ANALYSIS AND MAPPING OF FLOOD LINE IN GODAVARI RIVER BASIN WITHIN THE NASIK MUNICIPAL CORPORATION AREA

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Introduction:

All through history it is evident that man has constructed his settlement along the streams, rivers or coasts. Stream or river water has been a source for consumption, agriculture or industry. Small settlements are converted into big cities as population is fast increasing and at the same time constructions are also increasing which has reduced the percentage of available land. This has increased the tendency of encroachment in river flood plain areas. Countries having high population density are more sensitive to floods because of lack of flood control, lack of emergency response infrastructure and early warning systems.

Flooding is a natural and recurring event for a river or stream. Statistically, streams will equal or exceed the mean annual flood levels once every 2.33 years (Leopold et al., 1964). Flooding is a result of heavy or continuous rainfall exceeding the absorptive capacity of soil and the flow capacity of rivers, streams, and coastal areas. This causes a watercourse to overflow its banks onto adjacent lands. Floodplains are, in general, those lands most subject to recurring floods, situated adjacent to rivers and streams. Floodplains are therefore "flood-prone" and are hazardous to development activities if the vulnerability of those activities exceeds an acceptable level. In short, floods is an overflow or accumulation of an expanse of water that submerges land

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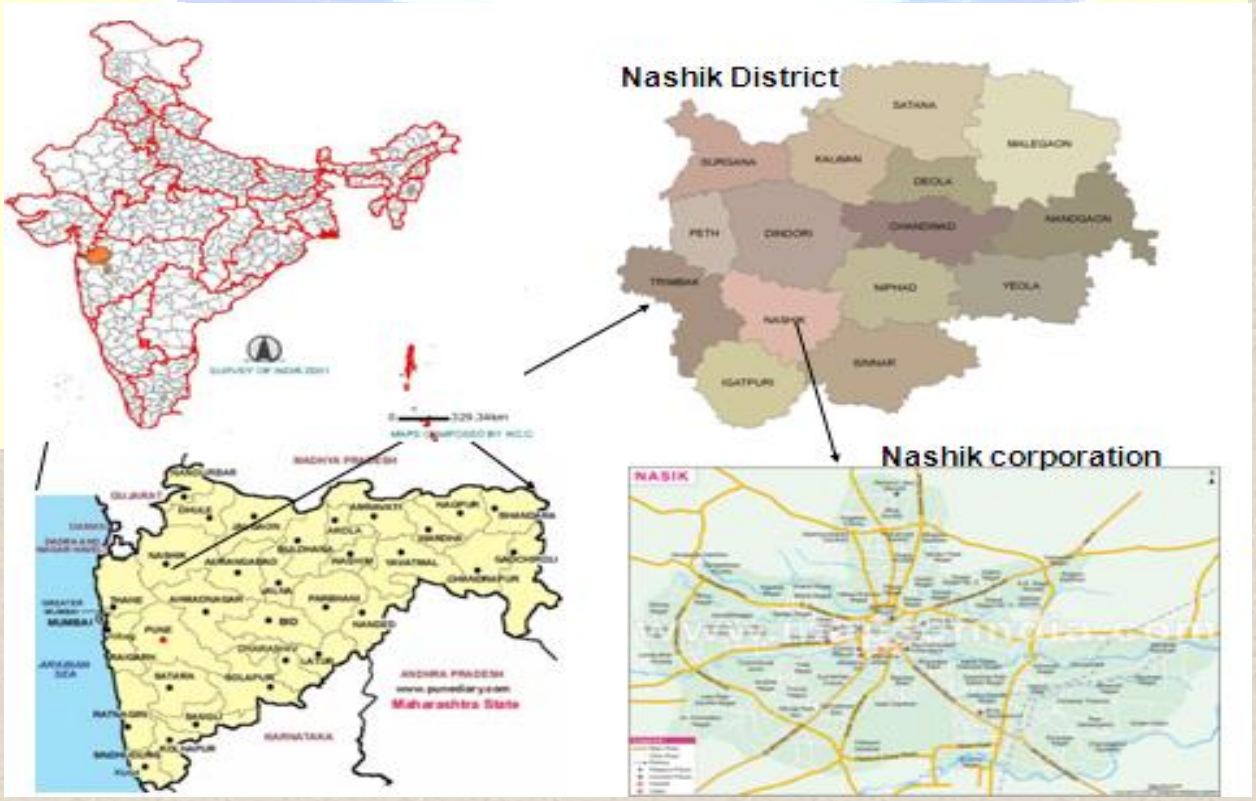
when discharge of a river cannot be accommodated within the margins of its normal channel so that water spreads over adjoining area and creates havoc.

Flood can take place in a multitude of ways. Most floods take days or hours to develop but some generate quickly without any warning. These flash floods are quite dangerous and within a short period of time may sweep away everything that comes its way.

Location of Study Area:

Nasik is situated on East side of Western mountain range on the banks of River Godavari and its tributaries like Nasardi, Waghadi, Darna, and Waldevi. Sub- channels of river Godavari were spread throughout the Municipal Corporation area. Geographical location of Nashik is 20^0 01' to 20^0 02' North Latitude and 73^0 30' to73^0 50' East Longitude. Nasik city is situated on both the banks of river Godavari and extends East West along the banks of river and its sub-tributaries. Total area of Nasik Muncipal Corporation is 264.23 Sq.km (102 Sq.mt.) Height from M.S.L is 328 feet (101 mt.).



Aims and Objectives:

The rate of human encroachment has increased due high land prices and high construction rates, resulting in disappearance of sub-tributaries. Similar is the case of River Godavari's main channel, as year by year the width of the channel is decreasing due to encroachment. After the construction of Gangapur dam on river Godavari in 1965 (Gangapur dam is the nearest storage dam situated 15 km upstream of Nasik city) rain water has been blocked in the dam which has moderated the floods from upstream dams. The percentage of rainfall was average between 1990 to 2002 but from 2002 the figures suggest that percentage of annual rainfall has been increasing. During the last few years the amount of rainfall has increased in short period of time which has created problems near the banks of river Godavari.

The main aim of this paper is to study the reasons responsible for the creation of problems near the banks of river Godavari.

Methodology:

The study is based on primary and secondary data. The primary data was collected from Irrigation Departments of the Government and the published data from Water Conservation Department of India. A detail study was made to understand the catchment area, source of water, length of river channels by dividing the catchment area of river Godavari into 11 sub-zones above Nasik.

Flood levels of August 2008 were considered and points were demarcated for the mapping of flood line with the help of G.P.S and measurements by tape. Cross sections where taken at an interval of 1 Km in which existing channel width of river and highest flood points during the last 25 years were demarcated.(August 2008)

The reasons responsible for flood level rise were identified, elaborated and analysed.

Analysis:

For the analysis and plotting of recent high flood line some data which was helpful for the conclusion is shown in table No-1 which reflects the location, area, longitudinal and

latitudinal extension, catchment area, gross storage capacity, spillway length of dams, number and size of gates etc. This data is helpful to understand the nature of dams and supply of water to the main channel of river Godavari.

The data available from Irrigation department is calibrated with the procedure recommended by Central Water Commission, New Delhi as shown in Table No-2.This table shows that catchment area of Godavari basin up to Nasik Municipal Corporation border was divided into eleven sub-zones. Unit hydrograph was computed by using Clark method with the help of parameters like Catchment area of each Sub zone, Tcal - Time of concentration by California formula for each Sub zone and Time – area ratios.

Out of the several factors responsible for the cause or rise in water level in river Godavari the following are considered:

a) Rainfall

b) Number of Dams

c) Encroachment

d) Construction of Bridges

e) Improper management and planning

f) Cross section:

a) Rainfall:

Nashik city is located towards the East side of Western mountain range. Generally city receives rainfall from South West Monsoon in between June to October. There are less chances of rainfall in October but during the last few years it has been noted that rainfall occurs in September which is known as return monsoon or North East monsoon. If the percentage of return monsoon is more than the water in river Godavari increases because due to early monsoon dam levels are raised and there is little space for accumulation of return monsoon water. On 28th August 2008 Nasik and its adjoining area received heavy rains and it was measured around 150 mm in 24 hours which was above average rainfall.

b) Number of Dams:

There are two dams namely Gautami and Kashypi which are constructed above river Godavari and the work upon the third one (Kakvi) will start soon. Out flow waters of Gautami and Kashypi are channel routed to Gangapur reservoir. The flood water of Kashypi and Gautami reservoir are then routed through the spillway. These catchments being in high rainfall zone are contributing to the inflow at Gangapur dam. The addition of water from free catchment of Gangapur reservoir is also added to the channel. The routed floods from Kashypi and Gautami and free catchment of Gangapur dam increase the water level of the Gangapur dam. Maximum water level and full water level of Gangapur reservoir is same so it does not have any flood absorbing capacity. The excess water from Gangapur dam increases the water level in river Godavari below Gangapur dam. Flow water from Alandi dam and catchment area below Gangapur dam also adds to the flow of river Godavari.

c) Encroachment:

River Godavari has a historical significance from the religious point of view. In Hindu religion it is believed that if ashes of the dead are put into water of river Godavari then the person attains nirvana or moksha. Lakhs of people gather here once in every twelve years for Kumbh Mela (gathering of Hindus). Due to its religious importance we find a number of temples near and around the riverbanks. Panchavati is known as a holy place from ancient time. People from all over India come to this place for worship hence the old city is concentrated here. At this place the river does not have its natural channel. The natural channel is converted into decorative channel by constructing a wall, and creating cement flooring in river bed which has disturbed the gradient of river. Many people have explored this importance from tourist point of view which has forced them to construct hotels and lodges near the banks which has disturbed the original channel. Whenever water level rises above normal level this area is affected first and faces problem every year.

Secondly, newly developed area is observed between Anandwali to Ramwadi. Due to establishment of schools, colleges, and planned settlement many people prefer this area. This heavy demand has decreased the percentage of land in this area.

Due to moderation of flood water after the construction of Gangapur dam and less average rainfall before 2005 has reduced the width of the river channel. Flood plains which were used for agriculture are converted into plots for the construction of buildings. In many areas river width is less than 60 meters. In recent floods many houses and buildings were under water for upto 10 to 15 hours. More encroachment is observed from Asaram bapu ashram to Kanamwar Bridge. Roads are constructed in flood plain areas as shown in Photograph No.01

d) Construction of Bridges:

Nasik is one point in golden triangle which is developing between Pune and Mumbai. The importance of Nashik city in respect with economical and industrial development ranks third after Mumbai and Pune. Hence the rate of growth has excelled which is faster than other cities of Maharashtra. Most of the settlement is concentrated in right side of river Godavari. To develop the left side of river the municipal corporation has built 12 bridges to increase the connectivity with this area. Details of bridges are shown in table no 03. The table reveals the fact that while constructing the bridges proper height was not maintained. Out of 12 bridges 06 bridges have height less than 15 meters. Total width of pillars reduces channel width by 10% which interrupts flood water and helps channel water level to rise. When flood water is above average level Ramwadi and Amardham Bridge submerges under water. Weirs built to store water in river have disturbed the gradient of river channel and helps the flood level to rise.

e) Improper management and planning:

Regulation of dams comes under Irrigation Department and City disaster management comes under Muncipal Corporation. These two departments have no coordination with each other. Improper infrastructure, lack of advanced technical instruments for measuring rainfall and processing of data at the source area (Kashyapi and Gautami dam) can not reveal the danger of water supply from catchment area. To maintain the full reservoir level of dam, water is routed through spillway. Once the water level of the reservoir reaches full capacity, the flow of water is beyond control of responsible department. This increases water level in main channel of river Godavari causing havoc in flood plain areas. Slum settlement near banks is first target of this

raised flood water e.g. 'Malharkhan' slum, 'Waghadi slum' etc. Automatic alarming systems are not properly installed and flood line was not demarcated by Muncipal Corporation which has given rise to construction in flood plain areas.

f) Cross section:

The study of cross section suggests that at many places width of river has reduced due encroachment, especially in Panchavati area and near the right bank of river between Asaram bapu ashram to Ramwadi bridge. The difference between current channel and highest flood line is more than 200 meters in panchavati and more than 125 meters between Asaram bapu ashram to Ramwadi Bridge. All this area was submerged under flood water which has caused heavy damage to individuals as well as Government of Maharashtra. Flood level of August 2008 is 2.5 feet less than the flood line of 1969. Two zones are created in Godavari basin with the help of cross sections:

1) Average Flood level Line or Regular Flood level Line and

2) Sudden flood level line

Conclusion:

- Water flow from catchment area of Kashypi and Gautami should be calculated on half hourly basis, advance climatic data recording center should be established on both the dams which will provide in advance, information of water flow and traditional methods should be improvised by using advanced techniques.
- By taking in to consideration all analysis and readings it can be concluded that flood waters in river Godavari in Nasik Muncipal Corporation area can be well managed if the Government forms joint organization of Muncipal corporation, N.G.O, and Irrigation department which will maintain-record and calculation of rainfall, water supply from catchment area, flood water rise in channel , atmospheric changes, alarming system and related aspects with floods, which in turn will help disaster management system to respond soon.

- Construction should not be allowed inside the highest water level in 25 years. This area may be used only for the open land type of use such as playgrounds, gardens, river side roads, cultivation of short duration crops etc.
- The construction of bridges is important to develop the city in all directions. While constructing the bridges height should be not less than the height of flood in last 25 years also length and distance between two bridges should be maintained.
- Cross section suggests that heavy encroachment in specific areas which are under constant threat in rainy season should be shifted at proper altitude (e.g. Malharkhan, Waghadi Slums)
- Authorities responsible for granting permission for the illegal Construction in flood plain areas should be held responsible and Proper action should be taken.

Salient features of dams in the catchment of Godavari Basin up to the Nasik Municipal Corporation border are as below

Table No.:- 1

Sr.No	Particulars	Kashyapi Dam	Gautami Dam	Gangapur Dam	Alandi Dam	Waldevi Dam
1	Name of the River	Kashyapi	Godavari	Godavari	Alandi	Waldevi
2	Toposheet No	46H/12	48E/9	46H/12	46H/12	-
3	Longitude	$73^0$36'24"	73034'00"	73019'00"	70042'00"	
4	Latitude	20004'08"	19038'00"	20038'00"	20007'00"	
5	Catchment Area (Sq.km)	46.10	41.18	356.40	74.59	51.84
6	Gross storage In MCM	52.69	54.68	215.2	29.53	42.16
7	Spillway length (Mt)	29.0	41.0	102.0	100.0	73.00
8	No. of gates	3	3	9	-	-
9	Size of gates	8.0*4.0	12.0*5.0	9.15*6.10	-	-

Table No.:- 02

Table showing particulars of subzones

Sr.No	Particulars	Subzone	Catchment Area (Sq.km)	Length longest river course	Origin of river	RBL/FRL	Tc
				In Km	In Mt.	In Mt.	In Hours
1	Gangapur (Free)	*A*	272.12	40.177	1287	612.35	5.545
2	Gutami	*B*	41.18	7.20	1286.67	695.85	0.80
3	Kashyapi	*C*	46.1	15.25	1061	661.8	2.217
4	Alandi	*D*	74.59	7.75	905	650.8	1.207
5	Alandi (Free)	*E*	78.198	16.6	765	572	3.689
6	Gangapur Dam to Confluence of Alandi	*F*	17.25	7.55	610	572	2.437
7	Alandi to Waghadi	*G*	76.18	13.78	725	555.5	2.743
8	Waghadi river	*H*	27.36	10.97	700	555.5	2.242
9	Nasardi river	*I*	96.82	24.7	740	549.5	5.113
10	Waldevi dam	*J*	51.84	10.35	1300	667.68	10187
11	Below Waldevi driver	*K*	107.00	26.49	975	536.59	4.407

(Source N.I.D)

Table No.:- 03

Table showing particulars of Bridges

Sr.No	Particulars	Total Length	Total Pillar Width	Total Pillars	Pillar width –Total width
1	Gangapur Bridge	150	13.5	05	136.5
2	Asaram Bridge	270	24.3	09	245.7
3	Suyojit Bridge	210	18.9	07	191.1
4	Raka Bridge	363	33	11	330
5	Ramwadi Bridge	132	16	05	116
6	Victoria Bridge	301	21	07	280
7	Holkar Bridge	336	32	08	306
8	Dahipul	480	64	16	416
9	Amardham	340	20	10	320
10	Kanamwar	350	25	08	325

Table No 04

Details of Cross section

Sr.No	Cross Section Numbers	Width of Channel (Mt)	Width of Channel(Highest Flood) (Mt)	Difference	Latitude & Longitude
1	01	80.467	128.747	48.28	20 02’ 10.45”N 73 43’24.74”E
2	02	64.373	177.027	112.654	20 01’ 21.89”N 73 43’ 24.74”E
3	03	64.373	144.840	80.467	20 01’ 21.89”N 73 43’47.27”E
4	04	64.373	160.934	96.561	20 01’ 15.67”N 73 44’ 20.39”E
5	05	80.467	128.474	48.007	20 01’ 06.73”N 73 44’ 47.39”E
6	06	80.467	144.840	64.373	20 01’ 18.37”N 73 45’ 17.62”E
7	07	80.467	177.027	96.56	20 01’ 20.81”N 73 45’ 51.27”E
8	08	64.373	225.308	160.935	20 01’ 00.07”N 73 46’ 13.26”E
9	09	80.467	241.401	160.934	20 00’ 35.41”N 73 46’ 33.25”E
10	10	112.654	241.401	128.747	20 00’ 35.45”N 73 47’ 07.74”E
11	11	32.186	209.214	177.028	20 00’ 21.76”N 73 47’ 33.63”E
12	12	48.280	321.868	273.588	20 00’ 05.70”N 73 47’ 57.96”E
13	13	48.280	305.775	257.495	20 00’ 03.12”N 73 48’ 33.02”E
14	14	48.280	257.495	209.215	19 59’ 51.07”N 73 48’ 58.32”E
15	15	48.280	289.681	241.401	19 59’ 26.11”N 73 49’ 14.92”E
16	16	80.467	305.775	225.308	19 59’ 15.33”N 73 49’ 47.34”E
17	17	80.467	241.401	160.934	19 59’ 02.69”N 73 50’ 19.22”E
18	18	128.747	160.934	32.187	19 59’ 23.86”N 73 50’ 43.86”E
19	19	64.373	193.121	128.748	19 59’ 21.02”N 73 51’16.96”E
20	20	96.560	241.401	144.841	19 58’ 59.60”N 73 51’ 43.54”E
21	Malharkhan	96.560	386.242	289.682	

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