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Need and Scope of Stormwater Management in Chandigarh City

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Abstract**:** *Rainfall and snowmelt is the root cause of urban flooding. Precipitation that seeps into the ground or runs off the land into storm sewers, streams and lakes contributes to the urban stormwater flooding on a large scale. It may also include runoff from household level activities such as watering lawns, washing cars and draining pools. In India, heavy rainfall occurs only in monsoon season. But due to climatic change in recent years the rainfall pattern has changed adversely. Yet in urban areas, the miles of impervious surfaces have increased exponentially such that heavy rainfall for a short duration causes a flood like situation. Chandigarh is one of the best planned cities of the world, yet, monsoons instills fears in the hearts of the residents, even if the rainfall is for the short duration. Therefore, in this paper we have reviewed different papers by different authors and analysed various technologies used worldwide to reduce the flooding caused by stormwater*

Keywords: *Floods, Monsoons, Rainfall, Stormwater management.*

1. Introduction

Urban flooding is one of the costliest natural disaster in terms of both human causalities and damages especially in urban areas. Besides, the urban water infrastructure system is a complex and dynamic system which is constantly adapting to the changes in the urban environment, to sustain existing conditions and provide additional services. Chandigarh is one of the most well-designed city in the country. The city caters well for all the basic as well as luxury needs of people of the city. However, from the last few decades the population of the city has sprung up rapidly. Efficacy of a city is measured by its ability to deal and manage all the available water resources efficiently and to the best. Therefore, unless it is dealt efficiently, storm water runoff can cause problems and inconvenience. Also storm water is the leading cause of water pollution. In the past few years Chandigarh city has witnessed many floods especially in the low-lying areas like sectors 15, 19 and 35, besides villages of Kishangarh, Mauli Jagran, Bapu Dham (Sector 26) and Mani Majra. The storm water drains in the city are connected to the Sukhna choe and the N-choe. The tail ends of the drains have been constructed along the choe. The total length of the storm water sewer and its branch water sewer has been estimated to be 720 km.

Due to rapid urbanisation and increased impervious area the well graded system of the city faces problems outright.

General Layout of the UT

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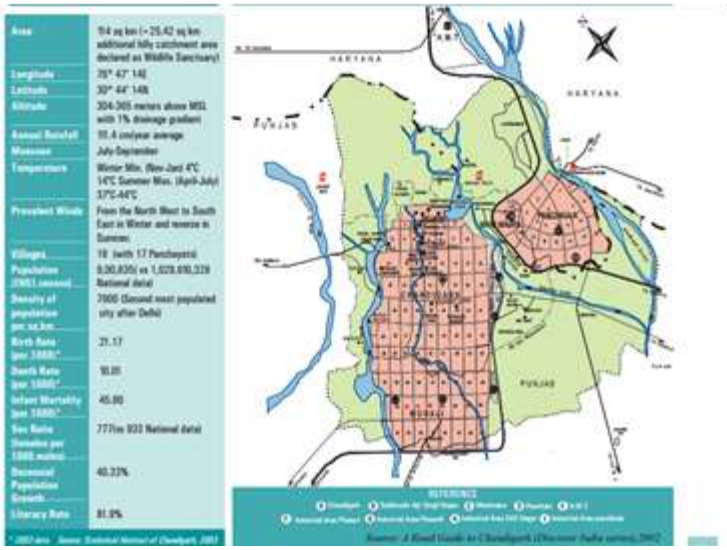

Fig. 1: Source: A Road Guide to Chandigarh (Discover India Services), 2002

According to Chandigarh Master Plan 2031, Reasons for Floods in Chandigarh

The key reasons for this situation are assessed as follows:-

- Some areas of city experience floods due to inadequate drainage system, which was designed for rainfall of 12 mm/hour excessive concentration of flood due to heavy down pour.
- Disappearance of flood absorbing 'N'- choe because of urbanisation.
- Dumping of debris and garbage into the open nallahs / N-choe.
- Illegal encroachment of natural water courses.
- Indiscriminate laying of service lines all along and across natural courses.
- Filling of 'N'- choe in Chandigarh which decreases the drainage capacity.
- Diversion of natural water courses to accommodate habitations.
- Increased run off due to increase in impervious areas.

Stormwater Management is also one of the most integral part of Smart City Model accepted and promoted by the government of India.

As per the Chandigarh Report "The storm water network collects water from the roads (15.89 sq. km), from rooftops of residential areas, (30.19 sq.km) from shopping areas (3.97 sq. km), public and institutional buildings (7.94 sq. km). This amounts to more than 70% of the total land area. The total quantum of water that would be available for recharge annually would be: 58 sq. km (area) x 1059.3 (rainfall) x 0.5 (rainfall coefficient) = 30720 million litres. (18.46MGD).This is equivalent to almost 90% of the total groundwater supply and this is available only from tapping the storm water drain network. By careful planning of recharge in the parks and green areas of the city, it would be possible to recharge the entire groundwater the city takes out."The ultimate goal of stormwater management is to maintain the health of streams, lakes and aquatic life as well as provide opportunities for human uses of water by mitigating the effects of urban development. To achieve this goal stormwater management strives to maintain the natural hydrologic cycle, prevent an increased risk of flooding, prevent undesirable stream erosion, and protect water quality.

2. Literature Review

Although trees appear to hold great potential in strategic urban Storm water management, Berland A.; et al. (2017)[3] suggested additional research is needed in four major areas: (1) documenting the performance of trees as a Storm water control with respect to species and life stage; (2) considering the influences of local soil, atmospheric, and landscape conditions when determining the applicability of trees for Storm water control; (3) navigating arboricultural challenges to situate Storm water control in the context of other urban forestry goals, for example, by maintaining diverse tree assemblages while choosing species that maximize Storm water control, and maintaining tree cover in the face of factors like tree pests and urban expansion; and (4) developing policy and economic mechanisms that encourage strategic tree planting and maintenance on public and private lands to promote cost effective management of Storm water runoff. During urban development, the land surface is changed from undisturbed soils with natural vegetative cover to disturbed soils, managed landscapes, and built materials. Malik U (2015)[6] says that the change in land uses causes the Storm water runoff from impervious areas to be as much as 16 times higher than from natural areas which implies increase of frequency of local flooding and more contribution to the streams carrying urbanized runoff. They used HEC-RAS, powerful, yet easy-to-use software package for determining water surface profiles in a wide variety of streams. The major findings through the publish are that the urbanization had led to flooding from past to present condition but due to construction of bridges at upstream locations the situation of flooding has been mitigated from past to present condition. The stream needs maintenance in terms of removal of encroachments such as debris, trees etc., erosion control, maintaining lining, rip rap etc and control of water quality of runoff. Rao Y. R. S.; et al. (2015)[10] made an attempt to do Storm Water simulations through the existing drainage networks of Patna and Chennai urban areas using Storm Water Management Model (SWMM). The input for the model was extracted from different sources and maps in GIS environment. Research found out that micro level drainage system is very poor and at many locations there is no connectivity to the macro level drainage system. Maintenance of the conveyance system is also very poor and people are less concern about the health of the system. The drains are chocked due to throwing of garbage and polythene bags, wastages of vegetable, fish markets etc. directly into it. Thus people need be awakened and attention should be given for renovation of the existing drains. This is very useful information and recommended for Best Management Practice (BMP) for design of sumps or ponds and also to decide pump capacity. The approach to sustainable stormwater management must be flexible and multidisciplinary, and consider law, economic, social and environmental aspects, among many others says Barbosa A.E.; et al. (2011)[1]. Best Management Practices (BMP) should also be seen as an opportunity for development and improvement of social, educational and environmental conditions in urbanized and nearby areas; therefore, it requires a wide perspective and the participation of different stakeholders. In addition to some limited knowledge about the potential harmless long-term effects of most recent alternative solutions, constraints in properly designing and implementing stormwater managing strategies may arise from current data gaps on the mobilization of organic compounds by stormwater. Such data gaps are of particular concern in the context of recent climate changes. Megdal S.B.; et al.; (2017)[8] stated a very important yet ignored fact that stakeholder engagement is an important tool in developing the common understanding of context that is necessary for making decisions that affect sustainable water management. Another theme threaded throughout these papers is the importance of legal, regulatory, and institutional frameworks in supporting or hindering the development of governance for sustainable water management. Frameworks that lack clear engagement goals or represent a restricted set of interests can limit participation to the detriment of management and governance processes and outcomes. On the other hand, frameworks can be catalysts for action. They can support processes that bridge interest divides and resolve conflicts and can be a source of forward momentum for the planning and implementation of water management and governance strategies.

3. Need and Scope As Inferred

- The study on Storm water management has been carried out in limited places in India. Since most of the study cases are on the foreign lands, lack of knowledge and furthermore lack of targets may lead to ineffective or less efficient drainage systems of cities.
- BMPs Play a very effective role in management of runoff. BMPs are preferred for their energetic hydraulic performance, but the operational and maintenance costs are very high depending upon the constraints associated. Each and every structural BMP Component shows sensitivity to changes in BMP Specification Inputs in a model.
- Though Urbanization has led to 16 times higher impervious areas but if the existing storm water drains are taken care of, they can be put in good and effective use to control flooding due to Storm Water.

Fig. 2: Source: Internet

- Tree Plantation and research on the various erosion control methods (as included in BMPs) have a tremendous effect on the control of floodsUnits
- Collaborations along with stakeholder, Government and Non- Government Organizations, though challenging but will help in overcoming various constraints. It will help in building up strategies and planning of the Management of drainage system and stormwater.
- Rain Water Harvesting in most of the research areas, is suggestively spoken of as a most economic and cost-effective measure to control runoff and flooding. If it is not possible on community level then we shall be looking for alternative methods which are effective at household level.

4. Recommendations

Fig. 3: Latest picture depicting 2017monsoons in Chandigarh

After reviewing the paper and the inferences drawn the following recommendations are being suggested:

(a) The city needs LID structures at the most problematic areas and rainwater harvesting technologies at the private properties so that the water from any private property does not flow onto the roads.
(b) The drainage network needs to be digitized and analyzed using a software, in which various BMPs can be applied and their pros and cons can be studied.
(c) A rapid water expulsion techniques needs to be innovated for high intensity rainfall duration.
(d) Besides looking into the fact that the existing drainage networks have to be changed for the good, attention should be paid to the maintenance of the sewer systems as well.

5. Conclusions

Flood management and techniques to reduce floods during monsoons is the call of the hour in India. Sadly, this sector is paid less attention to. We need to take a step forward to save the environment from monsoon floods before it is too late. Rapid urbanization and increase in imperviousness leads to decrease in infiltration and hence waterlogging. Runoff from the impervious areas also leads to the depletion of groundwater which is very vital for the survival of any city for long term. Therefore, until people are fully aware of the danger that is walking towards them head-on, any efforts by the government bodies will not sufficient to curb floods. The private sectors, government sectors and educational sector needs to work as a team to fight against monsoon floods.

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