FLOOD RELATED DISASTERS: CONCERNED TO URBAN FLOODING IN BANGALORE, INDIA

Shubha Avinash[1]

[1]*Project Scientist, Karnataka State Natural Disaster Monitoring Center, Bangalore, Karnataka*

Abstract

Flood is one of the significant and frequent disasters in the world. Of these more than 50% of the events occur in Asia. Every year there is loss of human life, animals, houses, goods and property due to the outrage of floods. Urban areas are witnessing drastic population growth resulting in decreasing rainwater infiltration and increase in runoff and flood peak. Severe and frequent flooding events are possibly due to climate change, socio-economic damage, migration, development practices and political instability, which constantly reshape flood vulnerability. As a part of an integrated urban flood studies at KSNDMC, we are developing a plan for "Urban storm water flood management"–for Bangalore city, which is often subjected to monsoon fury.

This paper describes the causes, circumstances and impact of flooding events in Bangalore city. In an urban scenario, like Bangalore, floods occur due to natural phenomenon such as heavy and / or high intensity rainfall, human factors such as blocking of storm water drains, population growth leading to improper land use & unplanned settlements etc. The immediate impact of floods will be mainly on the public transportation because of water submerging the roads, urban settlements in low laying areas due to inundation, chocking of storm water drains inundating the surrounding houses. In the Developing countries, like India, the activities of Flood management are handled by government and are still adopting a reactive approach during floods. This should be changed to proactive action which enhance effectiveness of management and reduce losses. For planning and implementing an effective short and long term flood management plan participation and co-operation between Government, non-governmental, private agencies and public is a prerequisite.

Keywords: *flood vulnerability, socio-economic damage, migration, development practices and political instability.*

----------***----------

1. INTRODUCTION

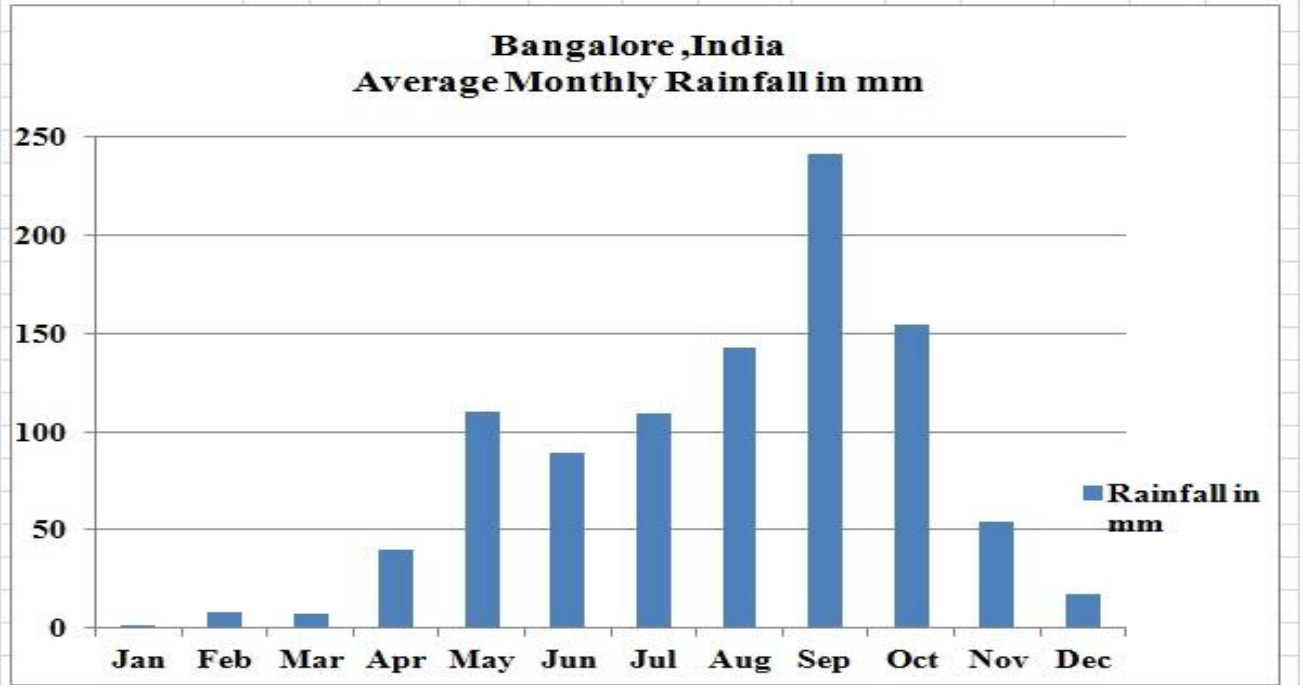
Flood is a significant and recurring disaster. Repeated floods lead to loss of human life, animal life, property and assets. Many factors, natural and human activities is responsible for flooding in the urban scenario. Urban flood is a highlighted issue of disaster management which needs a first order priority focusing on the assessment of flood vulnerable areas, Flood hazardous mapping, mitigation plans and flood early warnings and forecasting .This will help in proper decision making towards mitigating and management of floods.

Bangalore with a geographical area of almost 800SqKm, is located almost equidistance forms both the eastern and western coast of south Indian peninsula. The Mean annual rainfall is about 975 mm with about 59 rainy days a year. It has 12.591North latitude & 77.571East longitude. It has an altitude 0f 920m above sea level. Bangalore is the fifth largest city of India with population of about 9.6 million, located around 100 km from the Kaveri River. There has been a growth of 32% in urban areas of Greater Bangalore across 37years (1973–2009).Encroachment of wetlands, floodplains, etc. is causing floodway obstruction and loss of natural flood storage in Bangalore.

Table- 1 & Graph-1 (Reference -1)

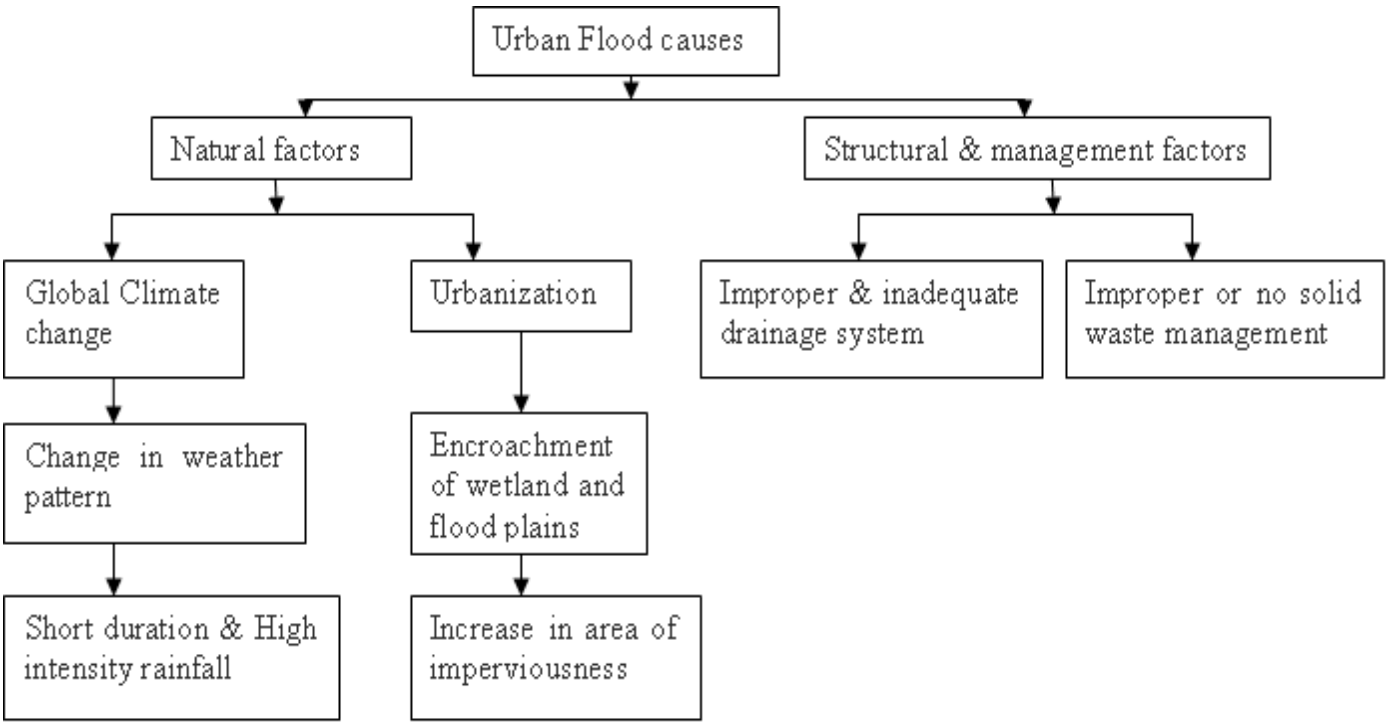
Average Annual and monthly Rainfall variation in Bangalore:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall mm	1.8	7.9	7	40	110	89	109	143	241	155	54	18	975
Avg. rainy days	0.2	0.5	0.8	3	6.9	6	7.4	10	10	7.9	3.9	1.6	58.5



As in Table-1 and Graph- 1, according to IMD sources, wettest months of the year are September, October and August for Bangalore city.

2. CAUSES FOR FLOODS IN BANGALORE:



Urban floods happen in a relatively short period of time and can inundate an area with several feet of water. It is due to short duration and high intensity rainfall. As areas become 'urbanized' or go through the process of urbanization, there are increased flood risks. The main problem with urban flooding is the fact that they occur in highly populated areas. Although the property damages and death toll is not to the peak in urban flood scenario, it is very significant.

Urbanization leads to migration of people to urban areas for living. It directly leads to increase in population. The developments and utility services cannot cope up with the population growth, which directly impact on improper solid waste management system. The garbage disposal into the storm water drains choke the flow and the carrying capacity of the Storm water drain leading to over flooding of the drains during the high rain events.

As more wet lands, open spaces, tanks and wooded areas are converted to urban and suburban areas, the amount of surface area available for water infiltration into the soils decreases. Home sites, parking lots, buildings, and roadways all decrease the surface area of soil on Earth's surface. Because of the entire paved areas the imperviousness of the land increases with which water is redirected into sewage and storm water drainage systems.

Circumstances and Impact of floods in Bangalore: High rain event study in the year 2013:

Urban storm water flooding effects mainly the low laying areas in city. There are almost 147 low laying areas in the city as surveyed by Bruhath Bengaluru Mahanagara Palike (BBMP). Almost 130 low laying locations are been mapped in Arc GIS with Zone wise distribution as in Fig-1.

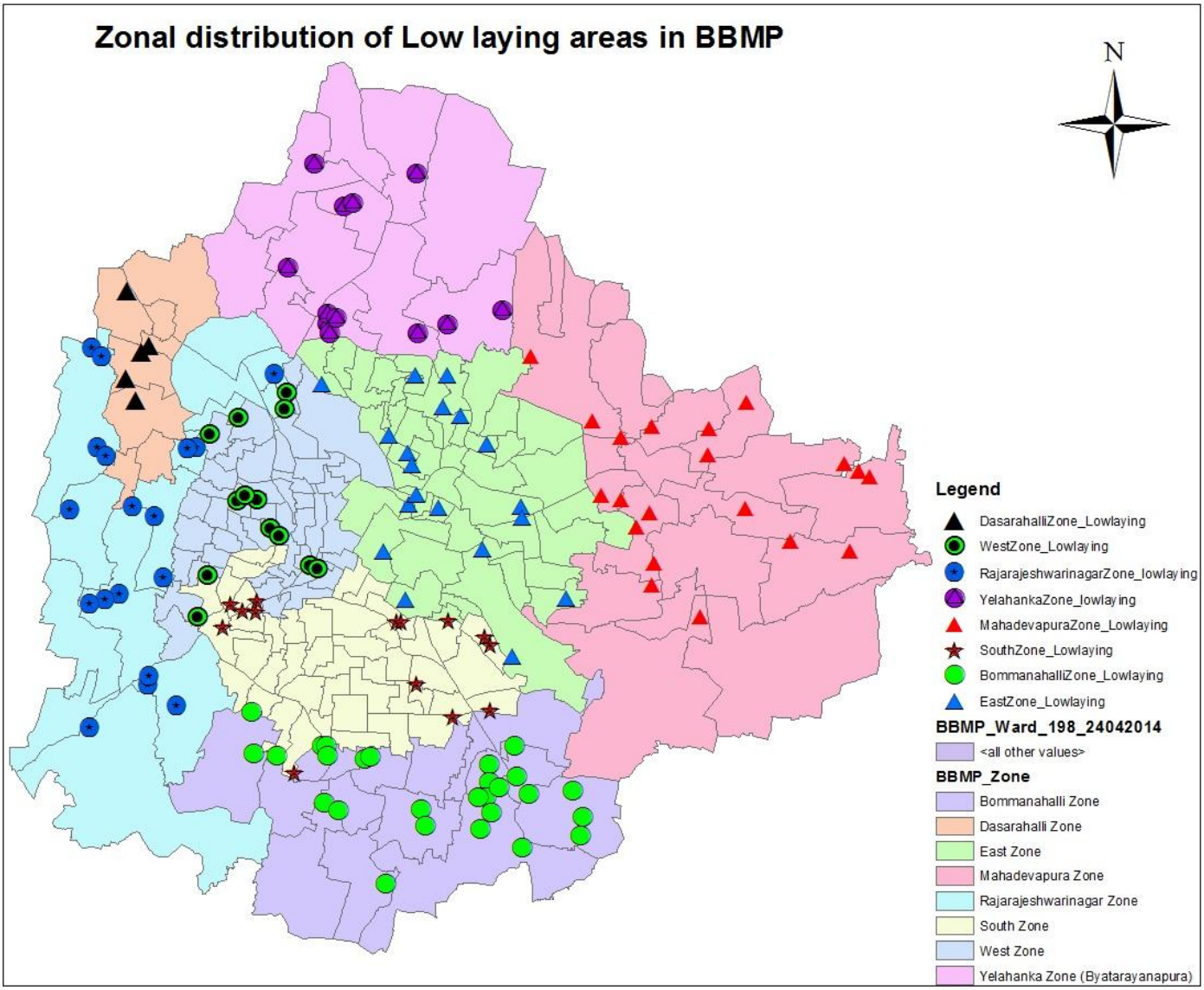


Fig-1 Zonal distribution of Low laying areas in Bangalore (Reference -2)

Bangalore has four major watersheds. Hebbal valley, Vrishabhavathi valley, Koramangala valley and Challagatta valley watershed. Part of Hesragatta valley watershed falls inside Bangalore BBMP area. These watershed delineation is made using Arc GIS as in Fig- 2.

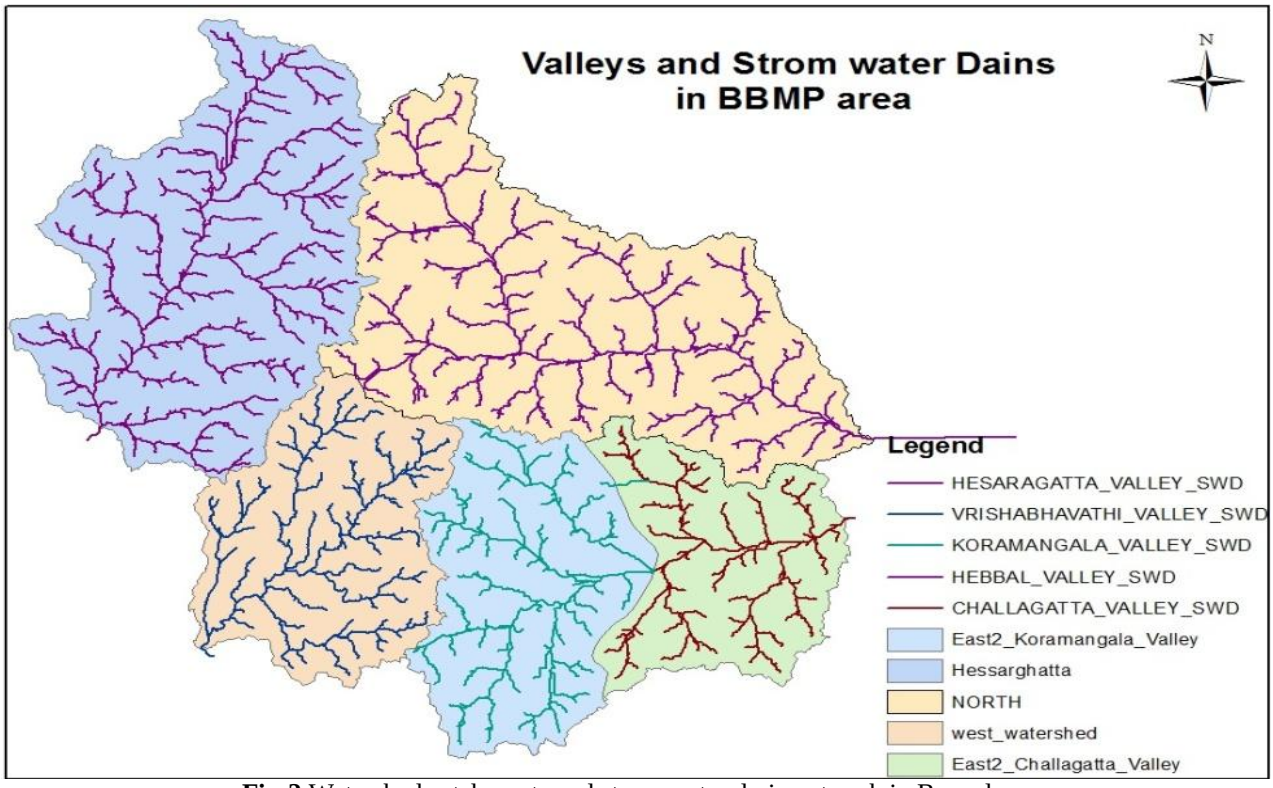


Fig-2 Watershed catchments and storm water drain network in Bangalore

The center has 100 solar powered GPRS enabled Telemetric Rain gauge network in BBMP area which has 198 wards and 8 zones as in Fig- 3

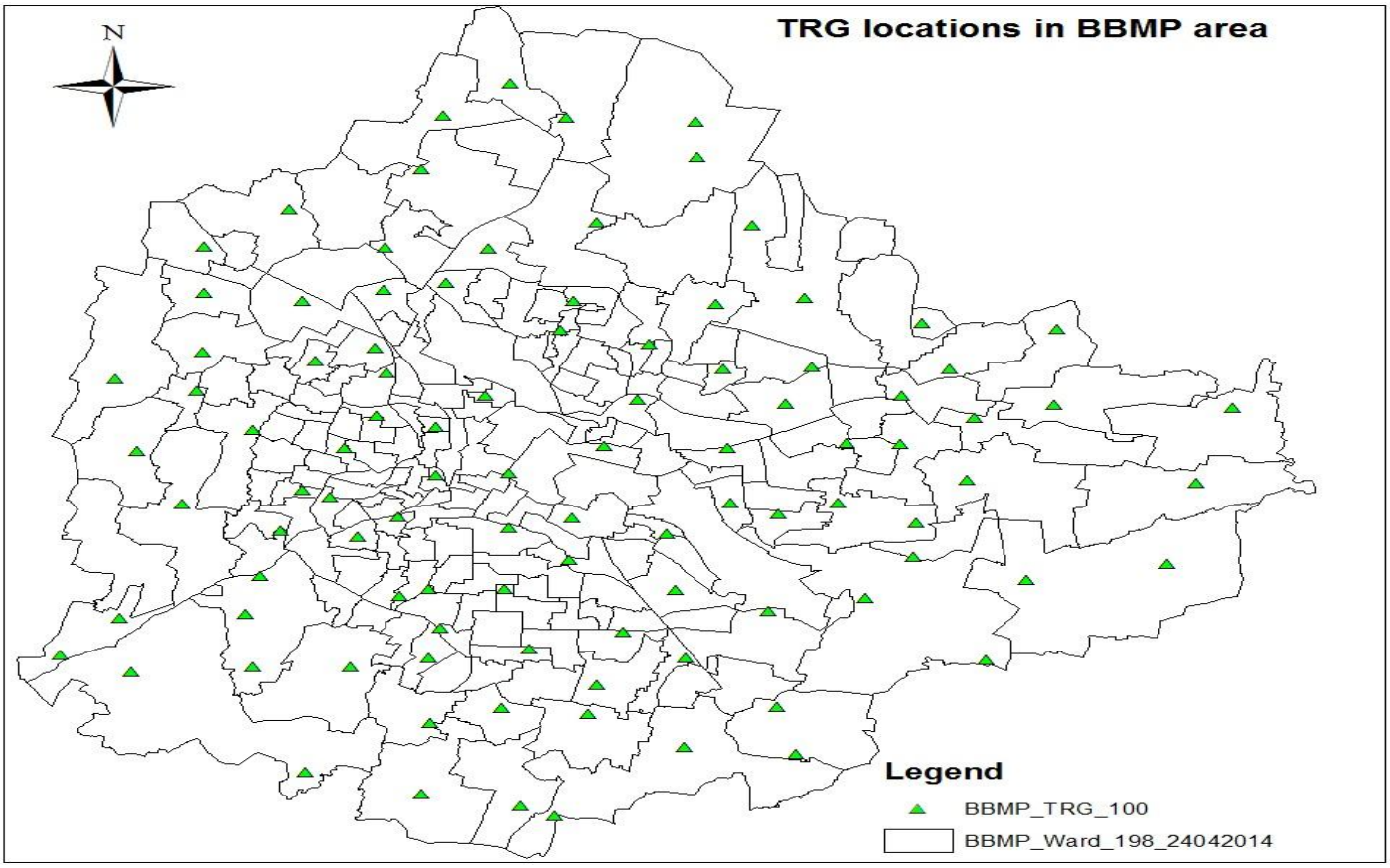


Fig-3 Watershed catchments and storm water drain network in Bangalore

According to our study in the center, the high rain events suffered in Bangalore city in the year 2013 has affected in a very bad way. The residential units, transport path near to the drains are flooded resulting in disturbed living of the people/public.

3. NOVEMBER 23rd 2013 RAIN EVENT:

Rainfall Runoff calculation was done for November 23rd 2013 rain event for a particular low laying area in west zone. It was observed that the runoff generated was six times more than the carrying capacity of the drain. The following Table-2 shows the calculations done to estimate the Runoff volume.

Table- 2 Runoff analysis for West zone low laying area for 23rd November 2013 rains

RUNOFF ANALYSIS FOR WESTCORE LOWLAYING AREA -23rd NOVEMBER 2013 RAIN

SL.NO	FID_grid	AREA_GRID (SQ-KM)	Ward_No	Ward_Name	FID_Theiss	Area_Sqkm	TRG	Rain(mm)	Drain_id	CARRYING CAPACITY(swd)	AREA WEIGHTED_AVERAGE GRID	WATERDEPTH IN GRID(MM)	VOLUME(M3)GRID	%IMPERVIOUS	RUNOFF COEFFICIENT	RUNOFF VOLUME(M3)	Q (M3/SEC)	V (M/SEC)
1	486	0.4	138	Chalavadipalya	41	6	2309	64	V106	19186.57125	0.066666667	4.26666667	1706.6667	96	0.91	1553.06667		
2	487	0.6	138	Chalavadipalya	41	6	2309	64	V106	19186.57125	0.1	6.4	3840	98	0.93	3571.2		
3	519	0.3	122	Kempapura	41	6	2309	64	V100,V106	120706.5338	0.05	3.2	960	99	0.94	902.4		
4	520	0.95	120	Cottonpete	41	6	2309	64	V100,V107,V108	122325.0338	0.158333333	10.1333333	9626.6667	95	0.9	8664		
5	521	0.45	94	Gandhi Nagar	36	6	2327	110.5			0.075	8.2875	3729.375	96	0.91	3393.73125		
6	522	0.1	94	Gandhi Nagar	36	6	2327	110.5			0.016666667	1.84166667	184.16667	95	0.9	165.75		
7	553	0.35	108	Sri Ramamandir	35	4	2342	65.5	V115	6643.21875	0.0875	5.73125	2005.9375	96	0.91	1825.40313		
8	554	1	108	Sri Ramamandir	35	4	2342	65.5	V100,V112	134738.2125	0.25	16.375	16375	100	0.95	15556.25		
9	555	1	94	Gandhi Nagar	35	4	2342	65.5			0.25	16.375	16375	96	0.91	14901.25		
10	556	0.35	94	Gandhi Nagar	35	4	2342	65.5			0.0875	5.73125	2005.9375	98	0.93	1865.52188		
11	587	0.35	108	Sri Ramamandir	42	6	2306	42			0.058333333	2.45	857.5	95	0.9	771.75		
12	588	1	96	Okalipuram	35	4	2342	65.5	V112,V113,V114	37601.25	0.25	16.375	16375	93	0.88	14410		
13	589	1	95	Subhash Nagar	35	4	2342	65.5	V100	101519.9625	0.25	16.375	16375	98	0.93	15228.75		
14	590	0.5	94	Gandhi Nagar	35	4	2342	65.5	V110	588	0.125	8.1875	4093.75	97	0.92	3766.25		
15	621	0.6	99	Rajajinagar	42	6	2306	42	V112	33218.25	0.1	4.2	2520	94	0.89	2242.8		
16	622	0.95	98	Prakash Nagar	35	4	2342	65.5			0.2375	15.55625	14778.438	95	0.9	13300.5938		
17	623	0.75	65	Kadu Malleshwar	35	4	2342	65.5	V100	101519.9625	0.1875	12.28125	9210.9375	97	0.92	8474.0625		
18	624	0.6	77	Dattatreya Temp	40	9	2310	121.5			0.066666667	8.1	4860	99	0.94	4568.4		
19	655	0.22	67	Nagapura	82	7	2300	45			0.031428571	1.41428571	311.14286	97	0.92	286.251429		
20	656	0.2	45	Malleshwaram	82	7	2300	45			0.028571429	1.28571429	257.14286	96	0.91	234		
21	657	0.35	35	Aramane Nagara	40	9	2310	121.5			0.038888889	4.725	1653.75	95	0.9	1488.375		
22	658	0.35	35	Aramane Nagara	40	9	2310	121.5			0.038888889	4.725	1653.75	94	0.89	1471.8375		
		12.47											129755			118642	33	4.4

AREA OF THE WATERSHED FOR WEST LOWLAYING = 12.47 SQKM

VOLUME OF WATER GENERATED IN THE WATERSHED DUE TO RAIN EVENT= 129755 CUBIC METER

RUNOFF VOLUME IN THE WATERSHED = 118642 CUBUC METER

AT POINT "A" : CARRYING CAPACITY OF THE DRAIN ,V106= 19186.57 CUBIC METER

COMPARING THE VALUES, RUNOFF VOLUME IS 6 TIMES MORE THAN THE CARRYING CAPACITY AT POINT "A"

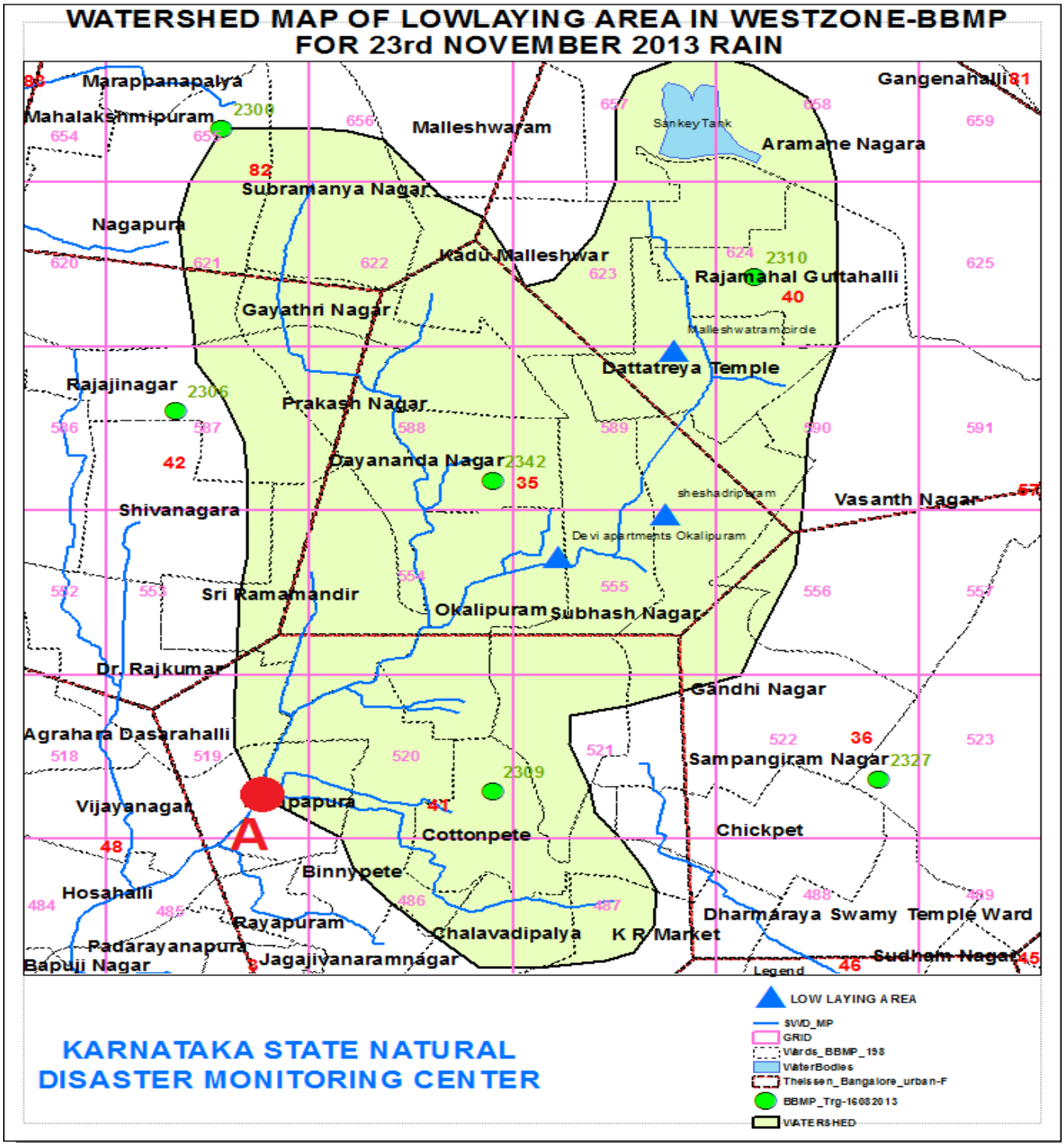


Fig-4: Low laying area in West Zone of Bangalore BBMP area

The analysis reveals that the excess runoff is due to less carrying capacity of the storm water drains in the area. Due to urban developments on wetlands and open spaces, the paved area has been increased. It has causes less infiltration and more runoff volume.

The impact of urban flooding is directly on the daily living of the people. The inundated residential layouts make it tough for the people to live. The inundation of roads makes it difficult for the public transport. Many trees will be uprooted and it will be difficult for the authorities to clear the debris of the high rain events. Due to fall of electric poles BESCOM will suffer crores of rupees loss. Uprooted trees and electric poles have damaged the vehicles parked in the vicinity.

The ill effects of urban flooding in low laying areas hinder the development of that area. The economy of the land declines due to under developments. Overall, the socio economic decline will be resulted as an impact of urban flooding.

Fig-5 Koramangala tank today & effect of urbanization in Bangalore, flooded residential areas – 23rd November 2013 rain (Courtesy: TOI)

ಬುಧವಾರ ಸಂಜೆ ನಗರಾದ್ಯಂತ ಸಾಧಾರಣದಿಂದ ಭಾರೀ ಮಳೆಯಾದ ಹಿನ್ನೆಲೆಯಲ್ಲಿ ಚೌಡಯ್ಯ ರಸ್ತೆಯಲ್ಲಿ ಸಾಲುಗಟ್ಟಿ ನಿಂತಿರುವ ವಾಹನಗಳು.

Fig-6 Heavy rain in Bangalore- Urban flood affects on 23rd November 2013 (Courtesy: TOI) (Reference -3)

The above Fig-5 & Fig-6 shows the flood related disaster in Bangalore city.

REFERENCES:

[1] India Meteorological Department, NOAA (1971–1990))

[2] Ramachandra T. V. and Pradeep P. Mujumdar, 2009, Urban Floods: Case Study of Bangalore, *Journal of the National Institute of Disaster Management*, Vol. 3, No. 2, April 2009, pp. 1 – 98.

[3] Time of India articles