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A Review of the Deterioration of River Musi and its Consequences in Hyderabad City

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Abstract

River Musi flows through Hyderabad city of Telangana State. It is a tributary of River Krishna. Lot of encroachments have taken place along the riverfront, which is causing slowly the shrinkage of Musi river. The river is is also getting highly polluted due to release of toxic chemical waste from industries into it. The consequence of which is seen as the flooding of the city during heavy rains and contmination of river water as well as ground water. Over the years, various initiatives have been taken by the respective governmentsfor the revitalization of the Musi river. This paper reviews the changes that took place in the study area over the past few decades, their consequences and puts forward the solutions suggested by the researchers and environmentalists for the rejuvenation of the Musi river and their implementations by the respective agencies.

Keyworks: *Musi River, Encroachments, Urban Flooding, Contamination and Revitalization.*

1. Introduction

Due to urbanization and exponential population rise, urban flooding has become a common occurrence these days in India. A number of metro cities in the country including Mumbai, Chennai, Delhi, Bengaluru and Hyderabad have suffered from it. In the last five decades, Hyderabad city has spread in all directions. Additional roads, establishments and structures crop up daily. With the urban development, housing colonies have come up. There is a lot of difference in the design of urban localities built at the beginning of the last century and today. The narrow lanes and roads, become rivers when heavy rains due to depressions, cyclones and cloud bursts occur. Hyderabad city consists of a good slope. Some part of the city is located at height and some parts that are closer to the Musi river are at a lower level. Naturally the flow takes place from a higher level to a lower one. Generally, Hyderabad city does not get flooded due to monsoonal rain, which is spatially spread for a large period. But during the last few decades, depressions and cyclones cause rain water which takes place for a few days or even hours. Due to which, more water gets accumulated in an area during short time. The same situation is created by Cloud bursts which casuses a heavy downpour within 1-2 hours. Therefore flooding of the cities can take place due to depressions, cyclonic rain and cloud bursts which is becoming a critical problem for major cities in India. The population as well as the size of the cities are increasing continuously. The natural way of flow of water from higher to lower regions is interrupted by new structures, markets, colonies, etc. Finding no way, the rainwater takes other routes and over the roads and streets of colonies. Upon that, if the roads are narrow then the flooding of the streets takes place and water may enter houses also. The need is to reduce the catchment areas in every colony so that the amount of water available to flow in a particular lane is considerably reduced(VP Dimri, 2020).

As the Environment Agency sustainable development Unit said in June 2001: “Major floods that have only happened before say, for every hundred years on average, may now take place for every ten to twenty years. The flood season may become longer and there will be flooding in places where there has never been any before”(Tiffany Means, 2018). The water way in cities has to follow a particular path as shown by large water systems that direct water where to flow. The basic philosophy of urban drainage system for storm water management for redirecting water flow has been to get the optimum benefit at an individual site by the quick exit of excess surface water after a rainfall and the containment and disposal of that water as quickly as possible through aclosed/ Open conveyance system. In other words, "get that water out of here NOW" has been the overlying philosophy of creating drainage systems in urban areas(Urban Food Risk Management - APFM , 2008).

Hyderabad city has experienced the floods in September 1908, which caused death of 15,000 people and made innumerable one homeless. The occurnce of this flood prompted the Nizam to build flood mitigation structures, including the creation of boundary of the Musi banks in the city and creating two reservoirs on the upstream region to Hyderabad city to stop and contain the hige waters due to rain. But now the river Musi river which flows through Hyderabad is shrinking slowly and vanishing, getting polluted due to the surrounding activities. The Musi river is transforming into a huge sewer and getting filled up with garbage and industrial waste from the city, and being continuously neglected over a period of time has got the name of the most polluted rivers in the country.(Harsha Sai, 2016)

Activists argue that far from modernising such mitigation measures, over the past few decades, successive governments have overlooked the developments taking place along the riverfront, the rapid encroachment of waterbodies, hundreds of lakes and the Musi river bed itself. According to the report "Overcoming Barriers to Urban Flood Resilience: A Case of Hyderabad, India," the total build up area in the city was 17,092 ha in 1964, which increased to 45,550 ha in 1990 and to 86,535 ha by 2015(Prasad Nichenametla, 2020)

2. Musi river and Hyderabad city

Fig. 1 Krishna basin, Musi river and Hyderabad city

Musi River or Musinuru or Moosa River is a tributary of the Krishna River in the Deccan Plateau flowing through Telangana state in India. Hyderabad City exist on the banks of Musi river, and this river divides the historic old and new city. The Hyderabad city is divided into the south and north by River Musi. The city was founded on the banks of this river by Md. Quli Qutub Shah, the fourth ruler of the Golconda kingdom. The River Musi starts from Anantagiri hills in Vikharabad district situated at 661 metres above mean sea level. It flows for 70 km and meets the reservoirs of Osmansagar & Himayatsagar, which were erected on Esi (its tributary) and Musi respectively. These reservoirs are used as source of supplying water for Hyderabad city. Mir Osman Ali Khan, the VII Nizam constructed these reservoirs after the deluge of 1908. Sir Mokshagundam Visvesvarayya, a renowned civil engineer has planned and designed these reservoirs. Osmansagar has a storage capacity of 110 mcm (million cubic metres) a watershed of 738 sq. km. The Himayat Sagar has a storage capacity of 84 mcm and watershed area of 1311 sq. km.

Musi river takes the east direction path in city from these reservoirs. On the lower side of this stream there are 24 diversion weirs, locally known as kathwas, starting from Uppal Kathwa. It was planned to irrigate 25000 acres under these irrigation structures, but this was enhanced to 87000 acres due to large quantities of sewage that gets into the river from the urbanised area of Hyderabad. In 1963, a huge reservoir was erected on this river at Suryapet at about 216 km from its start point, where Aleru, joins the Musi. About 30183 acres of land is estimated to be irrigated under this reservoir. At about 40 km down from Suryapet, the River Musi meets the River Krishna at Wazirabad,. That makes the total length of Musi to be 256 kms. In the city the river takes the slope of 2m per km. Conservation of Musi has assumed relevance only in recent years. Until the 1960s, Musi River was looked at from the point of view of a river flowing through the Hyderabad city and as a means of water source due to the creation of reservoirs on it.

3. Diminishing waterbodies

The study by Vikas Sehra and Milap Punia of the Centre for the Study of Regional Development, Jawaharlal Nehru University, says that " The people of Hyderabad are at more risk during floods, due to construction works on the lake and the riverbed. Waterbodies in Hyderabad reduced from 2.28% to 1.64% between 2001 and 2016. During the period, 2001 to 2015, in Hyderabad city, 84.61ha of waterbodies are being encroached upon every year. The steps taken up by the Government for river line rejuvenation such as Nandanavanam project in 1997 and Save Musi. The recommendations of Kirloskar committee after the August 2000 floods, like removal of encroachments, broadening of sewers from 40 to 60 feet and a nine feet buffer zone around the nalas were not implemented. (Deccan Herald, Oct 13, 2020)

In 2017, municipal administration minister K T Rama Rao stated that it is not possible to implement the expert committee recommendations of demolishment of nearly 28,000 structures, for which Rs 12,000 crore compensation must be given. Instead, the Greater Hyderabad Municipal Corporation (GHMC) officials were asked to demolish of few dilapidated buildings after a heavy rainfall, by the minister. According to Prasad Nichenametla, 2020 as the GHMC is not allowed to work properly, and due to lack of a holistic, sustainable approach such devastations will be occurring again and again," says Prof Purushottam Reddy, a noted environmentalist.

Anand Vishwanadha, 2020 states that it is a big lie that everyone has bought as it does not rain so much in Hyderabad, but history tells us otherwise. While the overall slope of all the localities in Hyderabad remains

the same, almost all the nalas, storm drains, culverts are gone due to either land-filled and built over or simply filled with garbage, detritus and forgotten. So, the water which is used to flowing in a particular way has no choice anymore but to flow in city.

4. Flooding of Hyderabad city

Musi River was the cause of frequent flood devastation of Hyderabad city. From 1572AD, floods have occurred eleven times in Hyderabad. The magnitude of rainfall was 153.2mm in September 1908 due to which 15,000 people were dead and over 80,000 were made homeless. About 600,000 people were affected by the river's devastation. Clogged up drains, unauthorized encroachments of Musi riverbeds and development along riverbanks caused blocking of natural drainage and further reduced storm water drainage capacity of the urban areas.

Table 1. Year wise record of heavy rainfall events of Hyderabad city

YEAR	RAINFALL(mm)
Sept2,1908	153.2
Aug 1, 1954	190.5
Aug, 1970	140
Aug 24, 2000	240
Aug, 2001	230.4
Aug, 2002	179.4
Aug, 2006	218.7
Aug, 2008	220.7
Sept, 2016	215
Sept, 2019	132
Sept, 2020	192

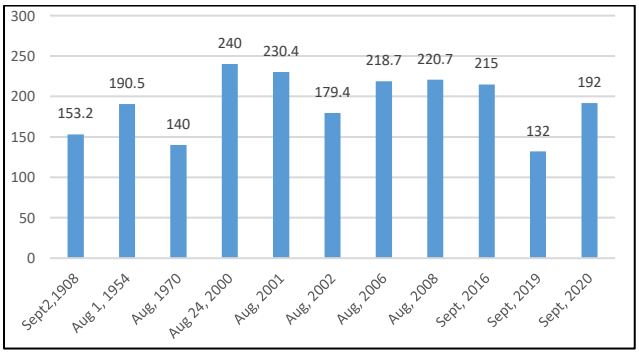

Fig. 2 Highest rainfall record of Hyderabad city

Hyderabad city with a population of around 3.82 million (2001 Census) and spreading over an area of 55sq km. It experienced unprecedented flooding in August 2000 leading to massive property damages and some human loss. Mohd Safiullah, 2020 expressed that there are no more statesmen but only politicians. Hyderabad's administration was better in 1900's when compared to todays as after the 1908 floods, amends were made. Sir Visvesvaraya was asked to study and recommend measures to take care of the impact of floods on the city. At that juncture, two reservoirs, Osman sagar and Himayat sagar were recommended and constructed to act as flood control centres. The drainage system with the modern technologies was constructed. After that the August 2000 rains created a devastation. This flood became the worst one after 1908 with magnitude of 469 mm rain. During these rains, about 90 residential areas were inundated. No doubt, the committees were formed, reports were submitted, and review meetings were held, but there was no outcome of it. He stated that there are no more far-sighted and efficient statesmen, but only politicians.

Anant Maringanti 2020, the urban geographer and director of Hyderabad Urban Labs stated that 'A whole new city is built on top of an agrarian imprint, and it's all forgotten. It is to be understood that Hyderabad is a system of catchments. The western region of the city, i.e., from Kukatpally, Ramchandrapuram, to Gachibowli lies in Godavari River basin and the eastern part of the Hyderabad City lies in Krishna River Basin. The Deccan plateau region, of which Hyderabad is a part, has a chaotic drainage pattern. The surface water in this region does not flow in a single direction as there is multiple direction slope. For the last few decades, this agrarian imprint is taken up the drastic developmental structures. The water bodies were bordered by Road without leaving any buffer areas. A very good example of such an activity is the Necklace Road. The real estate developmental activities have increased rapidly in the command area and in the foreshore of tanks.

The lakes are fed with a diet of garbage, sewage and are made sick, mainly due to the mismanagement of the waste. There will be a certain water holding capacity of a water body , which with time if is filled with the industrial waste and sewage will be reduced and hence the capacity of the lakes, vertically will be affected. And so, waterbodies or lakes will not be having their original 'full tank limit' anymore. The officials also stated that the FTL is reduced by half, since the rest is filled with silt. (Dr. Lubna Sarwath, 2020)

5. Pollution of the River

The growing of urbanization and industrializations are main causes of Hyderabad city and Musi river's pollution due to exponential populace explode. The riverbed and the bounds of lakes are encroached, and a few are disappearing and the population and their unorganized offerings together with electroplating, leather tanning, engineering, oil extraction and commercial processing are heavily polluting the tanks, lakes, and River Musi. The river has become a receiver for the untreated sewage and contaminated industrial water due to unsystematic urbanization and lack of planning. The city-based Forum for Good Governance

has stressed on this point in the PIL filed with High Court in Hyderabad.

"The ground water is getting polluted due to infiltration of chemical waste which gets into the river from industries. When the same water is used by people their health will be adversely affected," says Jasveen, co-convener of civic group Save Our Urban Lakes(SOUL). The common effluent treatment plants (CETPs) which have been set up to treat effluents from industries are not able to do so efficiently with the chemicals ending up in the river.

In March 2020, Minister for Municipal Administration and Urban Development KT Rama Rao said that 51 nalas on the 30km stretch of Musi which runs through Greater Hyderabad releases sewage directly into the river. Only 605 MLD of the 1,250 MLD sewage generated is treated. The rest reaches the river untreated.

M Padmanabha Reddy, the Secretary of Forum for Good Governance says that the River Musi is still polluted due to the methodology of interception and diversion adopted by the Government. The water coming into Musi river was intercepted by using check dams and diverted to Amberpet area where sewerage treatment plants would remove the contaminants after which the water is directed back into the river. This technique could work out only for a short period. The Greater Hyderabad Municipal Corporation (GHMC)had invested Rs 50 crore in the construction of a rubber dam near the Hyderabad High Court to separate waste from water. The water was getting accumulated at the rubber dam and caused a stink in the area and promoted breeding of mosquitoes. So, this methodology had to be stopped after receiving complaints from the residents of that area. According to Reddy, the Telangana government is yet to come up with a proper plan for Musi's conservation. He also states that, the Government does not realize, that the waters of the Musi are tied to the people of Hyderabad.

6. Water (or lack of it) in Musi River

The environmental expert Vedakumar, president of the Forum for Better Hyderabad, states that there are many reasons for Musi river not carrying water. These include degradation of the catchment of Musi upstream in Vikarabad, impounding of water at Osman sagar and degradation of their immediate catchment area, change in drainage pattern of Hyderabad affecting free flow of water into the Musi from various directions, and disturbing the linkages of several tanks in the region and their occupying with time.

Till about two decades ago the Osman sagar and Himayat sagar were overflowing into the main river during the monsoons. In extreme cases flooding would occur and the river would get washed up. During the normal rainfall period, these two reservoirs are not reaching will not reach their full reservoir level. The major reasons of the deterioration of the catchment of the two reservoirs are building of thousands of check dams within the catchment area, indiscriminate plotting of the catchment area by the real estate players, changing land use and changing agricultural practices like converting fallow lands to agriculture, and shift from rainfed crops to irrigated crops etc. The quarrying activities in the catchment area will divert some of the feeder channels.

Fig. 3 View of shrinking Musi river

There is hardly any water flowing into the Musi. The river water flows rapidly downstream during rainy seasons. Water can be seen only at the kathwas or at the reservoir at Suryapet. Whatever the water that is found in the riverbed in the form of a small stream is the sewage/drainage from Hyderabad city. Large parts of the urbanized area do not have underground sewer systems. Many settlements have septic tanks which is not a good system of disposal from a long-term perspective, or there is single line for sewerage and storm water. Thus, many natural storm water drains have been carrying domestic sewage into the river. Compounding to the problem immensely are the industrial effluents which are treated only partially and retain harmful trace elements which enter the food chain. The CETPs (Common Effluent Treatment Plants) are a typical case of a system getting away with murder due to official connivance. The two CETPs present in the Hyderabad urban agglomeration have not been functioning to their capacity.

The Musi river has been reduced to a sewer drain carrying the domestic and industrial waste generated in Hyderabad city. This has had an adverse impact on the river ecology and the villages in the downstream of the river. Even today, the government's approach to the conservation of Musi is piece-meal in nature and not integrated. The future water security of Hyderabad city lies in an integrated management of the entire catchment area of the Musi river and several water bodies that are still existing in and around the city.

7. Musi Riverfront Development Projects

Various projects for rejuvenation of the River Musi have been taken up from time to time over a period, at different situations, but were not successful completely. The Great Musi Flood of the year 1908,

was the most devastating flood for the city. To avoid that type of floods, the reservoirs Osman Sagar and Himayat Sagar were constructed in the year 1920. These reservoirs prevented the occurrence of flood, and became a source of drinking water for the city.

The next initiative taken was the Nandavanam Project, according to which the government's focus was to beautify the Musi River. The relocation of people living along the river side to another site nearby was a part of this project. Through this Nandavanam Project, 20m wide channels were constructed into the river basin, to control the flood waters. But this channel could not be used after the occurrence of the flood in the year 1999. Also, two 20 m wide roads were built along the river on the North and South Banks. In the year 2000, the then Chief Minister declared, in the Legislative Assembly, the Nandavanam Project to be invalid.

After 1999 flood, the people residing along and downstream of the river initiated the Musi Bachao Andolan. The common people could raise their voice through the means of various civil societies, environmentalist and CHATRI.

The National River Conservation Directorate (NRCD), the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) and the Greater Hyderabad Municipal Corporation (GHMC) launched the Abatement of Pollution of Musi River project, in the year 2005, under the National River Conservation Plan. The beautification of the river and construction of sewage treatment plants to treat the sewage before the water enters the river were the main part of this project. The project missed the 30-month deadline and the construction of Attapur village has been delayed.

Again, in the year 2006, the Save Musi Project was initiated, to revitalize the heavily contaminated river to its original glory. The streamlining of the traffic flows to improve the east-west corridor through the city was also an objective integrated into the master plan. The complete Musi river front was to be transformed with gardens, rock formations, new bridges, and pedestrian zones. To stop the flow of the sewage into the river, several new sewers and sewer treatment plants were included. But this project came across protests in acquiring land and ran into a litigation with the residents of Ramanthapur village (Rohit 2012). After multiple delays and missed deadlines, nothing much had changed under the Save Musi campaign.

Rubber dams were constructed by the Greater Hyderabad Municipal Corporation (GHMC) in the year 2009, to develop a stretch for boating and water entertainment, which was not a plan of the initial plan of Musi River Revitalization Project. There was a delay in upstream STP in Attapur and this made rubber dams inoperable and downstream STPs ineffective. Due to the non-functioning of Attapur STP, the dams could not be used since the brief trial run in 2010.

A new Master Plan for the Hyderabad's Core Area was planned in the year 2010, by the Hyderabad Metropolitan Development Authority (HMDA) according to which, the land use and infrastructure requirements were designated an area of 172 sq. km. The particularity of this master plan was it recognizes the potential of the riverbanks to create a new major east-to-west connection through the city. According to this master plan two 80' wide roads were to be constructed parallel to the river.

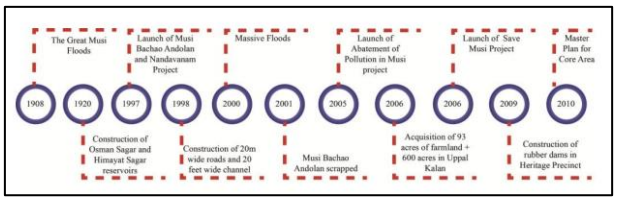

Fig. 4 Timeline of Musi Riverfront Revitalization Project(1908-2010)

The figure 4. shows the developments and important milestones of the Musi River Revitalization Project. The restoration work of Puranapul was carried out under the Inclusive Heritage City Development Plan (IHCDP). And several promenades, boulevards and parks are being developed along the Musi River under the Inclusive Heritage City Development Plan.

The recent project that was planned by the government was in 2017, by setting up the Musi Riverfront Development Corporation. The project guidelines were completed in February 2018 and a drone survey was completed in March 2018. The main purpose of the project was to rejuvenate the Musi river for a stretch of 57.5 km. A Musi Corridor with east-west connectivity by building a skyway was also proposed to be constructed. Additionally, river conservation and beautification from the outfall of Himayat Sagar and Osman Sagar on the west to the Outer Ring Road at Gowrelli on the east is also part of the project (Siasat Daily 2018).

Nabinder Bommala, 13th July 2021, states that members of the Musi Riverfront Development Corporation Ltd (MRDCL), the wing formed exclusively to rejuvenate the water body, say that by 2024, the smoothly flowing waters of the Musi will be dotted with boats after the launch of the mega project by the Chief Minister of Telangana State, which will be executed through two master plans. The first master plan is the Musi Action Plan, which aims to get back life to the water body and the second master plan deals with the Musi Road Development Plan to develop infrastructure in and around the river. This mega project includes construction of 13 bridges and 63 sewage treatment plants. A number of already planned

works alongside the water body that were neglected for decades were taken up.

Fig.5 Musi river stretch from Puranapul to Nagole (Source: Telangana Today)

Consequent to the initiation of this mega project, bushes have been removed, walking tracks were built, extensive greenery has been developed and tonnes of debris were cleared from Puranapul to Nagole as seen in the figure 5. To prevent the mosquitoes breeding along the river front of River Musi, anti-larval operations, extensive fogging and spraying of chemicals using drones is carried out. To large extent the efforts of the State government are showing good results. There is a drastic change in the part of the River Musi flowing across Nagole, which was earlier in a very pathetic condition. This length of the river was the filthiest place with people avoiding it due to the bad smell and risk of vector-borne diseases. After revitalization, the same area became a good place among locals and joggers.

8. Solutions for Hyderabad City

Many options are available that can combat these effects. The overview of the total sewerage system is to be done and just nalas. The entire city should be considered as a catchment area and the vacating of the most critical areas of encroachments is to be started. It looks like a cumbersome process, but it requires only an intelligent readjustment. For all this to be implemented, an executive and 'ecological' body like a "Lakes and Parks Authority", is needed which can call on correlate with various sections of HMDA, GHMC and departments like revenue, irrigation, roads, and buildings (Anant Maringanti, 2020).

In the short term, the natural path of water drainage from high altitude to a lower one should be traced. These routes have been blocked or encroached due to rapid urbanization, with the city becoming a patchwork of lanes and by-lanes, resulting in larger catchment areas. The main thought here is to lower the catchment area, which may get less rainwater over an area. The areas getting the rainfall water through it can be reorganized by doing good subdivisions into columns and rows. At some locations, the existing buildings need to be relocated. In the long term, an underground drainage system should be constructed to flush rainwater from any place, whether it is at a high or low elevation, till the final place of discharge, like the Musi river in Hyderabad's case. Since the long-term solution may be costly and time-consuming, it is advisable to use a combination of both, short-term and long-term solutions. These recommendations apply to the city of Hyderabad having many lakes that are interconnected due to its topography and geology. This is not valid for other Indian cities. The geology of an area is thus an important factor to mitigate the impact of urban flooding(VP Dimri , 2020).

In an overview, the changes in the Musi riverscape brings forward the strength of social and political forces that work to put people to use. The new liberal thinking of common urban people and technocratic visions breaks the link of their political, historical, and social identity which causes ecological degradation.

9. Way Forward Towards Ecological Sustainability

According to Ramachandraiah 2007, innumerable collaborators associated with housing, livelihoods, and environment would be affected in any (re)development of the Musi. The present scenario requires the inclusion of several narratives, rather than proceeding with only single technocratic consensus under the rubric of development agenda to normalize the control of urban commons. Struggling to make sense of complexities in a city, techno-managerial solutions are a simplistic fallback option. In the process, as Jane Jacobs (1961) notes, "Nature, sentimentalized and considered as the antithesis of cities, is apparently assumed to consist of grass, fresh air and little else, and this ludicrous disrespect results in the devastation of nature even formally and publicly preserved in the form of a pet." The lens of Musi riverscape highlights the need to bring the ecological and social aspects of sustainability at the centre of the planning process. Fortunately, there is a growing sensitization among the authorities concerned to have demarcation of maximum flood levels, to improve capacity of STPs, and to protect river from encroachments and indiscriminate waste disposal. The way forward is the realization of negative externalities of mindless accumulations and the real tragedy of commons. With the realization that the waterbodies are a part of network, any activity to disturb the flow of even one waterbody will create a negative impact on the whole river system. Hence, there should be a substantial plan for the catchment area and its linked water bodies, rather than focusing only on river front beautification. Such understanding by all the associated people will educate the urban commons to move towards socioecological sustainable, bottom-up and participatory governance of commons.(Vikas Sehra, 2020)

Conclusions

Urban water bodies in India have been a victim of unplanned urbanization, due to which encroachment, disposal of sewage and groundwater decline have become common. The management of storm water can be effective only if it is implemented in conjunctive manner. To find a solution to this problem, a multidimensional approach is to be adopted. For the recent case, some of the management options which must be carried simultaneously to address the problem are:

1) Maps of the areas which are risky should be prepared to assess the vulnerability, related to urban floods, using GIS Technology.
2) Limit, reduce and/or mitigate for impervious surfaces throughout the watershed by use of new engineering techniques like pervious pathways, pervious parking lots should be considered and implemented wherever possible to minimize the surface runoff.
3) The areas demarcated to prevent encroachments should be inspected regularly by the Town Planning department of GHMC to prevent the new encroachments.
4) The regions which act as recharge should be safeguarded. Utilize conjunctive management to enhance groundwater storage, in some cases, the surface water can be diverted towards groundwater infiltration areas which will also help in mitigation of flood by reducing peak flows.
5) The recharge of ground water and pollutant attenuation should be implemented by removing concrete flood-control channels and exposing the underlying native sediment.
6) GHMC/HMWSSB should change its policy of charging amount for rainwater harvesting structures while according to permission to plan. They should keep this as a check point for giving occupancy certificate.

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