

Impact of Anthropogenic Activities on Urban Ecology

A Case of Aurangapura Stream in Aurangabad(MS)

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Abstract— Urban ecology is one the very key element which defines an urban environment .The urban ecology is itself a complex interrelation of the humans and nature and also the impact of anthropogenic activities on the natural system. Due to rapid and insensitive urbanization and anthropogenic causes the complex interconnection is damaging ,thus affecting the urban environment and as a result rising the probability of disasters, resulting in losses which are difficult to recover. Aurangabad, a tier II city is the headquarters of Marathawada region in the ,sustaining a population of around 14 lakhs. The rate of urbanization observed in last two decades is phenomenal, thus in some cases insensitive and disturbing the ecological systems. Therefore this establishes the need to study and analyze the effect of urbanization on these ecological systems.

Thus the study aims to explore and identify various key ecological elements in an urban context, the anthropogenic factors affecting them and possible outcomes to conserve the systems while promoting healthy urban environment. The study will be taken forward through elaborating a case of a natural stream running across the urbanized area, in the Aurangapura area of Aurangabad, MH. Identification of the vulnerabilities and issues across the scales(from building to the catchment scale) will help in elaborating the argument further with generation of the primary data through multiple site visits. The nature of the proposed guidelines and possible tangible interventions will be outlined by the case specific, on ground observations and will also take into consideration the socio ecological resilience approach ,from the literature study.

Keywords—Urban ecology, socio ecological resilience, Aurangabad, water stream

I. INTRODUCTION

Urban ecology is one the very key element which defines an urban environment .The urban ecology is itself a complex interrelation of the humans and nature and also the impact of anthropogenic activities on the natural system. Due to rapid and insensitive urbanization and anthropogenic causes the complex interconnection is damaging ,thus affecting the urban environment and as a result rising the probability of disasters, resulting in losses which are difficult to recover.

The urban ecology is defined as ,”the study of ecosystems that include humans living in cities and urbanizing landscapes. It is an emerging, interdisciplinary field that aims to understand how human and ecological processes can coexist in human-dominated systems and help societies with their efforts to become more sustainable. ... Because of its

interdisciplinary nature and unique focus on humans and natural systems, the term "urban ecology" has been used variously to describe the study of humans in cities, of nature in cities, and of the coupled relationships between humans and nature. Each of these research areas is contributing to our understanding of urban ecosystems and each must be understood to fully grasp the science of Urban Ecology.(International Scientific journal).

II. SIGNIFICANCE OF THE STUDY

Since India set out on the path of liberalization, the cities in the country have started expanding rapidly ;in both economical and spatial terms. Maharashtra a western state in India ,has seen a dynamic urban growth. In the last two decades majorly the second tier cities of Maharashtra are under constant pressure of urbanization. Aurangabad the regional headquarter of Marathawada , is a major industrial hub .The city forms a crucial hub of trading due to its strategic location in the state. The city has seen a very rapid growth in terms of industry and economy in the past three decades. The population of Aurangabad currently is around fourteen lakhs .The decadal growth rate of the population is phenomenal in last three decades and averages around 80-85%. if compared to the average decadal growth rate of the Maharashtra state, which is around 40% ,it is almost double.

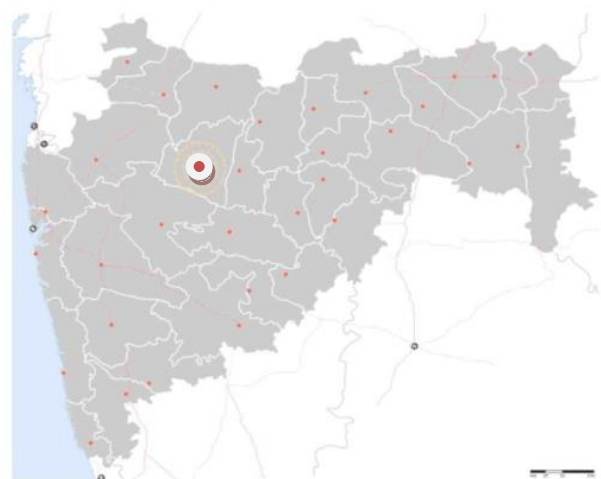


Figure 1:Location of Aurangabad in the state of Maharashtra
(Source:Author)

Multiple spatial implications of this growth can be observed in the city of Aurangabad. This rate of urbanization has certainly put on the stress on the existing ecological systems. Thus this establishes a need to acknowledge ,analyze and study the urban ecology in the city .This study thus will help us in building a case of conservation and rejuvenation of the urban ecological system through interventions at various scales.

III. METHODOLOGY OF THE STUDY

A. Aim

The study aims and explore and identify various key ecological systems in an urban context, and identifying anthropogenic factors affecting them and develop a structure to acknowledge ,conserve and rejuvenate the system at multiple scales.

B. Objectives

To discern relationships between various urban ecological systems

To examine the primary anthropogenic factors which are creating stresses on the urban ecological systems

To develop an format for cohesive conservation and rejuvenation of the existing ecological systems. (In this case ,the Aurangapura stretch selected for study).

C. Scope and limitations

Identification of the urban ecological system and analyzing the edge conditions to study the impact of anthropogenic activities on the urban ecological system defines the scope of the study. The geographical limitations based on the primary observations of the stream from the source helps in developing a nuanced perspective .The study will be geographically limited to the Aurangapura stretch of the stream.

D. Methodology

The methodology for the study is described as follows ,the method of site observations and primary data collection is used here to identify and analyze the vulnerabilities which paves the way for the interventions .These intervention thus helps in understanding and establishing urban ecological systems and their related components. The hydrology of the complete district is studied through mapping by the use of satellite images .Then the rivers in the city flowing through the urbanized areas are marked .After physical site visits to all the streams the aurangapura stretch is finalized based on parameters of the study and local interactions.The site and the surrounding is then analyzed to find out the anthropogenic vulnerabilities and their impact at various scales .The intervention suggested are thus cohesive n nature across various scales.

The analysis of the urban ecological system needs to be done at multiple scales. In the due process the four different scales

are identified for mapping of vulnerabilities .Interventions are the outcomes of the socio ecological aspect.

The Method of data collections is on site visits and surveys and primary observations by the authors.

Demonstrations of the strategies suggested in structure plan is done to illustrate the tangible interventions.

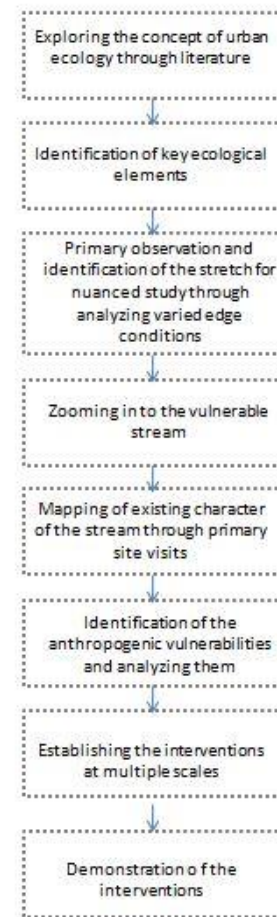


Figure 2: Methodology of the study(Source:Author)

IV. INTRODUCTION TO THE SITE

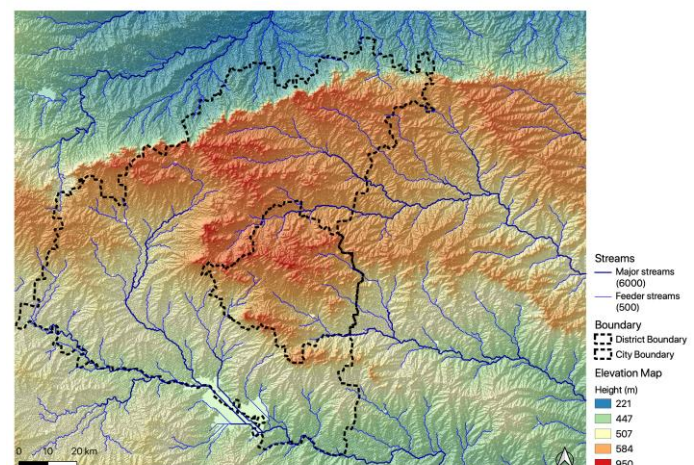


Figure 3: Hydrology of Aurangabad district(Source:Author)

The Aurangabad district is the central district in the state of Maharashtra .It falls on the leeward side of the mighty sahyadri mountains ranges. The sahyadri's acts as a barrier for the moisture carrying winds(monsoons),thus leading to the scanty rainfall on the leeward side. Thus Aurangabad features a semi arid climate and has thorny and deciduous vegetation. The district lies mainly in the Godavari river basin .Presence of significant hilly terrain in the district creates a intricate network of strems and rivers .The city of Aurangabad lies in basin of kham and sukhna river .There are multiple streams connecting to feed these rivers .Due to the multiple anthropogenic activities these streams are converted into nallahs ,thus degrading the healthy urban environment and creating stress on the ecological systems.

After primary observation of all the streams across the city brings us to the aurangapura stream ,which is converted into a nallah and has a critical condition and struggling for existence thus also possessing a threat to the dependent habitat. Thus this highlights the need of mapping and analyzing the edge conditions of the stream.

The stream originates within the city and acts as a feeder to the kham river.and cuts across the major aurangapura area of the core city .The stream flows through a dense fabric which is majorly the old city of aurangabad. There are multiple activities across this stream .and the point to bring to notice that this is the same area which also lacks open spaces and any green cover and has one of the highest density of population across the city.

The map(fig 04) highlights the two different cathcmnts .The left side catchment is of the river kham,while the right side indicates the catchment and flow of river sukhna.We can also observe that the highlighted streams flow through an dense urbanised area,where human and ecological interaction takes place ata large scale, thus creating a need of enquiry of the existing scenario.

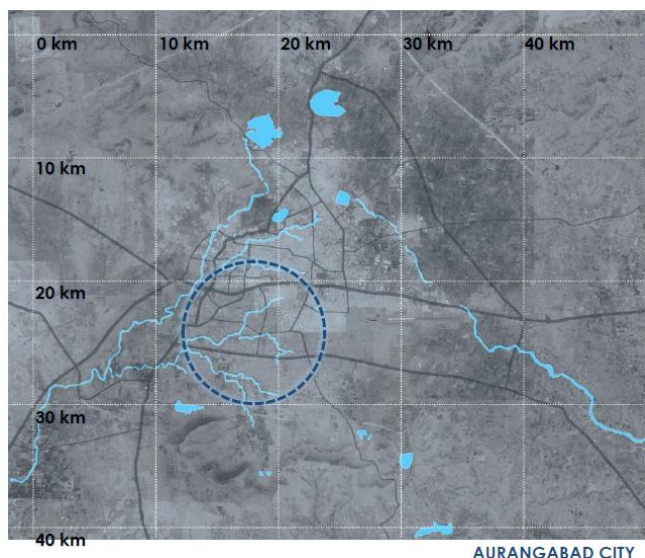


Figure 4:Aurangabad city hydrology(Source:Author)

The map illustrates the extent of the Aurangapura stretch .The study of edge conditions through primary site observations

brings us to the mapping and identification of the vulnerabilities caused by the anthropogenic activities



Figure 5:The Aurangapura stretch of the stream(Source:Author)

V. MAPPING OF THE SITE

The mapping of the site across various parameters is done to understand the character of the stretch and also thus leading to the identification of the vulnerabilities

A. Identification of the existing fauna

During the observation it was found that the edges of the strems are home to many species of mamales ,reptiles and insects .Various types of plans were are seen along the course.A peculiar noting of the existing species was done which is as follows The map illustrates the presence of the existing fauna on along the course .thus this brings us the conclusion that the habitat are still retained but are vulnerable to the continuous anthropogenic pressure.



Figure 6: Native fauna(Source:Author)

B. Ownership pattern

The mapping of the ownership patterns helps us in identifying various stakeholders living across the edge of the stream .this will help in a identification of the land parcels for interventions.The ownership map illustrates the major land under the private and multiple ownerships.

C. Building uses

This building use mapping hpls in knowing the various building use across the stretch as well as the activities and their types cn also be seen here.The major building use observed in this area is residential and commercial type.there is also presence of mixed use typology in the stretch.

D. Primary road network

As the area has a dense fabric ,the roads and nodes also act as public realm and also a continues open space across the fabric.The identification of crucial nodes and primary road network helps in understanding the traffic flow.Roads also contribute to impervious surfaces due to recent concrtization.

vulnerability Map

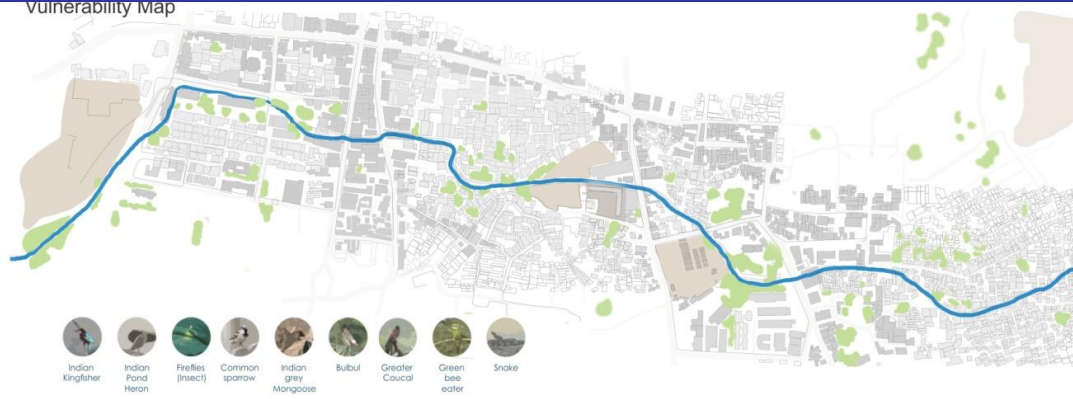


Figure 07: Native species

(Source:Author)

Ownership Map



Figure 08: Ownership Map

(Source:Author)

Building use map

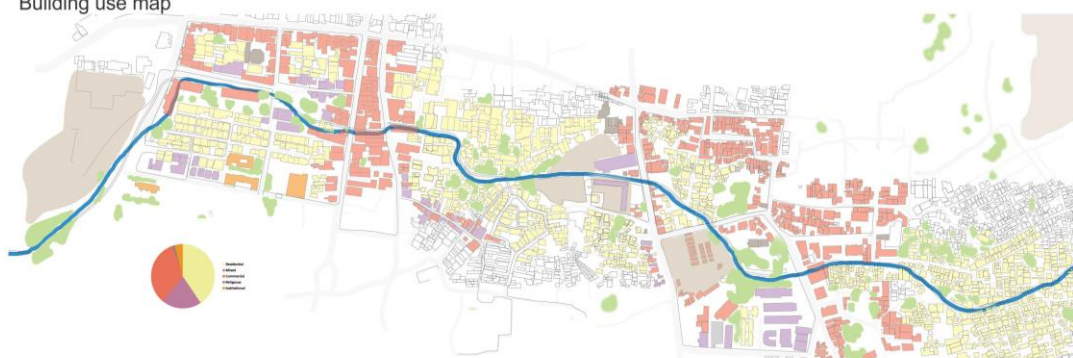


Figure 09: Building use map

(Source:Author)

Roads and Nodes



Figure 10: roads and nodes map

(Source:Author)

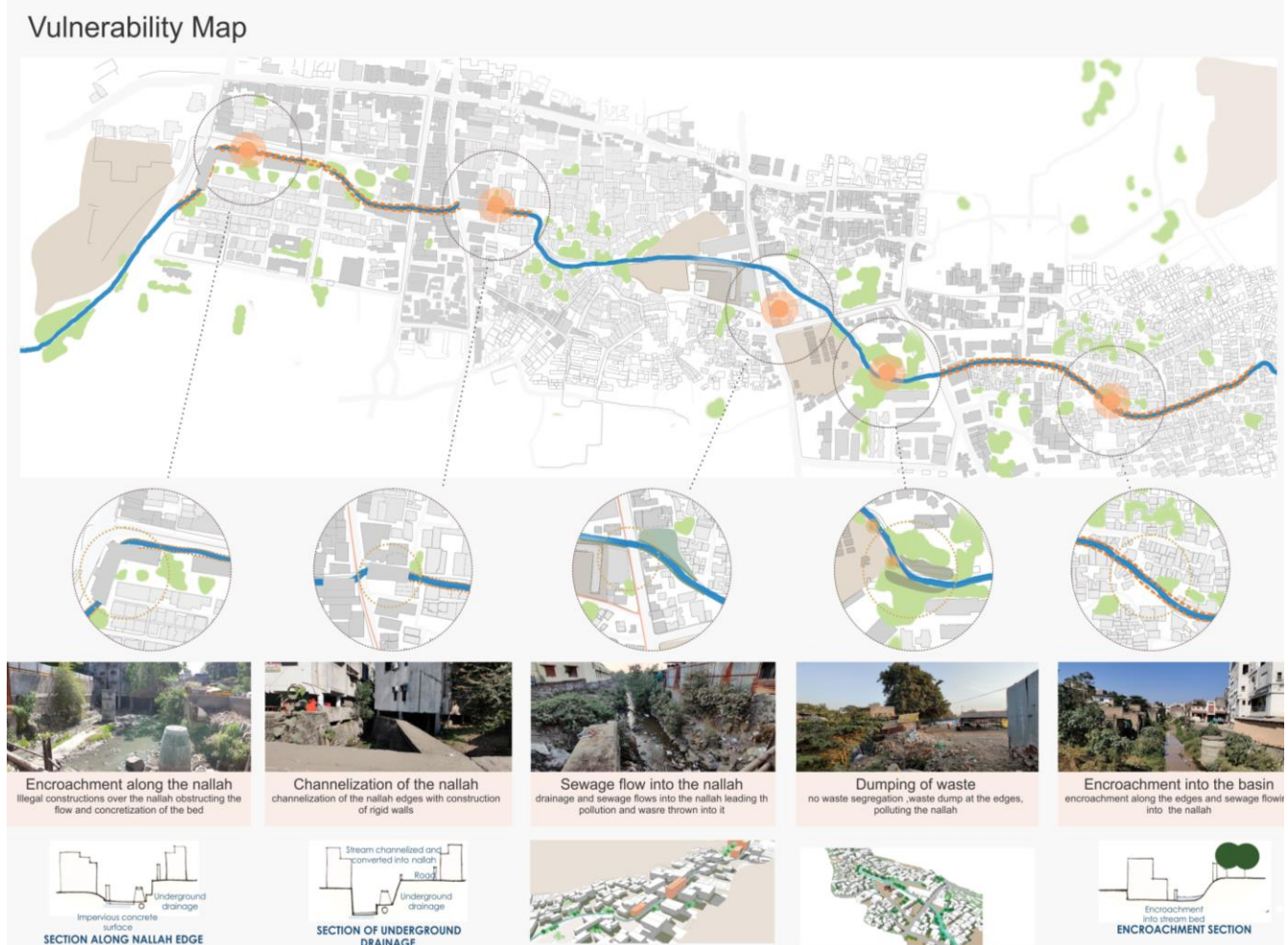


Figure 11: Vulnerability Mapping (Source: Author)

VI. MAPPING THE VULNERABILITIES

While mapping the edge condition of the stream various vulnerabilities can be identified .

There are five different crucial spots which are studied further based on their intensity of the vulnerability ,the above map illustrates the various anthropogenic vulnerabilities .The mapping is supported with on site photographs and an illustrative diagram to have an nuanced vision.

- Encroachment along the stream

There is presence of multiple encroachment along the edges of the stream and also in the basin thus disturbing the flow of the stream .The encroachment ranges from large commercial complexes to small residential units.

- Channelization of the stream

The flow of the stream is channelized at some places with creating walls along the edges ,and destroying the soft edges of the stream ,which are a crucial habitat for the native fauna. The newly laid underground sewage system also occupies space in

the basin reducing the water carrying capacity in the rainy season leading to localized flooding

- Sewage flow into the stream

The direct flow of the untreated sewage from the building along the edges creates pollution and degrades the soil and water. This water then directs leads to the kham river which flows to meet the godavari river.

- Dumping of waste

The open ground around the stream is used a dumping ground by the nearby residents creating an unhygienic and unhealthy environment. This can lead to spread of chronic diseases, and create pollution in multiple ways .Thus this can have an short as well as long adverse effect on the urban ecological systems and at the same time on human health.

- Concretization of the edges and basin

Due to passing of sewage lines from the basin the base of the basin is concretized to create a flow .this reduces the porosity of the surface and also reduce the ground water seepage .

Table 01: Analysis of the vulnerabilities at various scales (source:author)

Scale	Vulnerabilities	Impact
City	The Population pressure, concretization, Destruction of natural vegetal cover, Degeneration of wetlands and natural water bodies	Lack of acknowledgement towards presence of the urban ecological system
Catchment	Concretization of the surfaces Lack of integrated sustainable development policies. Loss in value and association with the water Systems.	Non porous surfaces lead to poor ground water table and water scarcity, and increasing local temperatures
Neighborhood	Improper and inefficient sanitation system. Inefficient policies for sensitive environmental development.	Absence of healthy open spaces
Buildings	Encroachment in the basin changing the flow, and loss in habitat	Loss in native flora and fauna, degrading the microclimate

Further the observed vulnerabilities can be then classified at four different scales and their impact assessment is done .This assessment helps us to identify the realm of intervention at different scales .

VII. THE WAY FORWARD: INTERVENTIONS

The interventions are also suggested at four different scales and prioritized based on the intensity and impact of the vulnerabilities. All the interventions are interconnected and are the part of the larger strategy of acknowledging the presence of the urban ecological system at the primary level .

Awareness generation and building community capacity also forms the larger goals of the strategy .

Permeable roads and sidewalks, green roofs, wetlands and natural vegetation absorb, infiltrate, store, purify, drain and manage rainwater.

A. Formulaion of the structure plan

The structure plan illustrates the cohesive vision for rejuvenation of the stream and the tangible interventions that are suggested for the same. The strategies are governed by the socio ecological resilience perspective .

Promoting porosity and urban open spaces is the key aim outlined in the structure plan .Spaces within the cities like streams converted into nallah are often overlooked and termed as non spaces due to limited accessibility and visibility .by converting certain spots into spaces tht focus on cohesive human and nature interaction could have dual impact

Table 02: Table showing Suggested interventions and their impact (source: author)

Scale	Interventions	Impact
City	Retention basins and urban wetlands, through sponge and porous city	Promoting porosity and corridor for biodiversity
Catchment	Bioswales and plantation of native species, continuous green corridors	Enhancement of ground water table and retention of existing flora and fauna
Neighborhood	Bioswales ,vegetative buffers ,permeable surfaces, guidelines for ecology inclusive development	Introduction of healthy open spaces and sensitive vision for the development along the water streams
Buildings	Terrace gardens ,green roofs, permeable surfaces, waste segregation systems	Enhancement of the microclimate and creation of healthy open spaces

- Breathable areas within the dense fabric
- Conservation of the existing urban ecosystem.

B. Demonstration of the interventions

The tangible interventions are under four different heads

- Bioswales
Bioswales are vegetated, shallow, landscaped depressions designed to capture, treat, and infiltrate stormwater runoff as it moves downstream(NACTO)
- Bioparks

The socio ecological system approach emphasizes that people ,communities, economies, societies, cultures, are embedded part of the biosphere and shape it ,from local to the global scales. at the same time people, communities, economies, societies, cultures are shaped by ,dependent on ,and evolving with the biosphere(clark and munn 1986, folke et al.2011,leach et al.2012)Hence people are just not interacting with but are inhabitants of the biosphere together with all other life on earth ,shaping its resilience in diverse ways ,across the scales consciously or unconsciously

The concept of sponge cities can be referred here while creating the tangible interventions Sponge cities are designed to absorb large quantities of water and disperse it back into the environment in a slow manner. Like sponges, they are made of porous surfaces and spaces capable of keeping water.

A interface between the fauna and humans where interaction can take place

- Waste segregation system
Solid waste segregation system

- Green corridor

Green corridors in cities can be defined as linear natural infrastructure, such as trees and plants, that link up other green and open spaces to form a green urban network. they bring numerous advantages: increasing and protecting biodiversity, mitigating the heat island effect, reducing air and noise pollution, et Policy level interventions

- Removal of encroachments along the riparian zone off the nallah. And strict guidelines in place for riparian zone along
- The nallahs/ drains/ watercourses/ flood plains should be clearly delineated and boundaries fixed in new developments. There will be strict enforcement of the relevant byelaws/regulations in the new layouts.
- Any encroachment on the drain will attract penal action and be treated as a cognizable offence, both against the encroachers and the officials responsible for enforcement of the byelaws/regulations

- Terrace gardens and porous flooring for surfaces and rain water harvesting systems should be promoted in the catchment off the nallah. Subsidies in the taxation system should be provided for implementation.
- Using native fauna for plantation in catchment area ,as they contribute in sustainable environment .(green spaces and biospheres)
- Concretization of the edges to be replaced with soft edges ,or gabion wall systems thus creating porous surfaces.
- Waste management system promoting segregation of wastes, thus avoiding dumping of waste into the nallah.
- All road re-leveling works or strengthening/ overlay works will be carried out by milling the existing layers of the road and recycling of materials obtained as a result of the milling so that the road levels will be not be allowed to increases



Figure 12: Structure Plan (Source:Author)

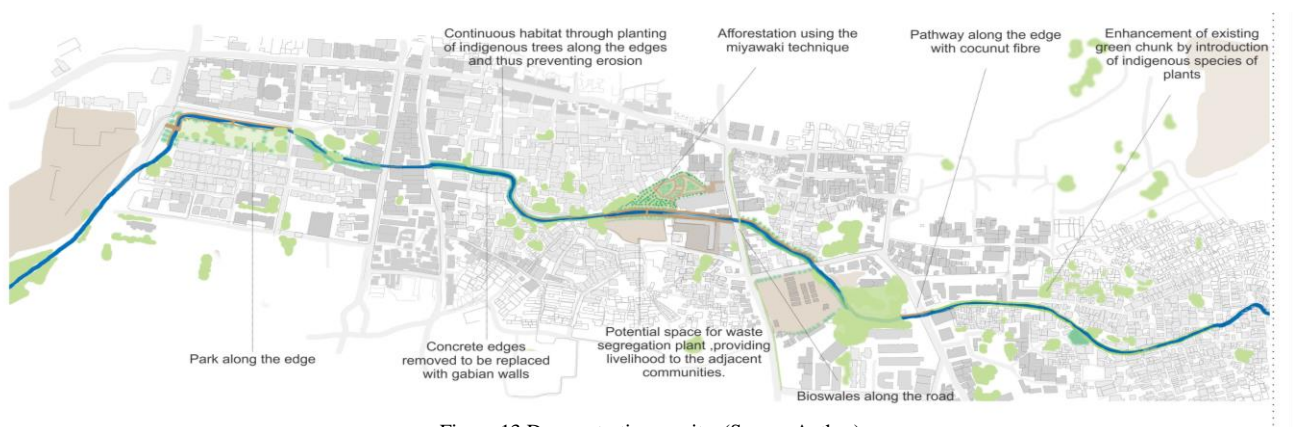


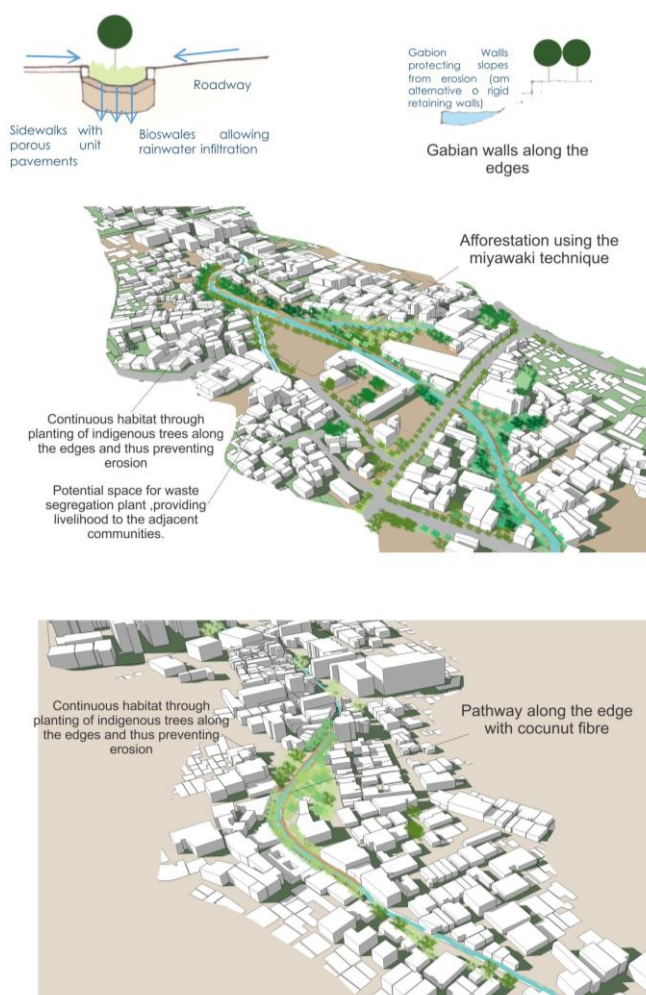
Figure 13: Demonstration on site (Source:Author)

Figure 13: Views of Demonstration on site (Source:Author)

The above figure illustrates the views of the tangible interventions suggested on the site.

VIII. CONCLUSION

- The study of the urban ecology is relatively new but requires an interdisciplinary and multi scalar understanding and cannot be looked at in isolation. Its complex web thus forming a very sensitive system.
- The urban ecological systems are not sacrosanct in nature but human existence is highly embedded in them.



- A small action at the very building scale will have its reputations at a larger scale.(at the city region scale)

- With introduction of new urban ecological areas ,Priority should be given to identify and conserve the existing urban ecological system, across the city, as it possess multiple health benefits .
- Awareness and values associations to the ecological system by the stakeholders is the very key method to conserve any system.
- The rapidly urbanizing cities, acknowledging the existence of small but crucial urban ecological systems can help in conserving the system and thus the dependent habitat. These efforts can aid in creation of the healthy and green open spaces for the neighborhood and the city .This can be a sustainable way forward for the city to expand. Therefore this case helps in understanding the interventions at the multiple scale which acts cohesively to aid conserve and rejuvenate a deteriorated system, and can be a case illustrating socio –ecological resilience.

Scope for further research

The different bioregions, geographical regions climatic regions provide an opportunity to understand and discuss the natural processes in the environment and their implications in design and planning. The research can be taken forward by indentifying and analyzing similar cases across varied bioregions and contexts. Reestablishing the lost connection with the ecological systems can help in sustainable development of the city.

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