Identification of flood control measures for Kolhapur city

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Abstract - During the month of July and August 2019 Kolhapur Districts in Krishna Sub- basin experienced extreme floods for long duration. According to reports 16.5 lakh cr economical losses had been reported. According to reports climatic changes is one of the factors for nature calamities over the years, indiscriminate pursuit of so-called development had reduced the capacity of catchment area to hold, store and absorb the rainwater. [1]

In this research, the area considered is around 10 sq.km (Appro.) which includes the villages as; Nigave Dumala, Vadanage, Kasaba Bawada. To come up with achievable adaptive measure with watershed management for this we did Topographical. Analysis for our sub-watershed by using Curve Number Method.

Completion of mathematical check of proposed hypothetical work and hydrological data and analysis of data pre-solution and post-solution. On the bases of the study we suggested some watershed structures like movable barrier, farm pond and percolation pond. Depending on capacity of the structure we can reduce 43% of total discharge from the sub-water shed which is causing flood near Kolhapur city.

Key Words: flood control measures, Curve Number method.

1.INTRODUCTION

During the months of July and August 2019, Sangli and Kolhapur districts in Krishna sub basins experienced extreme floods for long durations. Heavy losses to life, property and crops etc. had been reported. Different opinions at various levels were put forth concerning these flood situations faced by Sangli and Kolhapur districts. Floods of 2005 and 2006 were also noteworthy. However, the 2019-2021 flood situations were comparatively much more severe which lasted more than a week and losses experienced were also on a higher scale. Itis therefore necessary to find out different ways to counter flooding, in-depth analysis and other reasons behind the flood situation to prevent the repetition of such unfortunate events in future.

Flood devastation is increasing in this region due to rapid increase in the population and human activities. In 2005, 57 villages were heavily affected by flood and 27 villages were completely marooned by flood water. During that period 40,000 people were shifted to relief camps and 26 human casualties were reported. Agricultural area of 520 sq.km of Kolhapur district was also inundated as per state government's report. [2]

In the 2019, India faced a series of floods that affected over thirteen states in late July and early August 2019 due to excessive rains. At least 200 people died and about a million people were displaced. Karnataka and Maharashtra were the most severely affected states. People died but many were rescued with the help of the Indian Navy. It was the heaviest monsoon in the last 25 years. More than 1600 people died between June to October 2019. Thirteen states of India were affected by floods due to heavy rains in July–September 2019. News reports later stated that there were 500 people missing and 1000 were killed with many people losing their homes.

According to preliminary estimates, losses to public and private properties are over RS.4,000 crore (RS.53,88,00,000). Losses due to flooding in Kolhapur and Sangli are 700 crore (RS.94,290,000). Electricity infrastructure worth 1,200 crore (RS.16,16,40,000) has been damaged, while damage to roads and bridges is over 1,500 crore (RS.202,050,000). Crops across 338,000 hectares have been damaged in western Maharashtra and Konkan. The state relief is expected to cover all affected elements by widening the scope of the set norms. Maharashtra is now dealing with twin disasters, i.e., the floods in the midst of the ongoing pandemic. The floods have posed a grave threat to the healthcare of patients who are being treated in hospitals. [1]

At present, 133 villages are prone to flooding. The problems related to flooding have greatly increased in the Panchganga basin and there is need ofeffective modelling to understand the problem and to mitigate its disastrous effects. The main limitation of flood risk analysis is the generation of accurate terrain information and identification of inundated areas during the event. Cartosat stereodata with 2.5 m resolution can only provide vertical accuracy up to 6 m. The main objective of the present study is to identify potential flood risk in the areas of Panchganga river using Curve Number Method.

According to reports climatic change is one of the factors for natural calamities, over the years indiscriminate pursuit of so-called development has reduced the capacity of catchment areas to hold, store and absorb rain water. Climatological Changes and Abnormal Rainfall Pattern Formation of severe cyclones over Arabian sea leading to persistent and simultaneous occurrence over large spatial areas, of heavy precipitation in short duration, in the catchments of river Krishna and its tributaries, both in dam and free catchments. Absence of flood absorption capacities in reservoir planning of existing dams. At the time of project planning, the reservoirs are never planned with the provision of special cushion for flood absorption. The dead storage is designed to accommodate the silts and live storages are planned for complete utilization of the water stored. The Reservoir Operation Schedules are designed to assure for full storages by the end of the monsoon period. For ungated spillways or dams having fully automated gates, there is no manual control to moderate the incoming floods. We need to focus on creation of local water harvesting systems [3]

2. Problem Statement

In the present situation, we know about the flooding condition of Kolhapur city so we have to study watershed management of Kolhapur city and suggest Flood Coping Measures by Using Watershed Management Techniques in PANCHGANGA River Basin. In recent years Maharashtra state has witnessed flood situations in consecutive years. Reportedly the most affected regions of this flood situation are the districts of Raigad, Ratnagiri, Sindhudurg, Satara, Sangli and Kolhapur. Particularly for Kolhapur district the flood situation has caused quite a wreckage. It was reported the around 150,000 people from Kolhapur District were relocated and over 200,000 hectares of crops have been damaged in the floods. Besides the mentioned damages the damages there were a lot more damages in other sectors also. In the wake of this situation we must first study the geographical and climatic background of Kolhapur.

3. Significance of project problem:

Using morphometric analysis, we have done the flood coping measures using watershed management techniques in Panchganga river basin.

Using morphometric analysis, we have done with the help of this project we can reduce the flood by 40 to 45 %. We can apply this project in flood situation areas to avoid the serious flood situations.

4. Study Area: -

Study areas are geographic boundaries created in Business Analyst used to define the extent of your analysis. They are typically created when starting a project to ensure that your data is confined to a specified area. Study area means the land surface area which was mapped and quantitatively sampled during the baseline vegetation inventory. The study area generally coincides with the permit area (or amendment area) but may exceed those boundaries with prior approval from the Administrator.

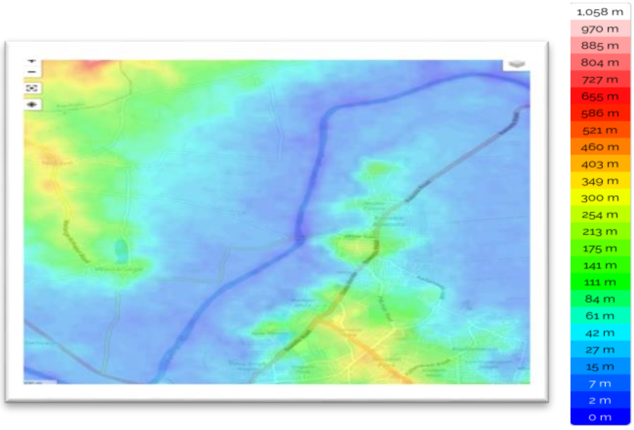
SW1 : Nigave dhumala

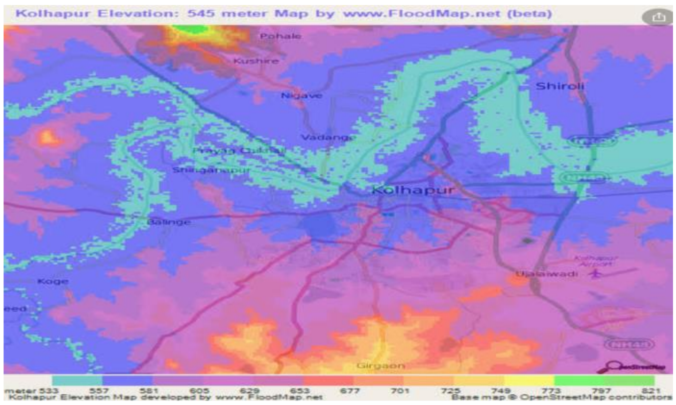
SW2 : Vadnage

SW3 : D.Y Patil College Of Engineering Campus Area

SW4 : D.Y Patil Sugar Mill

Google map of study area





Topographical map (www.floodmap.net)

5. METHODOLOGY: -

Collection of primary and secondary data of 4 Dams [Tulshi , Radhanagari , Kumbhi , Kasari and Free-catchment area].
To collect data about peak discharge, average discharge, average precipitation in free-catchment area, water levels at that area during flood situations and also in normal conditions.

To accomplish this, we used 2 types of data: -

Primary Data 2) Secondary Data

Primary data was obtained from WRD department Kolhapur.

30-07-2019 to 10-08-2019 Rainfall & Discharge data - Panchaganga Basin

Dam / Date	Radhanagari 10 Yrs. Avg. Rainfall mm	Radhanagari Rainfall 2019 mm	Radhanagari Dis. 2019 Cus.	Tulshi 10 Yrs. Avg. Rainfall mm	Tulshi Rainfall 2019 mm	Tulshi Dis. 2019 Cus.	Kumbhi 10 Yrs. Avg. Rainfall mm	Kumbhi Rainfall 2019 mm	Kumbhi Dis. 2019 Cus.	Kasari 10 Yrs. Avg. Rainfall mm	Kasari Rainfall 2019 mm	Kasari Dis. 2019 Cus.
30-07-19	46	165	1450	29	184	0	63	225	300	37	203	1960
31-07-19	65	204	4256	34	108	0	82	155	350	69	135	1960
01-08-19	61	170	7112	50	113	0	87	140	350	73	131	1960
02-08-19	67	162	4256	42	101	0	67	60	350	64	113	750
03-08-19	59	204	7512	50	168	0	82	180	350	76	173	1000
04-08-19	71	143	7512	33	110	0	77	135	350	74	234	1390
05-08-19	68	194	11368	41	191	1014	61	240	1550	68	364	2750
06-08-19	62	445	17400	38	335	3483	79	425	2550	55	210	2700
07-08-19	54	220	10256	32	324	4947	61	315	3950	35	134	2250
08-08-19	40	267	13112	27	219	2976	45	205	1600	50	164	0
09-08-19	38	178	7356	16	239	1962	35	191	1050	39	135	500
10-08-19	39	208	7112	13	279	2610	36	201	1250	28	108	600
Total	670	2560		405	2371		775	2472		668	2104	
Avg.	56	213		34	198		65	206		56	175	
		3.82	Times		5.85	Times	3.18	Times			3.18	Times

Statement showing Dam discharges & Free catchment discharges Panchaganga Basin

Date	Rajaram K.T.Weir			Dam discharges in Panchaganga Basin		Discharges in free catchment area of Panchaganga Basin	
	Rainfall at Radhanagari Dam (mm)	Level (Ft.) 1739+	Discharge (Cusecs)	Cusescs	TMC	Cusescs	TMC
1	2	3	4	5	6	7	8
30-07-19	165.00	34'2"	35014	3710	0.321	31304	2.705
31-07-19	204.00	39'1"	53985	6566	0.567	47419	4.097
01-08-19	170.00	41'6"	61209	9422	0.814	51787	4.474
02-08-19	162.00	42'8"	62398	5356	0.463	57042	4.928
03-08-19	204.00	43'8"	63269	8862	0.731	54407	4.701
04-08-19	143.00	44'8"	64201	9252	0.765	54949	4.748
05-08-19	194.00	47'3"	66164	16682	1.320	49482	4.275
06-08-19	445.00	51'3"	69751	26133	2.254	43618	3.769
07-08-19	220.00	55'7"	75352	21403	1.849	53949	4.661
08-08-19	267.00	54'8"	74008	17688	1.528	56320	4.866
09-08-19	178.00	52'11"	71679	10868	0.939	60811	5.254
10-08-19	208.00	52'2"	70776	11572	1.000	59204	5.115
TOTAL			66.14 TMC		12.55		53.593
					18.97%		81.03%

Secondary data was obtained from Krishna sub basin report [Vadanere Committee Report]

6. RUNOFF ESTIMATION

We have putting Rainfall in average of month July 2019 in Kasaba Bawada (Kolhapur) (W.R.D)

$Q = (P-0.2S)^2 \div (P+0.8S)$

where, P = Rainfall
Q = Runoff
S = Potential maximum retention after runoff

P = 148.5mm (Maximum rainfall on 6 August 2019)
$S = 1000 \div CN - 10$ (CN = Curve Number)
$= 1000 \div 85 – 10$ (CN = 85… Curve Number for Hydrologic Soil group D)
= 1.76
$Q = (148.5-0.2\times1.76)^2 \div (148.5+0.8\times1.76)$
= 146.40 mm

City Area = 3920000 m^2 (Kasaba Bawada Total Area at Survey of India 2009 Published by 2010)

Volume of Water in City $= Q \times Area$
$= 146.40 \times 3920000$
= 5,73,888 litres

7. SUGGESTION OF STRUCTURAL MEASURES

Sr. No.	Farm Pond	Percolation Tank	Movable Barrier	Total
SW1	10*10*3 =300 m^3 600 m^3	10*10*2 =200 m^3 400 m^3	3m ht. 200 m^3 400 m^3	1400 m^3
SW2	10*10*2 =200 m^3 400 m^3	10*10*2 =200 m^3 200 m^3	2m ht. 200 m^3 400 m^3	1000 m^3
SW3	7.5*10*2 =150 m^3 450 m^3	10*7.5*2 =150 m^3	2m ht. 200 m^3	800 m^3
SW4	10*10*2 =200*4 =800 m^3	7.5*10*3 =225*3 =675 m^3	3m ht. 208 m^3 625 m^3	2100 m^3

Sub Watersheds	Before Implementation Of Structural Measures	After Implementation Of Structural Measures	Difference	Structural Measures
SW1	2905.68 m3	1505.68 m3	1400 m3	Movable Barrier =2 Farm Pond =2 Percolation Tank =2
SW2	2260.39 m3	1260.39 m3	1000 m3	Movable Barrier =2 Farm Pond =2 Percolation Tank =2
SW3	1688 m3	888 m3	800 m3	Movable Barrier =2 Farm Pond =2 Percolation Tank =2
SW4	5223 m3	3123 m3	2100 m3	Movable Barrier =2 Farm Pond =2 Percolation Tank =2
Total	12077.07 m3	6777.07 m3	5300m3	Reduction % =43 %

Result and Discussion:

On the basis of Research papers and books we found that Curve Number (CN) method is most effective and appropriate method for calculating rainfall-runoff.

From the Curve Number Method, we have calculated maximum and minimum rainfall and from this data Average rainfall is calculated.

Using Curve Number Method we have calculated Discharge from K.T.Weir. On the basis of this data we have suggested these structures for maximum flood level and which we have discussed above we can reduce 43% of total discharge from the sub watershed that causing flood situation in Kolhapur city.

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