lies in Andhra Pradesh. The study area is taken within Tamil Nadu from LS 93.60Km to LS 131.60Km as the downstream part of the river is mostly prone to flooding.

III. MATERIALS AND METHODOLOGY

The required materials for this paper is the data of rainfall of past years of Araniyar sub basin from which worst impacted year is identified and the impact details of the particular year have been collected and discussed from which control measures are suggested.

The other details like river characteristics and structural details are also obtained for more clarity from different sources. The methodology of this paper is been represented in the form of flow chart (Figure 2).

Figure 1 Representation of river flow in study area

Along the path of study area of about 41 Km, there are three check dams and two anicuts and it joins with Pulicat lake discharging into Bay of Bengal.

1. Data Collection

The data collection includes features like river characteristics, rainfall details and hydraulic structural details.

1.1. River characteristics

The following figure 3 shows the map of Araniyar basin identified from the state map.

Figure 2 Flowchart of methodology

1.2. Rainfall details

The rainfall details were obtained from different rain gauge stations of Thiruvalur district which includes Ponneri, Minjur, Uthukotai and Gummidipoondi. The detailed pattern of rainfall is shown in the graph below (Figure 4).
1.3. Hydraulic structural details

The structural details of anicuts and check dams constructed within the study area are collected.

The anicuts within the study area are A.N.Kuppamanicut and Lakshmipuramanicut which are constructed across the river at 95kms and 114.8kms from the origin. The check dams is A Reddy Palayam which is constructed across the river at 119kms across the river.

The hydraulic particulars are given in table 2 and 3.

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>CHARACTERISTICS</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Year of construction</td>
<td>1965</td>
</tr>
<tr>
<td>2</td>
<td>Length of anicut</td>
<td>116m</td>
</tr>
<tr>
<td>3</td>
<td>Height of anicut</td>
<td>4.15m</td>
</tr>
<tr>
<td>4</td>
<td>Crest level</td>
<td>El. +6.85m</td>
</tr>
<tr>
<td>5</td>
<td>Catchment area</td>
<td>973.80sq.km</td>
</tr>
<tr>
<td>6</td>
<td>Maximum flood discharge</td>
<td>30290Cusec or 1424.04Cumec</td>
</tr>
</tbody>
</table>

2. Flood Impact

Flood impacts on both individuals and communities have social, economic, and environmental consequences. The consequences of floods are both negative and positive and they vary greatly depending on the location and extent of flooding, and value of the natural and constructed environments they affect.

2.1 Identification of most affected years

The most impacted areas have been identified by comparing the rainfall details of past years. The maximum values of every year are taken into consideration and a graph is plotted (Figure 5).

The news from “The Indian Express” dated 17th November 2015 says, “Highest rainfall in 10 years washes away Chennai’s expensive drainage, desilting projects. Heavy rains that sank Chennai in 24 hours was the highest rainfall in the last 10 years, says the Met department. Chennai had 246.5 mm rainfall in the last 24 hours which breaks the record of November 2005 which saw 142.4 mm, said Thambi Narayanan, deputy director general, meteorological department, Chennai.
From the above information, the year 2015 has experienced the maximum flood in the past 7 years and has caused greater impact.

2.1. **Flood impact of most affected year**

The extend flood impact in different region have been mapped by the obtained impact data from different sources (Figure 6).

![Figure 6 Flood impact in Araniar sub basin](image)

2.2.1 **Life loss**

The population affected in thiruvallur district during 2015 flood is listed in Table 4.

<table>
<thead>
<tr>
<th>Total population</th>
<th>37,28,104</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population affected</td>
<td>Approx. 1.75 lakhs</td>
</tr>
</tbody>
</table>

2.2.2 **Property loss**

The property losses include losses in household, live stocks, crops and land area. They are listed in the Table 5.

<table>
<thead>
<tr>
<th>Houses affected</th>
<th>More than 51,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of household</td>
<td>946949</td>
</tr>
<tr>
<td>Total no. of fully damaged houses</td>
<td>6949</td>
</tr>
<tr>
<td>Total no. of partially damaged houses</td>
<td>2925</td>
</tr>
<tr>
<td>Total no. of livestock loss</td>
<td>2218</td>
</tr>
<tr>
<td>Crop damaged in hectares</td>
<td>24870</td>
</tr>
<tr>
<td>Land submerged in water in haectares</td>
<td>15000</td>
</tr>
</tbody>
</table>

2.2.3 **Structural loss**

The evidence of pictures and the information published in newsletter are considered for assessing structural losses. The structures that was mainly affected are A. Reddypalayam Check dam, Lakshmipuram Anicut, A. N. KuppamAnicut At A. Reddypalayam the path of the river is a curvature. During the flood the water rushes outward from the path and enters into the land nearby and causes damage(Figure 7).

![Figure 7A. Reddypalayam check dam](image)
IV. RESULTS AND DISCUSSIONS

The process of obtaining impact data of the year of worst disaster would help in strengthening the structures and providing flood control provisions in the basins, thus protecting them from severe floods in the following years. It is necessary to follow up lessons from past years to avoid mass destruction. Damages and collapse of structures must be taken into consideration while at design to maximise its effect. Else it may impose a great demand on economy. From the listed impacts, some of the suggestions on controlling flooding are listed below. These can be adopted by analysing the cost, compactability and efficiency.

Construction of Flood wall at A.ReddyPalayam in the curvature so that water can be directed into the river path. This can be self-closing flood barrier which has greater advantage over other embankments.

Providing extra scour vent at Lakshmipuram Anicut The anicut was initially designed for the length of 116m. But it was only constructed for 100m. The extra length can be used for providing vent to control the flow.

Repair work of the hole below the A.N KuppamAnicut caused due to heavy gushes of water must be done to prevent from collision of structure.

Construction of reservoir along this path is not appreciated as mass evacuation has to be done. But then structures can be built at longer gaps. The distance between A.N Kuppamanticut and Lakshmipuramanicut is quiet longer of 16km. Hence a storage structure can be constructed, regulating the flow during flood.

Raising the level of river bank above the flood level in the impacted areas would prevent flooding. The flood level can be obtained by HEC-RAS software for the the whole stretch of river, applying maximum discharge at the different zones. However cost effectiveness must be considered.

Other controlling and managing measures can also be taken by widening river path or deepening the bed based on the effectiveness. The people of surrounding areas must be educated of flood precautions and preventives. Flood risk zones can also be created from the impact data and public can be made aware of it.

IV. CONCLUSION

This research paper is an impact study of flood in Araniyar river basin by collecting and gathering data from different sources. All the required data to prove the intensity of impact has been made based on a methodology. Certain control and managing measures are also discussed. This would help the other researchers and policy makers to implement the best way of controlling the floods in the upcoming years as much as possible considering the cost as well.

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REFERENCES


