AN ECOLOGICAL APPROACH TOWARDS- THE SOCIO-CULTURAL DEVELOPMENT OF A RIVERFRONT

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Abstract: Riverfronts are distinct places where land and water unite. Over the past few years, there is a rapid increase in urbanization and pollution due to which the condition of riverfronts is deteriorating and there is a necessity to preserve it. Also, there is a need to re-establish and revitalize the cultural base to make riverfronts more viable places and to promote local art and culture. Thus, converging the two identified major concerns, riverfront development and cultural hub with socio-cultural activities on a riverfront site seems idyllic in an urban context. Additionally, it would help to create a development model that can be useful to reconnect the city with the river and promote local art and culture. Along with the cultural hub, Passive recreational Landscape is considered as an essential element of riverfront development and can be effectively used to design an ecological development module for the riverfronts. This research will explore the role of passive recreational landscape and socio-cultural activities in any riverfront development project to ecologically restore the riverfront and to reconnect the river to the urban environment, focusing on the cultural background of a particular place.

Keywords: *Riverfront development, Socio-Cultural development, river ecosystem etc.*

1. INTRODUCTION

A 'river' is one of the valuable natural resources, especially for human life and its environment. Therefore, it is important to conserve it by using the ecological principles. A 'riverfront' is an area of interaction between a city and the water and it is considered as a unique and incomparable resource. In fact, it is the most attractive water features for the inhabited settlement. 'Riverfront development' has emerged as a key topic for inspired community development over the past 30 to 40 years.

Cultural institutions are centered on the basic principle of displaying masterpieces of artistic creation, enhancing creativity, animation and education. Its structure is based on broad spaces where different cultural manifestations enrich and enliven up the cultural life of the local populations. It provides services for the society and its development. Also, it brings the community into one area and provide numerous activities and events to keep the community involved with their city and each other.

Passive recreational landscape refers to landscape areas with recreational activities that do not require prepared facilities like sports fields or pavilions. It places minimal stress on a site's resources; as a result, it can deliver environmental benefits. It mainly focuses on the quality of environment and naturalness of an area.

Thus the above three aspects *i.e.* a riverfront development, cultural institution and passive recreational landscape when combined will produce a development module with an "ecological approach" for "Socio-Cultural development of a riverfront". It will help to covert the polluted and forgotten riverfront into the focal point of the city and benefit the local residents and the visitors by promoting the local art and culture. Moreover, it will ecologically develop the riverfront using passive recreational landscapes.

2. EVOLUTION OF WATERFRONTS

There are four stages of evolution of Waterfronts:

1. Emergence of waterfront cities/towns
2. Growth of waterfronts and the waterfront settlements
3. The deterioration of waterfront
4. The renewal of waterfront

All these stages of waterfront development can be understood through the following timeline:

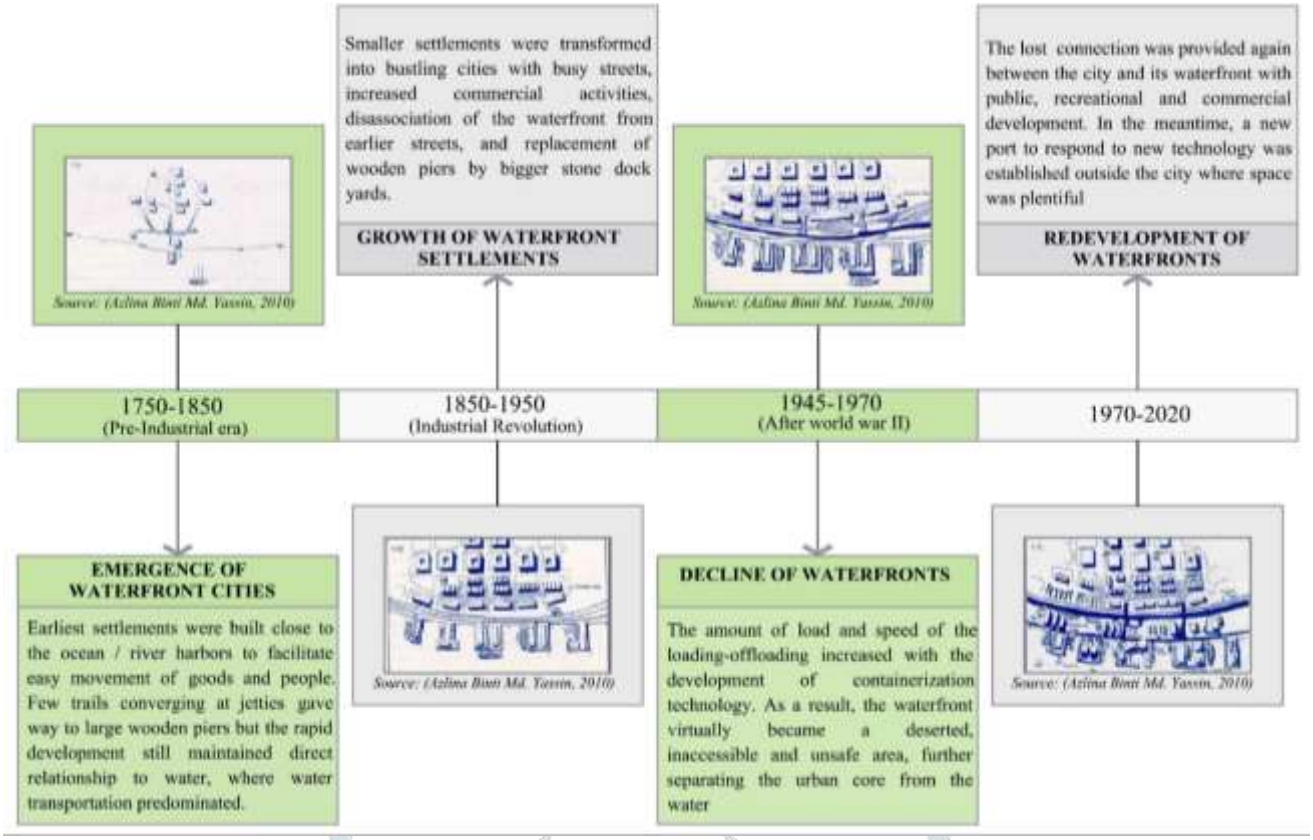


Figure-1: Timeline showing evolution of Riverfronts

The above four stages of historical evolution of waterfront are briefly explained below:

2.1 Stage 1: Emergence of Waterfront Cities/towns

Water plays a vital role in trade and water transportation. There was an intense use of waterfronts in pre-industrial cities and towns. Waterfront cities displayed a close and complex relationship with water. Initial settlements were developed nearby the ocean/river harbors to enable easy movement of goods and people. Trails converging at jetties provided a way to huge wooden piers, but the fast development still maintained a direct relationship to water, where water transportation predominated.

2.2 Stage 2: Growth of waterfronts and the waterfront settlements

In pre-industrial cities, the close relation in spatial and functional terms was interrupted due to huge ports and related commercial and industrial activity. As a result, Smaller settlements were converted into cities with busy streets, there was a separation of the waterfront from earlier streets, an increase in commercial activities, and replacement of wooden piers by stone dockyards. The formation of railway lines to the ports further detached the initial settlements and new parts of the expanding city from the waterfront. Port authorities were formed and elevated highways were constructed in order to deal with the congestion. Industry and transportation were the main land uses and industrial warehouses dominated the waterfront. The congestion from these uses started to pollute the water and the waterfronts started to lose its natural attraction to urban residents.

2.3 Stage 3: The decline/deterioration of waterfronts

With changes in means of transportation and containerization technologies, numerous waterfront industries changed, and waterfronts slowly experienced structural changes with separation from the city. There was an increase in the speed of port activities after World War II due to containerization technologies; an increase in the number of bigger container ships that could not navigate existing shallow ports; increase in highway travel in comparison to railroads; absence of urban residential neighbourhoods at the waterfronts and deterioration of manufacturing plants and industries at the waterfront.

2.4 Stage 4: The renewal of waterfront

The deterioration of waterfront areas and economies was accompanied not only by residential flight to the suburbs, but also increased pollution, crime, and abandoned paths of industrial properties. The Urban-Port congestion declined with the shift of container industries and other industries dependent on highway transportation to alternate locations where space was sufficient Authorities recognized the effects of these structural changes on the economy and quality of life of residents and advised citizens to recover the aesthetic scenery and access to waterfronts. Cities revived the strategic advantages of a waterfront location for leisure and recreation, and for mixed-use developments to improve the architectural and urban design character of the city's shorelines. These waterfront transformations are evident in coastal cities; it determines the continuous process that results from multiple forces acting in diverse ways in different environments. Waterfronts, used as a place for manufacturing goods and transportation in the past, has been converted as a recreational and visual resource in the post-industrial society.

3. SOCIO CULTURAL APPROACH TOWARDS THE RIVERFRONT DEVELOPMENT

Culture represents a term that unites the social behavior and norms found in human societies, as well as knowledge, beliefs, arts, laws, customs, capabilities, and habits of an individual in these societies. A cultural hub or a cultural Institution is an organization that promotes culture and arts. It inspires the creation and development of various art forms and helps in civic education. It

encourages creativity and provides various opportunities for local artists. It includes various programs that possess educational significance because it familiarizes the visitors much deeper and more contextual with aesthetic values and encourages numerous programs that have social and cultural meaning.

Cultural Hub along the riverfront plays a vital role, in transforming the forgotten and polluted river into the central attraction point of a city. To connect a riverfront with the tourist as well as local residents and to encourage the growth and expansion of the art and culture few important steps are:

i. Various new and unique landscape designs focusing on the art and culture can be incorporated to enliven up the unique cultural background of a city. (for example, the art of topiary can be practiced to design the landscape, and unique sculptures illustrating the traditional art form can be included in the landscape.
ii. Variety of flowering plants could be incorporated, and flower show could be organized every year to display rare and unique varieties of flowers through sculptures representing the culture of the city.
iii. Number of open-air activities, open-air workshops, and exhibition galleries can be designed with the help of landscape architecture considering the ecology of the site.
iv. Establishment of different opportunities for local artists to showcase their work and economically uplift them by constructing temporary structures for retail purposes wherein they can exhibit and sell their artefacts.
v. Constructing temporary structures in which the local cuisines could be displayed for retail purposes. It will help to liven up the traditional taste of the city by promoting the classical cuisines of different parts of India. It will offer employment to the local residents meanwhile it will also help to entice visitors to the riverfront development.

These kind of developments can become a great example to aware the world about the importance of the River, Art and Culture. It can act as an important characteristic in public education, because with its help the inhabitants can culturally up stand, they can develop their opinions about the world, their knowledge and skills and thus can function as an active, informed and successful citizens of a democratic society.

4. ECOLOGICAL RIVERFRONT DEVELOPMENT

The prime consideration of any kind of development near the riverfront should be the 'river ecology'. A river is a natural watercourse that flows in a channel with well-defined banks. They are nurtured by precipitation, through springs and seepages or from meltwater on the edge of snowfields and glaciers. Rivers, regardless of its nature, have similar stages of structural dissimilarities from source to delta. On the basis of the structural changes, the river profile can be segregated into three zones.

Figure -2 The river profile

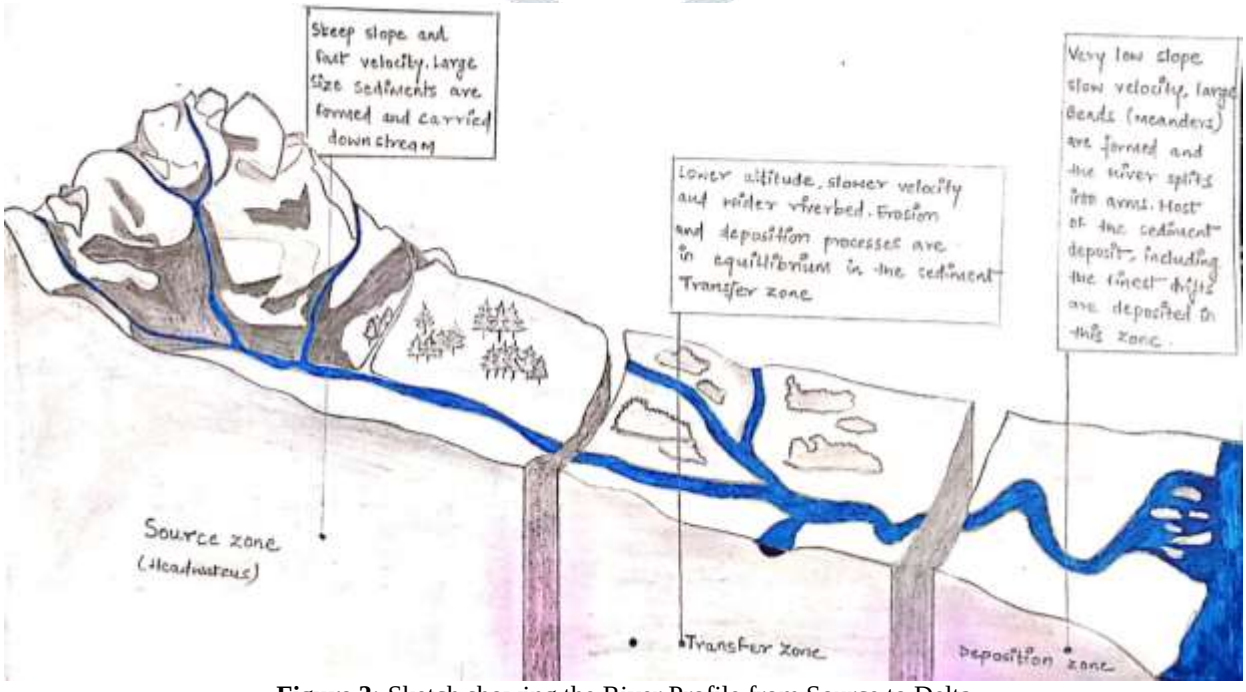


Figure 3: Sketch showing the River Profile from Source to Delta

Regardless of the form of river beds, rivers have intermediate sequencing of shoals and deeper sections, called riffles and pools. They are linked to the 'river midstream' (a line which shows the deepest section of the river, where the water flows fastest). Pools are formed in the midstream, next to the outside bank of a watercourse bend. Riffles are formed between two bends where the midstream goes from one river bank to the other The sequencing of pools and riffles inside a river section, and the presence of numerous habitats demonstrates the variation of life adapted to both fast and slow currents and serves as a prerequisite for a well-functioning river ecosystem.

Elementary constituent of river corridor is the riverbed. This is a naturally lowered landform generally used as a passage for flowing water. The next constituent is the floodplain – it is the adjacent portion of the riverbed, flooded by high water at different intervals varying from very often to seldom. The floodplain may be found on either one or both river banks. The next constituent is the transition upland fringe, which begins above the floodplain and forms the borderline between the river corridor and the neighbouring landscape.

The floodplain is segregated into two parts: hydrologic floodplain and topographic floodplain. The hydrologic floodplain is an area flooded about two out of every three years. The topographic floodplain includes the hydrologic floodplain up to the altitude reached by a flood peak of given frequency (every 100 or 500 years).

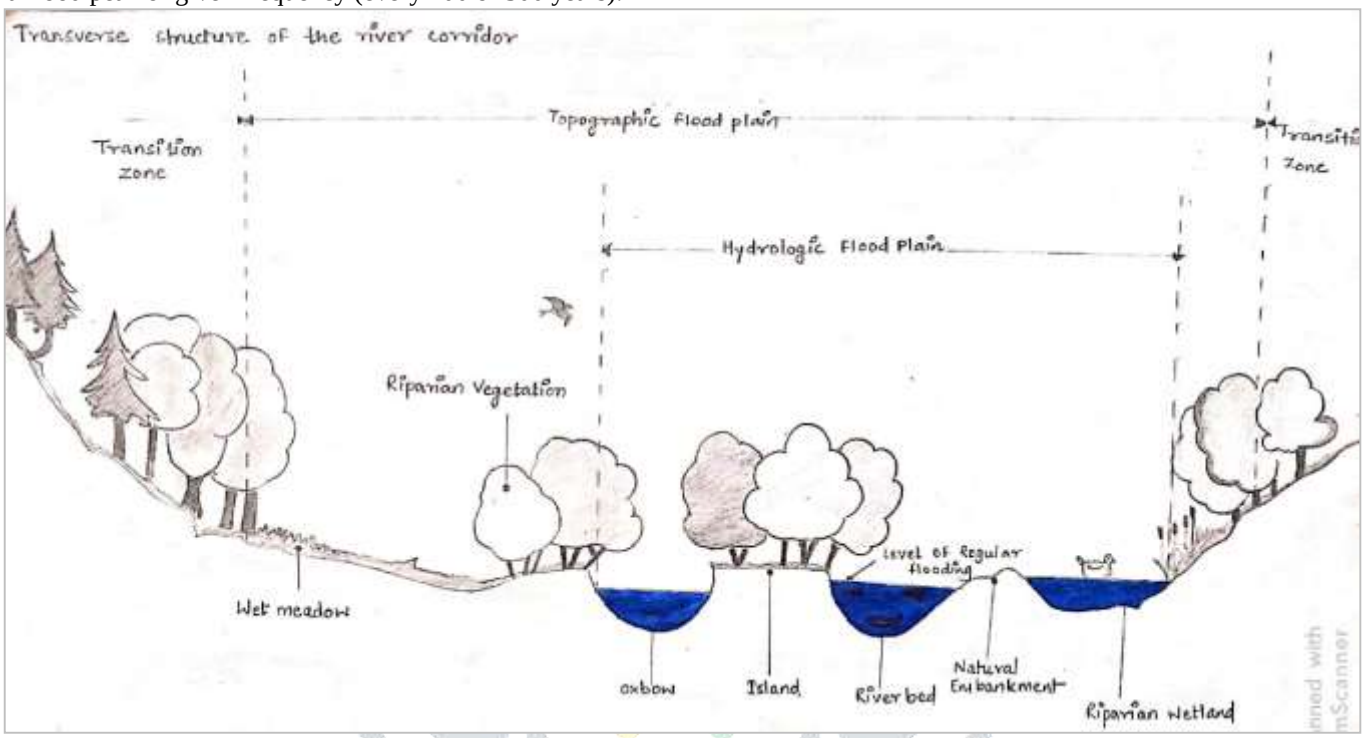


Figure 4: Elements of a river corridor

All the key components discussed above, combine to naturally form a river ecosystem and it should be essentially considered and conserved while developing a riverfront. But it can be easily observed from the existing projects of the riverfronts that river ecology is not believed to be a matter of concern while developing a riverfront and the result is that we are losing the natural form of the river. As an architect, we have to understand Each river is different and requires a design solution appropriate for its unique conditions. There are various upcoming projects of riverfront developments all over the world. The primary aim of these projects is to transform neighborhoods, turning unapproachable lands into public spaces that to faster economic growth. Furthermore, these projects aim to improve water quality by diverting sewage lines. It includes the development of riverfront promenades, parks, various residential and commercial projects on the riverbanks to experience a direct economic and social impact.

Along with all these provisions, the precious and natural river-ecosystem should not be overlooked. It is the need of the hour to respect our mother nature and hence work in the direction to protect it. Unless human beings will be at the risk by natural disasters like the flooding of the riverbanks. On the basis of preliminary research on the existing riverfront development projects, their negative impacts on the environment, river ecology, and the study of the different aspects of riverfront developments, few ecological principles are discussed below that should be considered while developing any riverfront.

i. **Use of site's natural resources in landscape development**
The natural topography, existing vegetation and locally available materials can be utilized for designing the landscape. It facilitates to create unique natural landscape elements like undulating pathways, terraces, water cascade etc.

ii. **Riverfronts should be easily accessible**
Visual as well as physical access to the riverfront from nearby areas is crucial to attract people to the riverfront. Various recreational opportunities could be developed, from bicycling to canoeing, access to the water should also be provided so that the visitors could touch and interact with water.

iii. **Use of Native plant species:**
Use of native species of vegetation in riverfront landscape design can achieve the aesthetic as well as functional objectives. It will require minimum supplementary irrigation after initial establishment period, occasional trimming will be needed and it also offers value to diversity of wildlife.

iv. **Preservation of Buffer sensitive natural areas**
Buffer area is the area next to shorelines, stream or wetland where any kind of development is restricted. It allows natural functioning of the rivers by improving connection between wildlife habitat and by protecting ecological integrity of the river. Preserving open spaces as buffers along the river provides a cost-effective means of storm water and flood control. Buffers also reduce erosion caused by uncontrolled runoff and stabilize riverbanks with vegetation.

v. **Restoration of riparian and in-stream habitats:**
Riparian and Instream habitat, like aquatic vegetation, rock, and wood is essential for typically maintaining the river ecosystem. As it offers a number of food sources, adequate shelter, breeding spots to an enormous variety of instream faunas including many fish species. Along with that, its contribution is essential in various biological processes in the river channel. For restoration of riparian and in-stream habitats watershed and regional factors must be addressed to maintain healthy hydrological cycles and water quality. For example, new planted buffer zones must be created and maintained, controlling and recycling storm water, minimize the construction of new dams and reservoirs.

vi. **Avoid Use of structural alternatives to manage water resources**
Use of structural alternatives harm water quality, cause flooding, and also destroys wildlife habitat. Flood plain development and engineered river corridor is the major reason of flood damages.

vii. **Reduce hardscapes**
Hardscapes prevent rainwater from filtering through soil and refilling rivers and streams as groundwater. Usually groundwater supplies about half of all stream flows but The impermeable hard surfaces degrade rivers because they do not absorb storm water.

5. ROLE OF PASSIVE RECREATIONAL LANDSCAPE IN ECOLOGICAL RIVERFRONT DEVELOPMENT

Passive recreational Landscape refers to landscape development that require limited physical exertion. It mainly focuses on the quality of environment and naturalness of an area. It also refers to non-conventional activity that offers productive and therapeutic human benefits and fosters appreciation and understanding of open space and its purpose, it does not impact environmental, socio-cultural, scientific, or agrarian values. As, today's urban life is interconnected with a lack of physical activity, contact with human-induced environmental hazards and chronic stress. Passive recreational landscapes can be utilized to decrease the mortality rate in urban residents by promoting physical and mental health. It helps in achieving psychological relaxation, in encouraging social cohesion, and in reduction of direct contact to noise, heat, and air pollution. As well as it can help to ecologically restore the riverfront

To develop a better understanding of the passive recreational landscape, two examples are briefly discussed below:

5.1 Shalimar Bagh, Kashmir

Basic information: Shalimar Bagh is located near Dal Lake, approximately fifteen kilometers away from Srinagar. It is spread in an area of 31 acres. This Mughal garden was built by emperor Jahangir in 1619 A.D. The garden is rectangular in shape and measures 587 meters long by 251 meters wide.

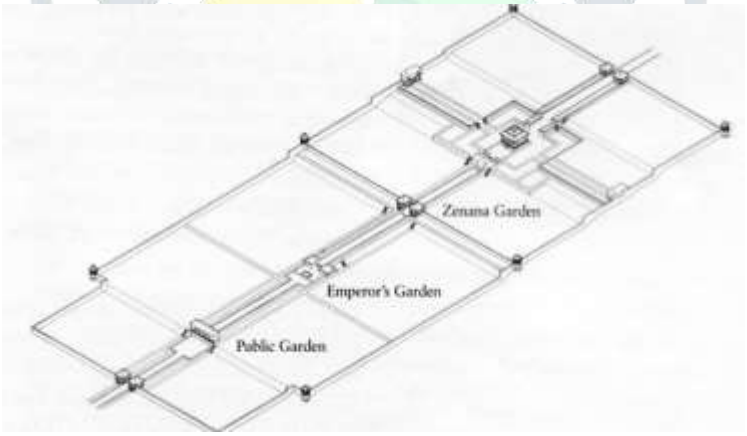


Figure -5 Isometric view showing three sections of Shalimar Bagh Kashmir
(Mitchell, 1978)

Concept: It is the replica of Persian Char Bagh. It represents the principle of "garden of paradise mentioned" in "Quran"or "the garden under which rivers flow".

Lanscape Architecture: It is uniform in shape with a central water body with four streams radiating from centre and dividing the garden into four sections. The mountainous topography of the site is properly utilized to design the Char Bagh by emphasizing the central water channel. The central water channel (Shah Nahar) connects the three terraces by fountains. The channel begins at the topmost terrace and runs through the pavilions (baradaris). The garden is segregated into three terraces, each terrace has a different function and a different level of privacy.
Terrace 1: The Diwan-i -Aam (public audience hall), it is believed that earlier the emperor used this terrace to held his daily court. A black marble throne surrounded by water cascades forms the central feature of the Diwan-i 'Amm.
Terrace 2: Diwan-i Khass, or the private audience hall, it was accessible only to the noblemen or guests of the court.
Terrace 3: The zenana garden, two small pavilions mark the beginning of and control the access to the third level, which was reserved for the royal harem.

a) b) c)

Figure -6 a) Diwan-i-Aam, b) Diwan-i-Khas, c) Zenana Garden
(Mitchell, 1978)

Analysis: The Shalimar Bagh of Kashmir is designed according to the geographical conditions of the site. For example: The terraces are designed in three different levels considering the topography of the site, a natural stream has been utilized for designing the water cascade, and native plants and trees are strategically planted in different parts of the garden. Therefore, it can be observed that Shalimar bagh places minimum damage to the natural resources as well as it has utilized it in a very efficient manner for designing a garden dedicated for passive recreation.

5.2 Garden of five senses, New Delhi

Basic information: The garden of five senses is located at Said- Ul-Azaib village, close to the Mehrauli heritage area in New Delhi, spread in an area of 20 Acres. It is designed by Pradeep Sachdeva and associates for Delhi tourism & transportation development corporation. The purpose of this garden is to provide leisure space for all sections of the society.

Concept: It is designed with a variety of activities for public interaction and exploration. It is a combination of color, fragrance, texture and form. All the five senses of touch, smell, sight, sound and taste are incorporated here in the form of landscape design by utilizing natural site features.

a) b) c) d) e)

Figure -7 a) Flower Garden with beautiful and aromatic flowers, b) A Bronze Fountain Tree, c) Curved Pathways and Steps/ Maze, d) A Walkway with Pergola Covered with Climbers, e) Contemporary Artwork

Landscape Architecture: In this garden the sounds of nature are emphasized by carefully selected music, the rocky terrain is responsible giving the sense of touch, the fragrant shrubs and herbs stimulates the smell, food court pleases the tongue and Beautiful flower gardens contribute to offer a stunning view.

The park is a theme based design and it organizes various festivals throughout the year. In this park, Large open landscape designs are emphasized in comparison to the built form. The site can be divided into two zones:

1. Intensively landscaped and developed zone -This zone is in the periphery of the site where large amounts of detailed paving's have been done with intensive landscaping. Along with that, there is a provision of few more activities, e.g., Food courts, shops, special theme gardens and the pathways etc. This zone is also accompanied by a special solar energy park.
2. Rugged zone- It comprises of the elevated parts of the site with mainly natural rock formation. In this zone, there is minimal intervention of manmade landscape designs and natural rocks are transformed into landscape elements.

a) b) c)

Figure -8 a) Sandstone Elephants, b) Idols of Children, c) Undulating and Curved Pathways with different variety of Plants and Trees

Analysis: The garden of five senses is designed with an aim to provide recreational opportunities, the maximum focus of the design is on the landscape development on the basis of natural conditions of the site. for example: the topography of the site and natural rocks are used to create different landscape elements. Also this park is designed to stimulate all the five senses by the using variety of landscape features and vegetation.

6. CASE STUDIES OF RIVERFRONT DEVELOPMENT

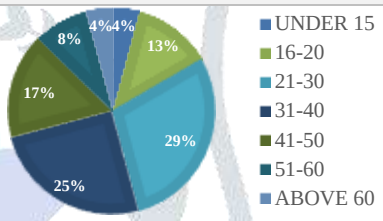
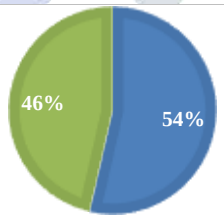
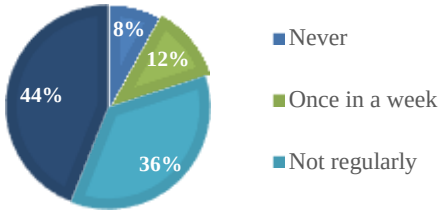
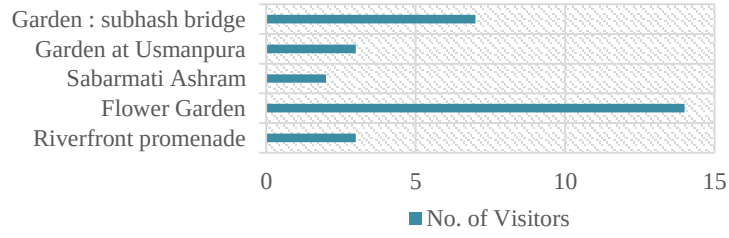
6.1 Sabarmati riverfront development

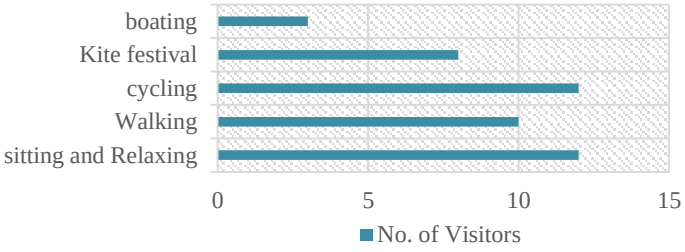
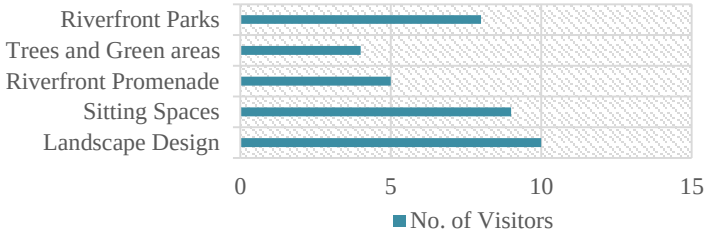
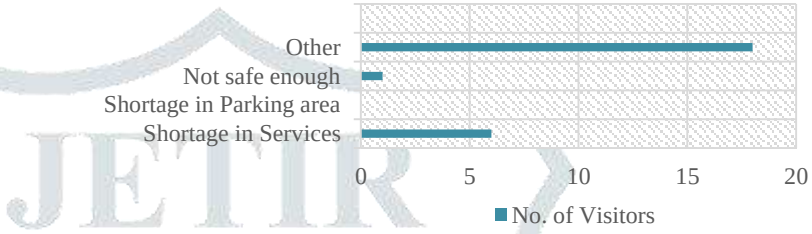
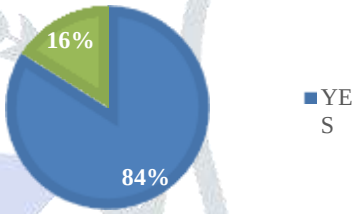
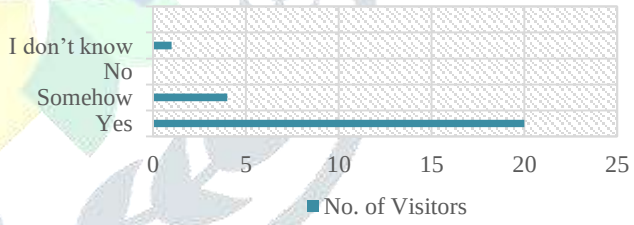
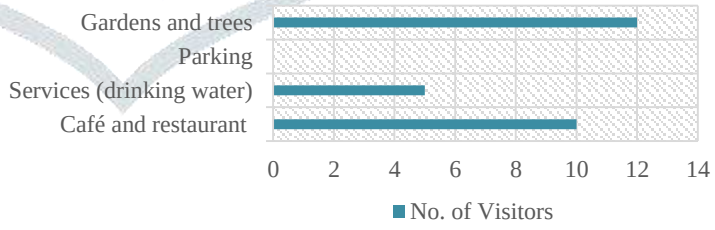
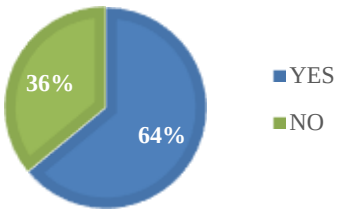
Basic information: Sabarmati riverfront is a waterfront being developed along the banks of Sabarmati river in Ahmedabad, India. This project started in 1996 and is still under construction. It is a city level intervention and is designed by Ar. Bimal Patel**.** Since 2012, various facilities of the riverfront are opened to public. The design philosophy of the architect was to transform the riverfront into a long-winding promenade with different socio-cultural and economic facilities. The main aim of the project is to design an innovative self-financing method to generate revenue, to positively transform the historic but neglected river Sabarmati and to redefine the identity of Ahmedabad along the river. The major objectives of project are environment improvement, social infrastructure and sustainable development.

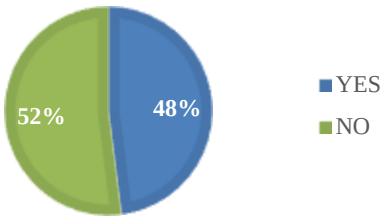
Different parts of Sabarmati riverfront development project are: riverfront promenade, Ghats, boating stations, utilities like toilets, drinking water facility, riverfront garden at Usmanpura, riverfront garden near Subhash bridge, Saabarmati flower park, event center, Gujari Market, Dhobi Ghat, Gandhi Ashram and urban forest at Paldi.

Questionnaire survey 1: To understand in detail about Sabarmati riverfront development, to find out its merits and demerits in an Urban area on the basis of socio-cultural, environmental and economic aspects a questionnaire survey was performed. This survey took place in December 2019. In this survey 25 visitors of Sabarmati riverfront were interviewed and their perception about the development is recorded.

Table-1: Questionnaire Survey

S.No.	QUESTIONS	RESULT
1.	Age range	
2.	Gender	
3.	How frequent you go to Sabarmati riverfront development?	
4.	Most preferred part of Sabarmati riverfront development?	

5.	What activities you like in Sabarmati Riverfront development?	
6.	What you like about Sabarmati Riverfront?	
7.	What you don't like about Sabarmati Riverfront?	
8.	Do you think having a riverfront development in Ahmedabad influence your leisure activity plans?	
9.	Do you think having a riverfront development makes life in Ahmedabad different?	
10.	What do you think is needed in Sabarmati riverfront to visit more?	
11.	Are the Public facilities like drinking water, placement of toilets, eateries are sufficient?	

12.	Are the facilities mentioned above are sufficient?	

Analysis: According to the case study and questionnaire survey following analysis can be drawn: This project is used for various kind of activities like cycling, jogging, sitting, relaxing and for water based recreational activities. It hosts various cultural and recreational activities every year. Sufficient spaces for parking has been provided in each part of the riverfront development. Placement of toilets are appropriate and provision of adequate facilities like Elevators and ramps for differently abled peoples are planned at regular intervals. In short this project has various socio-cultural and economic benefits.

Apart from that, there is a massive use of concrete. Excess use of concrete has various negative impacts on the river ecology. In a way, Sabarmati riverfront development has deteriorated the river ecology. The average width of the Sabarmati river channel was 382 meters and the narrowest cross-section was 330 meters. It is uniformly narrowed to 263 meters and the riverbed land is reclaimed on the both east and west banks to construct 11.25 km long riverfront promenade. The total of 202.79 hectares of land is reclaimed.

Figure -9: Lower Level Promenade of Sabarmati Riverfront

According to the responses of the visitors it was observed that Sabarmati riverfront is considered as a major recreational opportunity in Ahmedabad. Among the different parts of the riverfront development. Sabarmati flower park' is the most preferred outing destination because of the river view, lush green landscape, organic planning, variety of landscape features and use of wide variety of vegetation. Along with that other riverfront gardens are also major attraction point of the city. Meanwhile, it was also observed that the visitors would like to visit the riverfront development more often if there would be more greenery/vegetation instead of excessive use of concrete and minimum vegetation in the riverfront promenade. This survey also indicated that there were shortage of drinking water facilities and food joints in riverfront promenade.

6.2 Gomti riverfront development

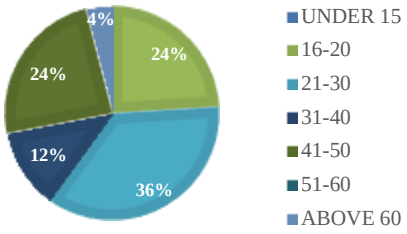
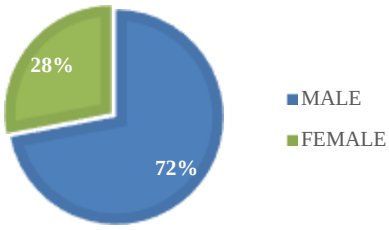
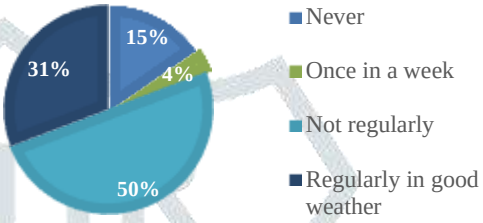
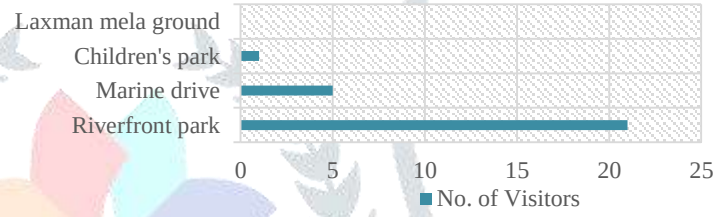
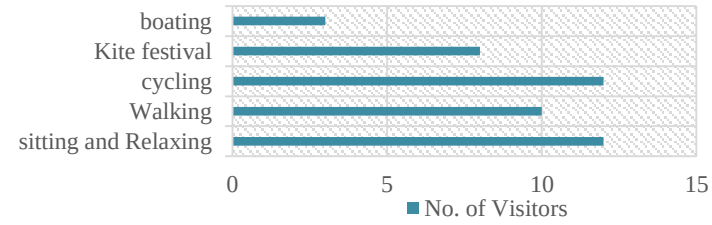
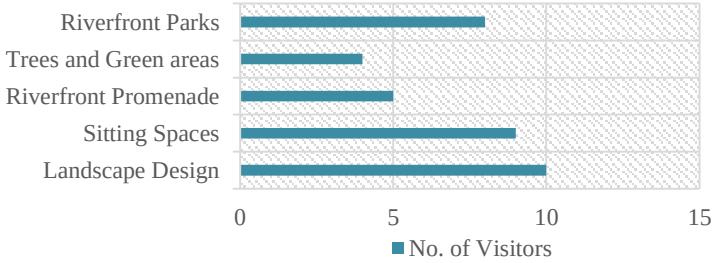
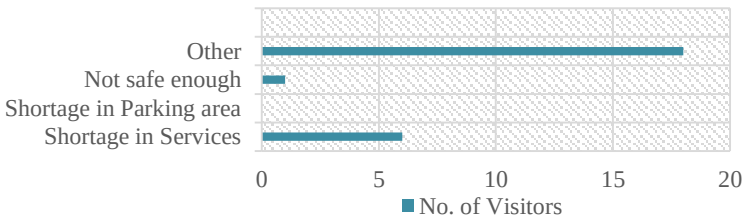
Basic Information: Gomti riverfront is a riverfront development along the banks of Gomti river in Lucknow, India, by the Irrigation and water resource department, Uttar Pradesh. The Gomti riverfront development project started in 2007 and is still under construction. This project is a city level intervention. Since 2016, few parts of Gomti riverfront parks are opened to public.

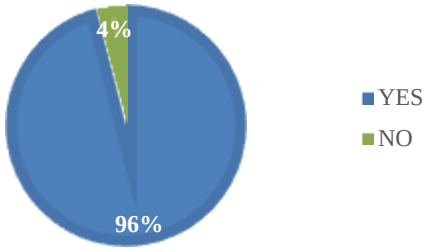
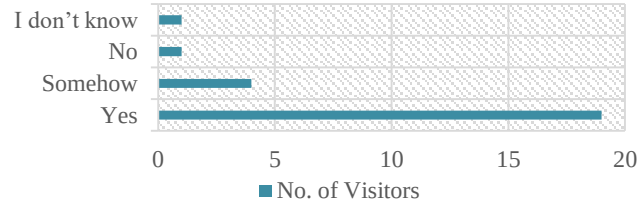
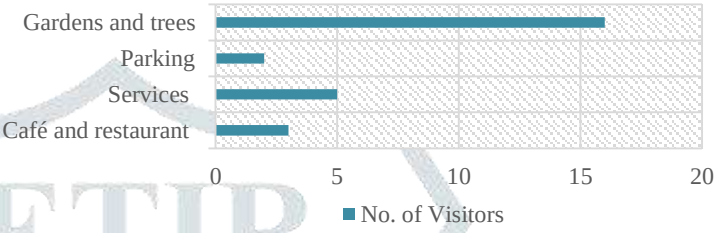
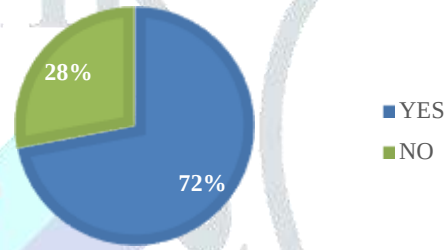
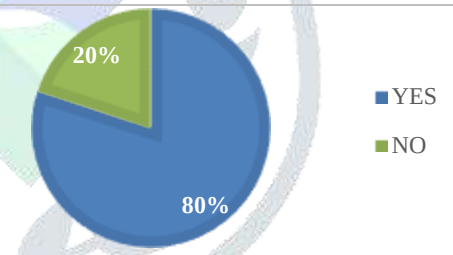
Figure -10: Gomti Riverfront

Design Philosophy of the architect was to develop Gomti Riverfront by developing green belt on the banks of the river, under which facilities like cycling, walking track, water sports facilities, water transport and tourism activities can be promoted. It also aims to improve the traffic movement by constructing roads on both sides of the Gomti river, channelizing river by constructing diaphragm wall on 8.1 km on both the banks of the river, Integrated development and beautification on the land to be reclaimed, cleaning of dredging of sludge brought into the Gomti river by drains, Construction of intercepting drains on both sides of the river to prevent the direct flow of polluted water into the Gomti river.

Questionnaire survey 2: Similar to questionnaire survey 1, another survey was performed at Gomti riverfront park. This survey took place in January 2020. The media of the survey was direct interview and total no. of participants were 25.

Table-2: Questionnaire Survey

S.No	Questions	Result
1.	Age range of the visitors	
2.	Gender	
3.	How frequent you go to Gomti riverfront development?	
4.	Most preferred part of Gomti riverfront development?	
5.	What activities you like in Gomti Riverfront development?	
6.	What you like about Gomti Riverfront?	
7.	What you don't like about Gomti Riverfront?	

8.	Do you think having a riverfront development in Lucknow influence your leisure activity plans?	
9.	Do you think having a riverfront development makes life in Lucknow different?	
10.	What do you think is needed in Gomti riverfront to visit more?	
11.	Are the Public facilities like drinking water, placement of toilets, eateries are sufficient?	
12.	Are the facilities mentioned above are sufficient?	

Analysis: The results of this survey indicates that the people of Lucknow believe that Gomti riverfront park is one of the most ideal location for recreational activities in Lucknow. Up to a great extent this park has influenced their leisure activity plans due to maximum use of soft-scape in the park, use of natural topography/undulating pathways and landscape elements like Gazebo. Also, few visitors think that cleanliness of the Gomti river would have been the matter of concern while developing the riverfront.

Gomti riverfront provides opportunities of various recreational and commercial activities. It is one of the preferred outing destination for the people of Lucknow. Riverfront promenade is used for various kind of activities like cycling, jogging, sitting and relaxing, for water based recreational activities. Drinking water facilities and public washrooms are designed at regular intervals in the park. Unlike Sabarmati riverfront there is no massive use of concrete and more landscape and greenery has been developed on the entire stretch of the riverfront promenade. Sufficient spaces for parking have been allotted in each part of the riverfront development. Separate places have been designated for street food vending activities. Ramps and staircases are provided in each part of the development.

Along with that, there are also some negative impacts of Gomti riverfront development: the project has disturbed the river ecology by reducing the width of the river to 250 m and constructing residential area in the flood plains. Construction of high embankments to protect Lucknow from flooding is also a major reason for deterioration of river ecology.

7. FINDINGS OF THE RESEARCH

On the basis of the research few strategies on socio-cultural, environmental and economic aspects are formulated which will help to develop a socio-cultural riverfront with an ecological approach.

Table-3: Findings of the Research

7.1	**SOCIO-CULTURAL ASPECT**
a.	**Public open spaces for the city dwellers** Clean, green and well managed public spaces provide different recreational opportunities for the inhabitants and enhance the socio-cultural environment of an urban area.
b.	**Public Amenities** Important services like restrooms, dustbins, drinking water facilities, sign boards, MI room etc. should be planned for the convenience of the public at the riverfront.
c.	**Social equity** There should be the provision of ramps and steps as per the norms (National Building Code) to provide easy access to the differently abled citizens. Public participation should be entertained in Planning and implementation process.
d.	**Community enhancement** Community enhancement by rehabilitation of slums, Health and Hygiene, Skill Development Programs- Capacity Building, Employment Generation through river based activities.
e.	**Promote local art and culture** Provision of new and unique Landscape designs and features highlighting the local art and culture. For example art of topiary can be used in landscape design.
f.	**Cultural hub** There should be Public Art & Plazas, exhibition galleries, open air workshops to enable the artisans to showcase their talent to the city dwellers as well as the tourists. The river walk or the riverfront promenade should be utilized to display artefacts and to create a sense of visual continuity.
7.2	**ENVIRONMENTAL ASPECT**
a.	**Regular Cleanliness drives** It will help to keep rivers clean, to strengthen natural habitat of plants and animal species and will socially and economically benefit the societies.
b.	**Passive recreational landscape design** Passive recreational landscape stimulates the senses, revive physical and mental health as well as it does not harm the river ecology and gives unique solutions of ecological riverfront development.
c.	**Use of site's natural resources in landscape development** The natural topography, existing vegetation and locally available materials can be utilized for designing the landscape.
d.	**Riverfronts should be easily accessible** Visual as well as physical access to the riverfront from nearby areas is crucial to attract people to the riverfront.
e.	**Use of Native plant species** It will require minimum supplementary irrigation after initial establishment period, occasional trimming will be needed and it also offers value to diversity of wildlife.
f.	**Preservation of buffer sensitive natural areas** Preserving open spaces as buffers along the river provides a cost-effective means of storm water and flood control, it reduces soil erosion caused by uncontrolled runoff and stabilize riverbanks with vegetation.
g.	**Restoration of riparian and instream habitats** Riparian and Instream habitat, like aquatic vegetation, rock, and wood is essential for typically maintaining the river ecosystem. It offers a number of food sources, adequate shelter, breeding spots to an enormous variety of instream faunas including many fish species. Along with that, its contribution is essential in various biological processes in the river channel.
h.	**Avoid use of structural alternatives to manage water resources** Use of structural alternatives harm water quality, cause flooding, and also destroys wildlife habitat. Flood plain development and engineered river corridor is the major reason of flood damages.
i.	**Reduce hardscape** Hardscapes prevent rainwater from filtering through soil and refilling rivers and streams as groundwater. Usually groundwater supplies about half of all stream flows but The impermeable hard surfaces degrade rivers because they do not absorb storm water.
j.	**Storm water management** Diverting sewage to treatment plants before dumping the waste water into the river would contribute to improve the quality of water.
k.	**Brownfield development** Brownfield development rejuvenates unused contaminated land on the riverbanks. It helps in job creation, and local economic growth reduces threats to public health and improves water quality
7.3	**ECONOMICAL ASPECT**
a.	**Water based recreational activity** It will attract the visitors to the waterfront and will also help in economy generation.

b.	**Food joints / restaurants** It will help to promote local cuisines to the world and will also provide employment to the local people.
c.	**Real Estate values** Riverfront development will ultimately enhance the real estate values in nearby area.
d.	**Employment for local artist** This kind of riverfront development will give a platform to the local artists where they will retail their unique artefacts. Along with that this type project will also give different opportunities to the performing artists by organising different events.
e.	**Tourism** Attractions such as cultural events, local artefacts, local cuisines as well as the waterfront development will provide tourists with access to educational and leisure activity; in turn, the local community benefits from the influx of additional capital \that is "imported" with travellers.
f.	**Cultural events** Various cultural events could be organised which will help in economy generation, to provide local employment and to connect the riverfront to the city.

8. CONCLUSION

प्रकृतिः रक्षति रक्षिता
Nature protects if she is protected

Rivers are an essential element of nature and are considered as the backbone of human civilization. Due to the upsurge of urbanization, these rivers and riverfronts are deteriorating and needs to be ecologically protected. Through this research, it can be concluded that: The deteriorated riverfront and river can be transformed into clean and green attraction point of a city by utilizing the natural resources and can be converted into the major attraction point of an urban area. For this, a set of basic guidelines is formulated on the basis of ecological, socio-cultural, and economic aspects.

An important factor to be considered while developing any riverfront should be the identity/cultural history of the city and the river. The riverfront development should focus to culturally upstand the citizens and local art and culture. As, India's diverse and precious cultural heritage such as music, dance forms, languages, cuisines, and architecture, has gained a lot of pre-eminence worldwide. This tangible and intangible legacy, which captivates people in the world, needs to be conserved and promoted so that it can be passed to subsequent generations. For this, various provisions for the promotion of the artifacts, employment and economy generation for artisans, and platform for the performing artists should be provided in the riverfront.

Another essential element for a riverfront development is to conserve the river ecosystem. In this research, various strategies are discussed which will lead to ecological riverfront development. Passive recreational landscape design can lead to conservation of river ecology at the same time it offers various recreational opportunities. It has numerous Psychological, environmental, socio-cultural, and economic benefits. It connects the city to the riverfront and introduces innovative ways of landscape design according to the site's natural conditions. Also, it promotes the use of native plant species which matches the life cycle requirements of native wildlife and offers recreational opportunities in the lap of nature. (For example bird watching, hiking, wildlife observation, sitting and relaxing, canoeing, cycling.) It is the need of the hour that we work in the direction to protect our nature. This research suggests a unique riverfront development module that will help to change the perception of riverfront development and will have various socio-cultural, economic, and environmental benefits.

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