Mumbai emerged from 7 islands and has developed its existing geographic form over decades. A narrow stretch of land entering the Arabian Sea gives almost 114 km of coastline to Mumbai Metropolitan Region (MMR). It has formed the eastern bay (fig.1) which is significant for its relation with MMR. Eastern waterfront has been the vital part of city’s identity with its contribution to economic growth and unique ecological character. Elephanta Island in the bay boasts monolithic basalt sculptures of 5th century. Mumbai was centered on port activities in past century and eastern coast was the hub of docklands. This attracted people from neighborhoods to migrate and contribute to socio-economic growth of the city. During British rule, the Eastern Bay served as an important node of water transportation. Sewri Fort built in 1680 was one of the defence forts built by British along this waterfront. This fort sits atop a cliff of about 60m and is landlocked on 3 sides. It was later converted as a Mumbai Port Trust (MbPT) godown and still stands with its bygone legacy in ignored state (fig.3).

Ecological significance of eastern bay

The ecology of eastern bay comprises of wetlands, mudflats and mangroves. Thane creek at north covers an area of 12,200 hectare with rich biodiversity. The southern part around Sewri predominately has mudflats, where about 53 species of vascular plants and 150 bird species have been recorded by Bombay Natural History Society (BNHS). According to Woodward (2007) this bay has developed its peculiar ecosystem due to various industries operating along the coast and pollution contributed by them. These activities increased algal growth in mudflats and developed correlated ecosystem. Flamingos started periodic migration for food to these mudflats from 1992 and have become integral part of its ecology. They attract visitors especially for birding. Considering all the facts, the bay is significant from environmental standpoint and needs to be protected.

Scope and need of sustainable waterfront development at eastern bay

The eastern waterfront covers an area of 7.3 sq.km and at present only 50% (3.4km2) of this land is used by MbPT for port activities. The recent strategies by Brihanmumbai Municipal Corporation (BMC) have offered opportunity to utilize 14.5 km stretch of eastern waterfront for public use, which was inaccessible...
for many years. The study conducted by Urban Design Research Institute (UDRI) demonstrated potential of eastern waterfront for creating public spaces, which are crucial need of the city. On the other hand, Mehrotra (2007) highlighted eastern waterfront as a vital zone to solve city’s physical deficiencies like transportation. Development authorities are also considering the eastern water fronts for infrastructure projects. In both the approaches ecology related to the area remains unaddressed. The paper focuses on recommending the waterfront development strategies for the eastern bay with sustainable approach to balance development activities and public space design with environmental setup.

**Methodology**

The study was aimed at investigating sustainable development opportunities at eastern bay by identifying appropriate node on this stretch. To achieve this goal, ecological analysis and contextual analysis were carried out. The ecological analysis was based on review of secondary data sources like research papers and annual reports on biodiversity of eastern bay and interviews with 4 environmental experts including the director of BNHS. Ecological parameters were identified prevalent on the selected site in urban backdrop. Contextual analysis was aimed at establishing relevance of sustainable development for public space design. It was based on site visits, author’s observations and interviews with development authorities, which included representatives from Mumbai Transformation Support Unit (MTSU), BMC and MMR Development Authority. Communal support is important for successful execution of urban development schemes. Thus public survey was conducted to study their needs and perception on bay development. Random sampling was carried out to select about 70% people residing within 200m proximity of selected site and visitors coming to the area. Global waterfront development case studies sharing similar grounds of geography, ecology and urban contexts like Kansai bay, Singapore Marina bay, Toronto coasts etc. were examined to derive the objectives and parameters for the development.

**Findings of the study & development strategies**

Sewri was selected to demonstrate bay development possibility, on basis of its ecological and historic significance as well as accessibility from all parts of city. At present this area contains many abandoned factories, container yards etc. (fig.2) and has potential to explore development schemes. Data gathered through interviews revealed that the authorities’ vision plan for MMR looks at eastern bay for transportation alternatives with little consideration to its environmental setup and potential to contribute to city’s public spaces. Public survey pointed out requirements of citizens, which included site improvement, civic infrastructure and safeguarding
existing biodiversity. Almost 85% of the surveyed residents belong to lower income groups and expressed their interest to participate in transformation process. 90% of housewives were found keen to have additional income source through opportunities created after development. Results that emerged from field observations, interviews and surveys pointed out the possibility of developing an ecological park at Sewri.

The operational definition of Ecological Park with respect to present site is the public space created with the objective of maintaining natural state of the area with due respect to ecological, socio-cultural and historic heritage of that area over a city. Following were the development strategies proposed on the basis of empirical findings of the site analysis:

### Planning Basis:

Ecological design process laid by McHarg (1969) was referred to divide region into its suitable land use. In present study, the area considered was under revitalization process and hence systematic layering of hydrology, geology etc. was not viable as in the case of virgin lands. Hence the essential components on site were mapped and strategies were developed around them for improvement of the site.

### Enhancing the key elements:

Creating strong link between the nature and users was a core strategy for ecological park development. To establish this connection the focus was to enhance the key elements like paths, nodes, edges and landmarks on site. This concept was based on theory of Lynch (1960) which illustrated importance of these elements in developing spaces for public and linkage to the city.

### Navigation:

Boulevard leading to the coast was proposed to support multiple public activities as well as to encourage bicycles and pedestrians. Pathways and nature trails leading to fort were recommended which would optimize connectivity of visitors to nature and act as ecological corridors for the existing fauna.

### Sewri Fort:

After analyzing existing ignored condition, revitalization of Sewri fort was one of the prime factors for development. This can be achieved under the guidance of conservation architects. The trails to fort were suggested to be flanked with trees, seating facilities and informative signage about its historical importance.

### Ecological centre:

Intersecting node on the boulevard was recommended for the ecological awareness facilities like...
research centre, museum, library etc. which came up as suggestions from citizen’s survey and as a need from interviews with environmentalists. These buildings can also accommodate additional facilities like auditorium, mini theaters, cafeteria to support the successful functioning of the ecological center.

Ancillary services:
Supporting activities for the park like eateries, stalls, entertainment areas were suggested to be placed on the boulevard and strictly not on the shore line to minimize disturbance to fauna. These services will help sustaining the maintenance of the park in long run with the help of controlled management system. These ancillary services along with the ecological center can create job opportunities for local people to be a part of the developed area as per their skills, contributing to the socio-economy of the region.

Ecotourism:
Informative tours for environmental awareness about ecology of this bay could be promoted. Ferries to Elephantana Island can help for the public recreation and economic sustenance.

Plantation management:
For conserving the ecosystem it was suggested to preserve the existing flora on the site with the comprehensive program on plantation management. The boulevard and trails in the park were proposed to be accentuated by planting native species. Sewri mangrove lands have already been declared as protected area by MbPT and need to be conserved during construction of transportation projects at the bay.

Park Management:
Activities in the park need to be managed from various aspects like access controls, timings, maintenance and continual improvement. Access ways to fort and waterfront were recommended to be strictly pedestrian with consideration to alert distance (fauna at safe distance from humans) and noise level restrictions to minimize disturbance to biodiversity of the area.

Neighbourhood development:
The abandoned yards and factories around the site can be strategically planned to merge with proposed ecological park in future extension. Existing Sewri village and small commercial units were proposed to be redeveloped forming mix-use community, which will help operation of park in long-run.

Sustainable approach for waterfront development at eastern bay

The sustainable waterfront development at eastern bay and creation of public spaces for the city can be managed by following approaches:

- Accessibility is the key to making the eastern waterfront a usable space rather than neglected backyard of the city. Every possible site on eastern bay coast needs to be studied and analyzed for its development suitability.
- A coastal act specially designed for MMR’s water edges need to be formulated to regulate the developments.
- Development of comprehensive design strategy and management policy outlined specific to the local, ecological and social context of each individual site on the eastern bay is important.
- Biodiversity required to be protected by involving environmentalists, organizations, local fisher folk and alert citizens in the proposal stages of developments.
- Eastern bay can become a part of the ‘Enclosed Coastal Seas’, which are managed by international ‘Environmental Management of Enclosed Coastal Seas’ (EMECS) center for efficient management.

Conclusion:
The study illustrates that identity of eastern bay can be uplifted with sustainable planning approach.
The success of waterfront development schemes lies in the organized management and maintenance over a period of time. As stated before, the idea of sustainable development comprises balance between social, ecological, and economic aspects. However, to accomplish this goal for public welfare, there also has to be a paradigm shift in the governing authority's role. Policy level decisions need to be formulated with unified involvement of authorities, local experts, and citizens. This would make noticeable change in perspective towards waterfront development in metropolis like Mumbai. The findings and recommendations of present study would help expedite this process as well as the practical implementation of such schemes benefiting the society.

References:


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