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Flood Management of SANGLI City

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A B S T R A C T

We have seen 2005 and 2019 flood situation of Sangli city. Also we witnesses the damages during and after flood situation whether it be economical or physical .The purpose of this project is to protect the Sangli city from flood situation without any heavy losses. The project consists of four parts. The very first part is a zoning of Sangli city by using contour maps. This will helps to understand the different locations of Sangli city at the different water level. So that we can mark the highly flooded zones to aware the peoples. The second part is that working of Krishna Koyana water lift irrigation projects during flood condition to reduce the flood impact, also for utilization of flood water. The third part is Krishna-Manganga river link project for the same purpose like third part. The fourth part is Co-relation between Koyana and Almatti dam regarding discharged water to maintain the flood situation. Additionally, safety is very important to every individuals out there who are suffering from flood situation. So that we should aware about flood control mitigations.

Keywords: Flood in Sangli, Flood Management, Flood

1. INTRODUCTION

Any flow which is relatively high and which overtops the natural or artificial banks in any reach of a river may be called a flood." In rainy season , when heavy rainfall occurs in the catchment area, the flow of the river is increased and sometimes it exceeds the normal carrying capacity of the river. Then the surplus water overtops the banks of the river and submerges the surrounding areas consisting of villages, agricultural lands, etc. This phenomenon is known as flood. Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an aerial flood.

While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals. Water is one of the most important natural resources, the other being the air available freely everywhere and at each split of second. In a nutshell, the universal importance of water can be put as the biological, geo-chemical, meteorological component of the environment, indispensable for the origin, existence and perpetuation of the Mother Earth and the biota inhabiting it. Hence, there is an immense demand for this unique renewable single chemical compound.

It is a boon that water constitutes more than three fourths of the area of the earth and hence, it is designated, appropriately, as 'watery planet' or 'blue planet'. Of the total water resources of the earth, the un-utilizable component accounts for more than 99%, this includes 97.2% of oceanic waters, 2.15% of glaciers and icecaps and 0.3% of UN utilizable groundwater. In fact, comparatively, a trivial quantity of less than 0.4%, including 0.3% of usable groundwater and even less percentage surface waters, is available for direct consumption. Thus, the utilizable surface waters constitute a very meagre

percentage in the total global water resources. Hence, proper planning is essential for judicious utilization of this precious commodity for striking an appropriate balance between demand and availability, and availability and utilization at the global, regional and local levels for the sustainability of their ecosystems. The universal fact that land can never be physically transferred, which annotates the present context as, from water surplus region to water deficient region; whereas water can and has to be transferred to form itssurplus region to deficit region subjected to its demand in the latter. This is the very concept of linking of rivers. Water status of the region whether it is water –surplus, water- sufficient, water – deficit constitutes water budget of the region. This is the result in its turn of many dynamic factors, environmental, economic, social and political (?). All these issues are discussed in the present review..

1.1. Sangli District:

Geological Details:

Sangli district is located in the western part of Maharashtra. It is bounded by Satara, Solapur districts to the north, Bijapur district to the east, Kolhapur and Belgaum districts to the south and Ratnagiri district to the west. Sangli district is situated in the river basins of the Warna and Krishna river. The physical settings of Sangli district shows a contrast of immense dimensions and reveals a variety of landscapes influenced by relief, climate and vegetation. The climate ranges from the rainiest in the Chandoli (Shirala) region, which has an average annual all of over 4000 mm to the driest in Atpadi and Jath tehsils where the average annual rainfall is about 500 mm. The vegetal cover too varies from the typical monsoon forest in the western parts to scrub and poor grass in the eastern parts.

Fig. 1 - Sangli District

2. LITERATURE SURVEY

WRD (Mr. R. D. Mohite, C.E. W.R.)Shri. R. D. Mohite, Chief Engineer gave detailed presentation regarding flood Situation at Sangli and Kolhapur cities with graphical analysis of rainfall and runoff occurred in Krishna basin. He also explained overall efforts taken by his team toMitigate severe flood experienced in early August 2019. For exercising effective flood control in Krishna and Bhima basins, flood control cells are created at Pune, Satara, Sangli, & Kolhapur districts under main control of CE (WRD) who is Basin Flood Control Officer. Shri.H. V. Gunale& Shri. S. D. Chopade, SE are working as sub basin flood control officers for Krishna &Bhima basin respectively. Krishna flows in Karnataka immediatelyAfterSangli city, as such Krishna sub basin flood control officer is keeping overall liasion and share data regarding rainfall in upper reaches of Krishna, releases from various upstream dams, discharges and water levels in rivers, discharge at state boundary, outflow, levels etc. All levels and required data are shared with Karnataka & Maharashtra officers every day and for every 3 hrs during the flood situation. Accordingly, flood monitoring is done with coordination between both state government officers and also in coordination with concerned departments from time to time. For Maharashtra all these interstate

activities are carried out by Shri. H.V.Gunale, S. E. Sangli. He is also working as Interstate Flood Control Officer for Krishna Sub Basin. Good coordination between both state governments is being taken at all levels viz SE, CE, Secretaries, Revenue officials. This year it was very much necessary. Even CM"s of both states kept close contacts during severe flood events.

CWC (Shri. NityaNand Rai, Director, CWC, New Delhi.) C.E. CWC Presented detailed study of back water of Almatti reservoir, which was undertaken by CWC during 2004 -05. He explained that CWC used surveyed cross sections and rating curve of Almatti reservoir. One dimensional mathematical model MIKE-11 and St. Venant"s equation of conservation of mass & momentum were used. Various scenario concerning Almatti&Hippargi reservoirs were considered for study of back water effect and sub mergence in Maharashtra territory due to construction of Almatti&Hippargi reservoirs. Even with PMF of 31,000 Cum / sec & 524.25m (future FRL) level at Almatti& 24,000 Cum/sec at Hippargi (worst scenario), CWC study indicated that the back-water effect reaches up to 221 Km from Almatti reservoir i.e. within Karnataka territory. In another scenario the back-water effect does not reach beyond 221 Km

IIT / WRD officer (Shri. H.T. Dhumal, S.E. WRD) Before starting his presentation, he pointed out that Mr. Rai, CWC has done backwater curve calculations considering channel from Sangli to Almatti dam site with constant inflow of 31000 Cumecs. He further suggested to do the same with Almatti dam as Inline structure/ storage area/ Reservoir. HanumantDhumal presented study entitled, "Hydraulic Reservoir of Krishna River and Almatti Reservoir to Heavy Rains during 25 July to 15 August 2019". He has used HEC-RAS (5.06) model. He has considered geometry of Krishna River from Karad in Maharashtra to Almatti in Karnataka. In Krishna he has considered three reaches Karad to Haripur (confluence of Warna), Haripur to Bubnal (confluence of Panchganga) and Bubnal to Almatti. He also added two tributaries Warna (from Mumbai Bengaluru Highway crossing to confluence) and Panchganga from Kolhapur to confluence.

MRSAC (Dr. S. N. Das, Director, MRSAC, Nagpur) Mr. Das gave a presentation regarding the remote sensing data, available with them. They are having images of inundation maps on 19th August, 6:20 p.m. Also, of 12th, 13th and 15th August with resolution of 0.5 m. Honorable chairman requested them to prepare overall report of as regards inundation effect. He was further requested by technical member (MWRRA) to prepare inundation maps for past years for Sangli, Kolhapur and Karad at different data showing levels of encroachments. This mapping may have to be co-related to actual ground conditions.

3. PROBLEM STATEMENT

During the months of July & August 2019, Sangli & Kolhapur districts in Krishna sub basin experienced extreme floods for long durations. Heavy losses to life, property & crops etc. had been reported. Different opinions at various levels were put forth concerning these flood events. Sangli & Kolhapur districts faced heavy flood situations in past also & floods of 2005 & 2006 were noteworthy. However, 2019 flood event was comparatively much more severe which lasted more than a week & losses experienced were also on higher scale.

The reason behind this kind of flood situation is very straight forward that is the heavy rainfall happened in the Krishna river basin. So that the excessive amount of water released from Koyana dam. This water did not passed down through Almatti dam properly. Hence flood situation was generated. This is all because of improper co-relation of discharged water between Koyana and Almatti dam which results to flood.

Fig. 2. - Flood in Sangli

4. REASONS OF FLOOD

Natural

- Overflowing of rivers
- Collapsed Dams
- Snowmelt
- Deforestation
- Climate change 6. Emission of greenhouse gases

Other factors Natural flooding is normally caused by natural weather events such as heavy rainfall and thunders forms over a short period prolonged , extensive rainfall , high tide combined with stormy conditions. Massive Rainfall drainage system and the effective infrastructure design aid during heavy rains

Natural floods :

- River flooding from long steady rain
- Flash flooding caused by sudden heavy rain
- Coastful flooding from extreme tidal condition

Man-made floods

- Infrastructure failures
- Development and infrastructure in flood prone area
- Deforestation 4. Impermeable surface
- Bridge construction
- Flood embankments

Constructing building and surrounding roads and paths creates impermeable surfaces which increase surface run off. Drains also increase the flow of water into surrounding rivers increasing the flood risk.

5. MAIN REASONS OF FLOOD IN SANGLI CITY

a) Simultaneous occurrence of unprecedented heavy precipitation in the catchments ofriver Krishna and its tributaries.
b) Tribunal Constraints on utilization of available waters in Krishna basin in Maharashtra.
c) Inadequate discharge carrying capacity of river Krishna to accommodate the releases of Koyna dam, the contribution of tributaries and the runoff of the free catchment.
d) The river Krishna flows, a near plain land, between Sangli and the State border. It is a general phenomenon that the river takes meandering course, while traversing on a plain land. Thus, River Krishna has so many curves and meanders. The velocity of the river is comparatively less while traversing curves and meanders, causing thereby more inundation on inner as well as outer sides of the curves and meanders as compared to straight reaches of the river. The Sangli city is on one of the curve of River Krishna and Kolhapur city is on the curve of river Panchganga
e) Flow stagnation in River Krishna from Sangli city to the State border, due to confluence effect. There exists series of confluences, Yerala-Krishna, Warna-Krishna, PanchgangaKrishna and Dudhganga-Krishna within a reach of about 50 to 55 km length. At confluence points due to formation of stagnation zone velocity isreduced.
f) Generation of backwater effect in the tributaries and nallas meeting the River Krishna. Due to comparatively higher discharge in the River Krishna, the backwater effect is generated in the tributaries. The flooding in tributaries viz. Yerala, Warna, Panchganga and other nallas like Bhilwadi, Nagthane was primarily due to backwater effect of theriver Krishna. The situation was further aggravated as these tributaries could not drain out their own discharge, till the flood in the river Krishna was receded. Water was spread on the side banks of the tributaries due to ponding effect. The river Krishna was flooded for a long duration from 5th August up to 13th of August. Consequently, the backwater spread in the tributaries and on floodplains could not return back to the river course. Thus, the floodplains were under water for a prolonged time.
g) Reduced discharge carrying capacity of river Warna and Panchganga due to siltation, vegetation growth and encroachments further delayed the reception of floods.
h) The lateral slope of the flood plains is very gentle. The flood plains are almost flat. This has resulted into spreading of flood on larger area on both the banks of the river.

Rainfall Pattern:

Rainfall data indicates that Konkan and adjoining Madhya Maharashtra experienced very heavy rainfall. In the beginning of the flood period i.e. from 27th Jul to 3rd Aug, the heavy rainfall events were localized in the northern part of the Konkan and adjoining North Madhya Maharashtra. Many stations in Pune and Nasik districts, recorded rainfall more than 150 mm/day during the period 3rd to 5th Aug. Towards the latter part of the week, rainfall belt shifted towards south Madhya Maharashtra. Mahabaleshwar recorded highest rainfall of 380 mm on 5th Aug. 2019. It is also observed that Kolhapur district continuously experienced heavy rainfall throughout the period with highest rainfall amounts on 6th Aug. 2019.
Gaganbawda recorded its highest rainfall of 340 mm rainfall on 6th Aug. It is also seen that though heavy rainfall occurred in the western part of the districts in Madhya Maharashtra, their eastern parts were devoid of rainfall. It is further seen that during the heavy rain spell of Aug. 2019, many stations in Kolhapur district and western part of Satara district have crossed their previous record of 7 days rainfall. This indicates that compared to previous years, rainfall over the region was widespread and remained very intense for a long period during 27th July to 13th August 2019.
Sangli, Kolhapur and Satara district received very heavy rainfall of 1918 mm in comparison to 333 mm normal rainfall during 27th July to 13th August. This was about 6 times the normal and at the same time, in the free catchment, downstream of the dams, it was about 18 times the normal. Such high range of continued rainfall in short duration resulted in extreme heavy flooding mainly in Sangli, Kolhapur town and few talukas situated near Krishna and Panchganga rivers
It is observed that, the Flood affected districts of Satara, Sangli and Kolhapur continuously received excess to large excess rainfall during the first fortnight of August.

Rainfall records in dam catchments-

It was seen that the observed actual rainfall in various catchments to the upstream of dams varies from 5 to 19 times the normal. Average actual rainfall was about 6 times the normal rainfall in all these catchments bringing abnormal flood to downstream areas.

Rainfall records in Free catchments

The actual rainfall during the first 56 days of the monsoon (starting from 1st June 2019) was measured at 6 rain gauge stations, situated in the free catchments of these three districts. It is observed that the total rainfall during the peak period of 18 days (27th July to 13thAugust) measured at the same stations, was about 1.6 times the total rainfall during the previous 56 days (1st June to 26th July). Also, the actual rainfall during the event in free catchments was varied from 13 to 29 times the normal rainfall. The overall observed rainfall over the normal was about 18 times. Such abnormal high occurrence of rainfall even in free catchments also aggravated floods in Sangli& Kolhapur districts.

6. ZONING OF SANGLI CITY

A Contour or Contour line is defined as a line of intersection a level surface with the surface of the ground. This means every point on a contour has the same elevation.

CONTOUR MAP: - The process of tracing contour lines on the earth's surface is known as 'Contouring'. The maps on which these lines are represented are called Contour Maps.

- R.L. Of Sangli City:- 553.00 M
- Highest Flood Level in 2005:- 543.36 M
- Highest Flood Level in 2019:- 546.90 M

Fig. 3.–Contour Maping

Flood lines mapping:-

As per the standard procedure of the WRD, the flood lines can be finalised and approved by competent authorities for the entire lengths of the main river courses for the guidance of city developments. These lines can be marked / superimposed on the city development plans and be kept accessible in public domain by the civic authorities. These lines can also be marked on ground, on permanent structures like bridges, old temples etc. so as to make public aware of the actual flood's situation and its further hazard potential. For every river course, three such lines can be finalised. The Blue line, Red line and the Yellow line

1) **Blue line:** normally**,** it's the line showing inundation level for 25 years flood. The area between the main river course and the blue line is called "Prohibited zone", where all kinds of constructions, obstacles are strictly prohibited.

2) **Red line:** normally, it's the line showing inundation level for 100 years flood. The area between blue line and the Red line is called as "Restricted zone", where part constructions are allowed with certain restrictions.

3) **Yellow Line:** This new concept is being introduced. At many places, it has been observed that the actually observed highest flood level, may be due to any back water effect, in a particular city is much above the red line, finalised by WRD. These lines can also be marked on city development plans as well as on the ground to make public aware of the possible risks while developing or investing in that zone. The area between Red line and the Yellow line can be called as "Alert Zone". However, no any kind of restrictions can be imposed within this Alert zone. Alert zone will be in existence when the yellow line is above the red line. However all three lines must be marked and updated from time to time**.**

Because of marking such lines we can understand the current situation of flood. As well as we can make alert those people who are comes under these zones. Also these lines helps to us for predictions of flood so that we can displace to peoples as well as their cattle.

7. KOYANA & ALMATTI DAM DISCHARGED WATER CORELATIONSHIP

2005 and 2019 flood situation of Sangli city was so critical. These flood situation had badly impacted on economical as well as agricultural sectors and made a big damage. In this flood situation so many committees are established for finding out actual reasons of flood and their solution. But, unfortunately no once report was 100% satisfactorily corrected. So that we need to find out actual origin of flood and work on it.

Generally, river has three stage. 1)Child stage 2)Middle stage 3)Last/ Old stage. These three stages are the main reasons of flood for Sangli city especially, as we can say. Basically river gets birth in hilly regions. So that river fall downs from a heights and gets erosion to earth surface. This is the child stage of river. When river flows ahead for some distance, the velocity of water gets reduced. That is now river flows in her middle stage. In this stage the less erosion takes place as compare to child stage. In case of Krishna river this stage occurs near to Karad. Now we see the old stage of river. In this stage river flows with very low speed that place means our Sangli and Kolhapur area. Also in this stage the erosion takes place at the banks of the river which results flood water gets spread outside areas. Similarly the suspended matter gets accumulated to banks of river and water spreads outward side in big volume.

In case of Sangli and Kolhapur same condition was happened. Now we consider different aspects, Krishna river has origin in Mahabaleshwar. At the same time there is a Koyana, Dhom, Kanher, and Nira Dams along with number of small dams. In these dams catchment area when heavy rainfall happens then in results dams gets filled with water and discharge starts. This discharged water flow with river and reach up to Sangli. Improper discharge through Almatti Dam has responsible for Sangli flood. Now we consider one ideal condition that is less rainfall in catchment area, less discharge from Koyana dam and more discharge from Almatti can reduce the flood intensity automatically. The most important thing is that Koyana and Almatti Dam corelationship about discharging water.

If we take the example of 2019 flood situation, generally from 1August to 4 August water level was medium and discharge from Almatti dam was also less. But after in between 4 August to 9 August , a heavy rainfall was happened in dam catchment areas. Because of less discharge from Almatti dam its backwater rises abruptly which results Sangli city flood water level also increased. Hence right after, Almatti Dam had started more discharge of water and then slowly flood situation was controlled. Similarly, if we make proper co-relation between Koyana and Almatti discharging water the and then only we can control flood situation in Sangli and Kolhapur.

8. RESULT AND ANALYSIS

ZONING ;-

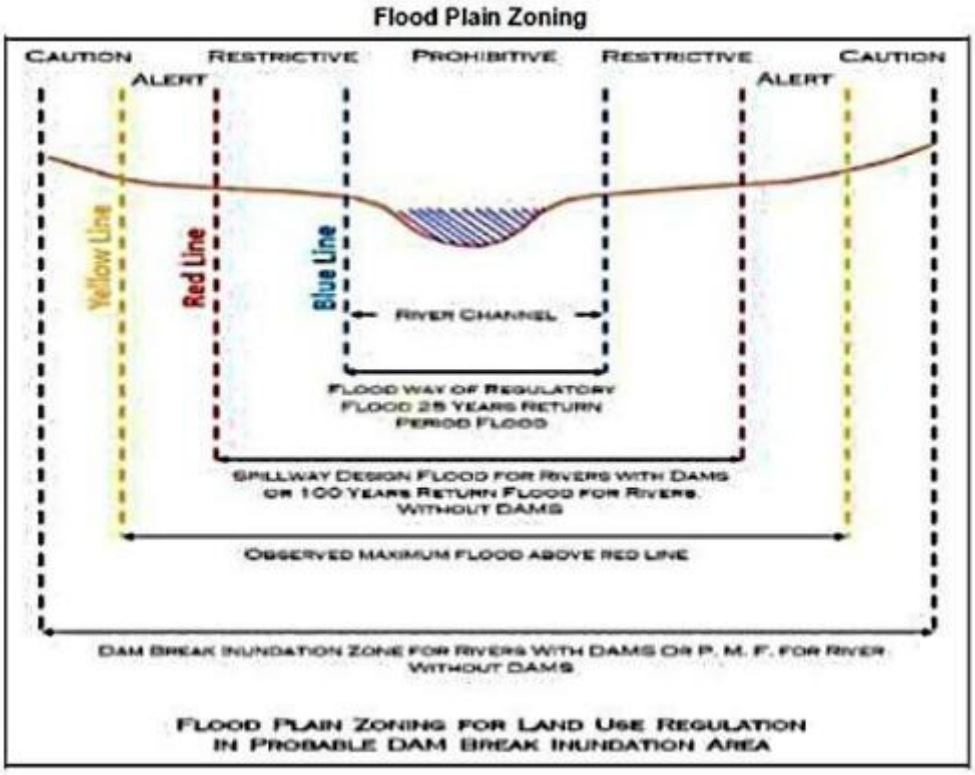

Fig. 4. – Flood Plaining Zone

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9. CONCLUSION

Flood is a state of high water level along a river channel or on the coast that leads to inundation of land, which is not usually submerged. Our schemes of Krishna-Manganga ,Takari-Mhaisal , Tembhu gives a effective impact on management of Sangli flood . If these schemes started with full capacity then it will get definitely good results in management of flood. Every year in July-August, there is chance of flood , so awareness within people living river side is also necessary . Government also have to look for safety of people by managing such floods in future. For that condition our project is a best solution

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