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## ESTUARINE ISLANDS WITHIN MUMBAI METROPOLITAN REGION: A STUDY OF NON-GEOGRAPHICAL, CONNECTIVITY INDUCED RURAL-URBAN FRINGE

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### Abstract

*The Northern part of Indian West Coast is known as Konkan. Mumbai is the largest metropolitan city in this region. In the MMR (Mumbai Metropolitan Region), the landscape comprises of creeks and estuaries. Near the mouth of the creeks, estuarine islands have been formed. There are three such islands, namely Panju Islands, Wadhiv island, and Jhow island. These islands are similar in several aspects and have peculiar characteristics. Being very near to Mumbai city, they have a great economic as well as ecological relevance.*

*Today, these islands, though within the MMR, are sheltered from the urban impact due to poor transport and inaccessibility. This presents a peculiar case of preserving a rural landscape in the midst of one of the largest metropolitan city. Population of these islands shows an interesting mix of rural and urban characteristics. In this sense, they present a non-geographical rural-urban fringe, which is determined by absence of connectivity.*

*These islands face an immense pressure of urban neighborhood, and may become a part of the mainland city one day. Development of transport shall make these as one of the several suburbs of Mumbai. This is also a matter of concern since these islands host a dense mangrove vegetation and a rich bio-diversity. The paper presents a comparative study of these islands, their socio-economic characteristics, their environmental importance and their future in an ever-expanding Mumbai.*

**Keywords:** MMR, Estuarine Islands, Urban transport, rural-urban fringe

### 1. Introduction:

Among various mechanisms causing widespread environmental degradation, conventional urbanization in its numerous manifestations has been identified as the most hostile and pervasive mechanism. Today, urbanization is facilitated by rapid growth of transport infrastructure that adds on to the environmental degradation process, in a collusive manner. In fact, these two agencies feed each other multiplying the environmental threat potential. It is this cooperative process which facilitates rapid spreading of urbanization around major urban centers.

## 1. Introduction:

However, these mechanisms are brought into play essentially by socio-economic forces. For example, spread of urbanization around major cities is caused by increasing population influx that results in saturation in population density that the city can handle. In the process the eco-systems around the city are subjected to threats.

Among such ecosystems, those of coastal islands in close proximity to major urban centers form unique study areas today. These areas exhibit the marine ecosystem which is the most fertile/abounding ecosystems in the world providing shelter to diverse and unique floral and faunal community. On the other hand, such areas exhibit dynamic interplay of socio economic forces caused by geographic isolation and poor transport connectivity vis a vis rapid growth of urbanization and transport connectivity in the immediate neighborhood.

Absence of tertiary activities or industrialization on such isolated islands does not encourage population influx. At the same time, a highly bio-rich diverse marine ecosystem thrives in such islands specifically because there are no widespread human activities interfering with the environment. Thus, lack of development in conventional sense, acts as a savior of the fragile coastal environment. However, there are some unique areas where a proper mix of conditions may exist which demand predictive investigations on prospects of impending urbanization and its environmental impact, so that the urbanization can be designed to minimize the environmental impact.

This paper is a predictive study on the prospects of urbanization and environmental impact of estuarine islands near Mumbai, India, that precisely satisfy the above conditions. In particular, it examines the socio economic forces which play an important role in the co-operative growth of urbanization and transportation with reference to a unique, semi-rural, sparsely populated study area, which is characterized by geographic isolation, highly challenged transportation, but at the same time witnessing intense urbanization and transport connectivity in its immediate neighborhood - thereby subjecting the relatively virgin island ecosystem to a potential threat. The comparative study and analysis reveals a major threat to the eco-system of some of these islands, which is a result of rapid urban growth and transport infrastructure encompassing the islands driven by intense socio-economic forces. Thus, in general terms, this study also reflects upon the complex interplay between environment, economic forces and transportation network peculiar to such island environments.

### 2.1 The Study Area:

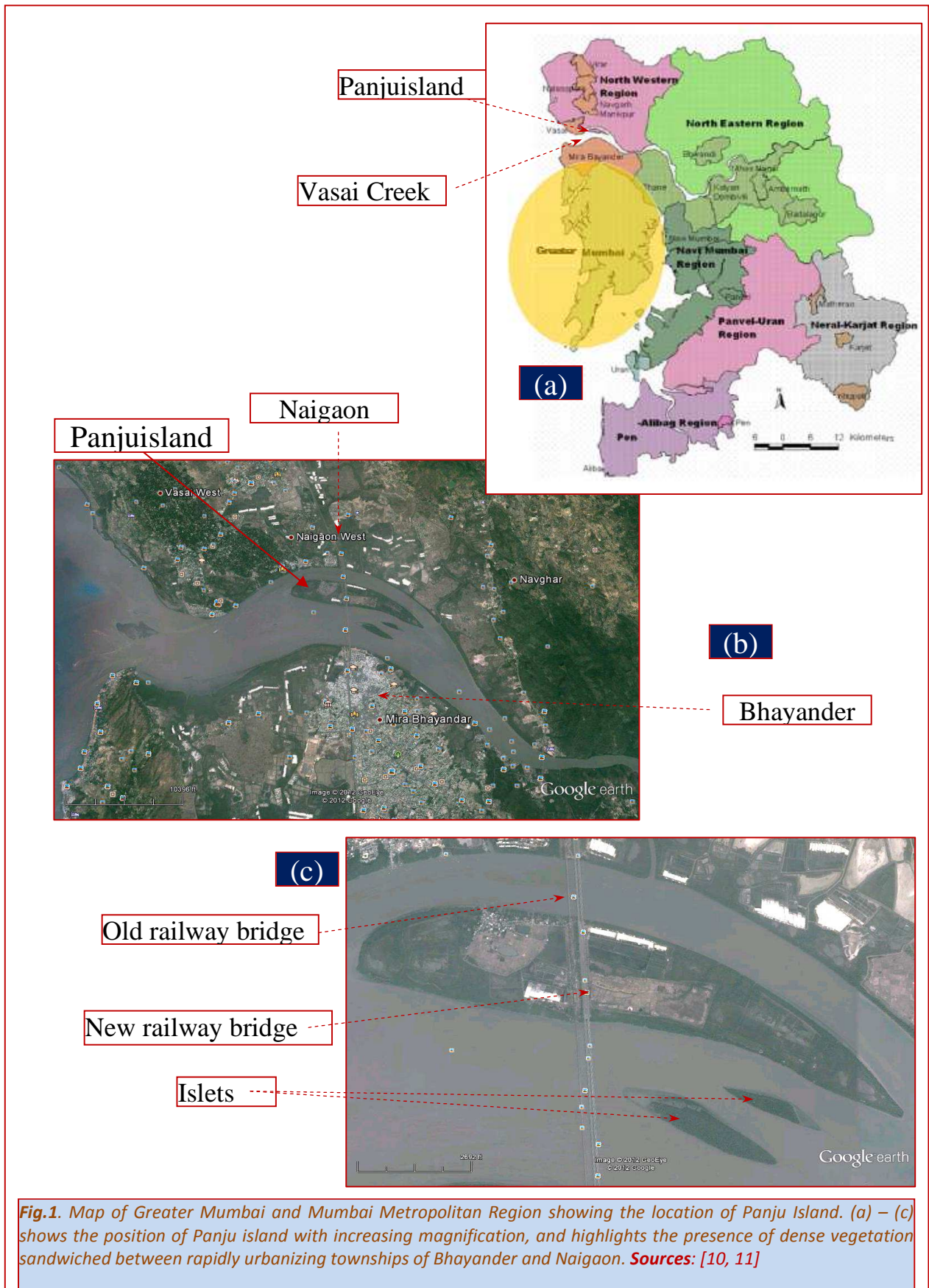
Three islands have been selected for this comparative study. These are Panju island(s), Wadhiv Island and Jhow Island. Panju island is an estuarine island in the Vasai Creek in Thane district of the Mumbai Metropolitan Region (MMR) (Fig.1), located at 19°19' 59" N 72° 51,00"E to 19.33°N 72.850°E, with a maximum elevation of 1m. It measures about 4 kms in length and only 800 meters across the middle, and is sandwiched between rapidly growing modern townships of Bhayander and Naigaon in the western suburbs of MMR.

The other two islands, namely Wadhiv and Jhow, are in the estuary of Vaitarna river, which falls north of Vasai Creek. Wadhiv is located at 19°31' 45" N to 19° 31' 50" N and 72° 52' 7"E to 72° 51' 49"E and Jhow island is 19 ° 30' 00" N and 72 ° 49' .01" E. These islands occupy the same river, Wadhiv being landwards, while Jhow is towards the mouth of the estuary.

Panju island, with an area of about 600 acres, is inhabited by approximately 1500 members of Aagri population. Wadhiv measures about 700 acres and has about 500 families scattered in three hamlets, namely Wadhiv, Vaiti and Saravili. The combined population is about 3000. The third island, Jhow is uninhabited. All the three islands are at sea-level and large portions of it are covered by chunks of mangrove forests. A common characteristic is that the island margins have mangroves and the interior land has been cleared for cultivation. Salt pans are also found in Panju. Traditionally, the main profession of the community is farming, fishing, salt farming and manual sand excavation.

The ancient village of Panju island is a unique example of isolation of an area that is sandwiched between rapidly growing modern townships of the Mumbai Metropolitan region. The primary reason for such isolation, despite a western railway bridge running across it connecting the Vasai area with the Salsette island is the absence a local station, and more importantly, lack of a roadway bridge to the main land. The ferry service with small transport boats operating from 6 AM to 9 PM is the only means of connectivity except during monsoon and bad weather. The other option is a 30 mins walk along the old defunct railway bridge from Naigaon, or 90 mins from Bhayandar. Both are unsafe modes of transport particularly for children, the aged and the infirm.

Wadhiv had been unaffected by the urban impact till recently, being further northwards to Panju and beyond the local train termination point, Virar. In terms of connectivity, Wadhiv has more severe problems. Unlike Panju, there is neither a ferry service nor any road. The western railway line passes over Wadhiv without taking any stop.



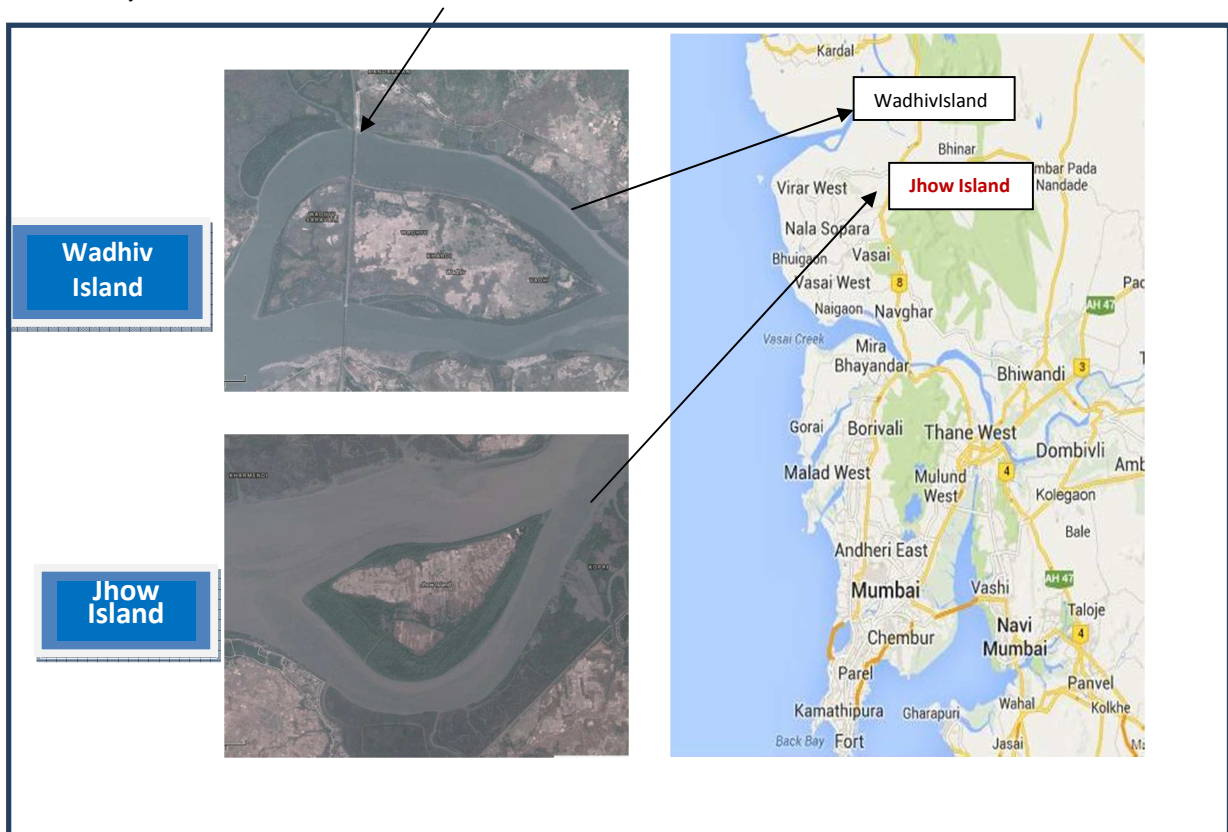
**Fig.1.** Map of Greater Mumbai and Mumbai Metropolitan Region showing the location of Panju Island. (a) – (c) shows the position of Panju island with increasing magnification, and highlights the presence of dense vegetation sandwiched between rapidly urbanizing townships of Bhayander and Naigaon. **Sources:** [10, 11]

**Methods:**

Thus, the only means to reach the island is a 45-minute walk over the bridge, from Vaitarna Station, the nearest railway halt. The bridge is old, and doesn't have enough space to walk between the rails. The people walking over the railway bridge are dangerously close to the train passing by.

Jhow is an altogether contrast to the earlier two, being a totally uninhabited island. It is more seawards in the Vaitarna estuary. Apart from the absence of a road link, the island is far from the railway line as well, making it an almost inaccessible location. Since the island is uninhabited, there is no need of regular ferry service. Only local farmers, who own agricultural fields on the island, visit the island with the help of small boats. These three islands share many common characteristics with respect to their formation, environmental conditions, social fabric, exposure to urban way of life and the problems faced.

Western Railway line



### 2.2 Techniques:

The study was carried out by using a combination of various techniques. As a first step, a pilot survey was carried out to determine the strategy, logistic requirement and research instruments for the main survey.

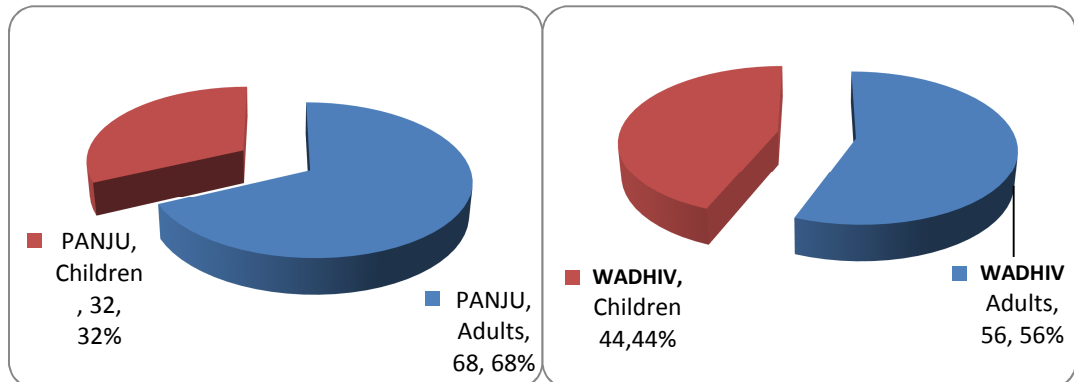
A comprehensive field survey was conducted using direct demographic survey technique through a questionnaire based door-to-door interview on Panju and Wadhiv. A survey questionnaire was designed to assess the socio-economic condition using standard indicators, however, with a focus on determining the state of urbanization and the factors influencing it. The survey itself was implemented through a door-to-door interview. The sample households were chosen on a random basis. The total population of Panju Island as per 2011 Census [13] is 1362. It was estimated that the number of households may be around 300. In order to cover about 30% of the population for a statistically meaningful data, 90 households would need to be surveyed. However, owing to constraints of time and feasibility and team resources, a sample size of 88 households was chosen. Population of Wadhiv is a combined number of three hamlets, namely Wadhiv, Vaiti and Saravili. A sample of 134 households was taken to represent the total population of 2400.

Information about Jhow Island was obtained from the 36 farm owners who reside in the nearby hamlets of Chikhaldongri and Naringi. This part of the study was used to determine the internal socio-economic forces acting as a driver for potential urbanization of the islands.

### 3.1 Demographic structure of Panju and Wadhiv:

At Panju, a random survey of around 88 families comprising 450 populations shows 68% adult population and 32% children, below the age of 18 years (**Fig 3**). A high percentage of population consists of aged people indicating that healthcare facilities may be accessible. In comparison to adults, percentage of children is quite low representing a typical feature of urbanization. In Wadhiv however, the percentage rises, showing the diminishing urban impact.

**Fig.3: Age-wise population structure of the Panju & Wadhiv Islands**



3.a. Panju Island

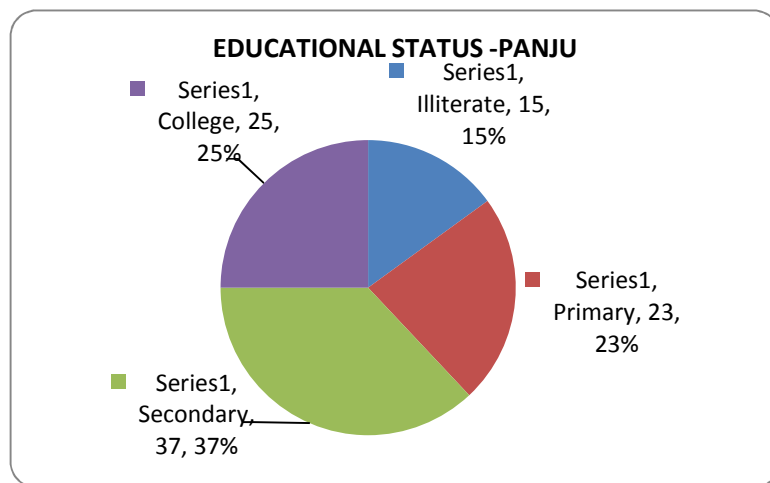
3.b. Wadhiv Island

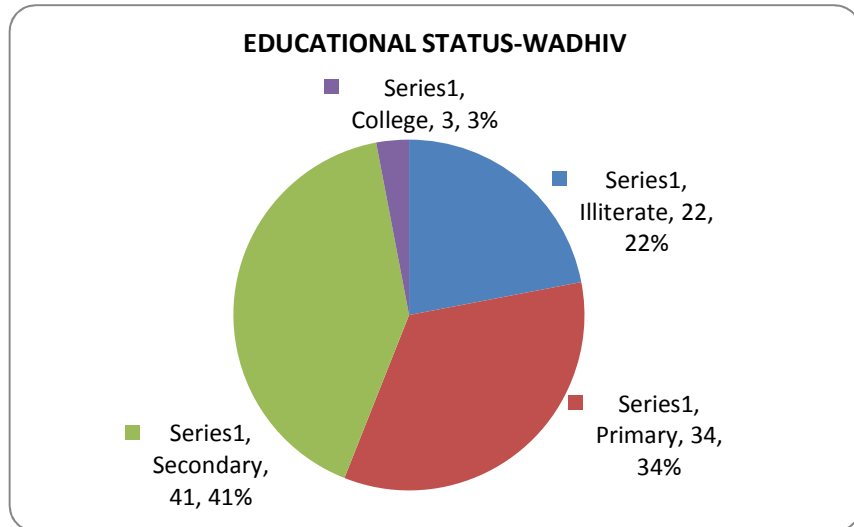
An interesting finding [14] was that the total population of Panju is approximately 1500, which comprises about 200 temporary workers who come from outside to work in the salt plants, agriculture, fishing as well as for construction. Wadhiv does not have any outside migrants

**3.2 Educational Status of the Population:**

Educational level shows a wide variation among adult population as shown in Fig 4. On the other hand, all children of eligible age are attending school. One primary & secondary school is located in Panju island. However, for attending higher classes and college, the Panju residents have to come to the mainland, either to Naigaon or to Bhayender. The comparative educational status of adults and children clearly exhibits the changing trend in favour of education.

**Fig- 4(a) Education Status of Panju Population**



**Fig.4 (b). Educational Status of Wadhiv Population**

Wadhiv, however, still has a negligible percentage of students attending college, while the percentage of illiterates is also higher. This can be clearly attributed to the comparative advantage of Panju regarding the nearness to the Mainland Mumbai and also to a relatively easier access to the mainland due to availability of regular ferry service.

### 3.3 Occupation Status of Population:

People of Panju island represent a varied occupational structure (Fig. 5). The traditional economic activities of the Island are salt production, sand dredging and agriculture. At present, sand dredging without Government permit is illegal, which has significantly limited this activity. Salt pans are also limited, more over absolutely seasonal. Agriculture, limited to paddy cultivation, is also on the decline in face of competition from technologically advanced approaches in the mainland. Thus, at present according to the survey data, major source of income for the people of Panju island are from various secondary and tertiary services in the mainland.

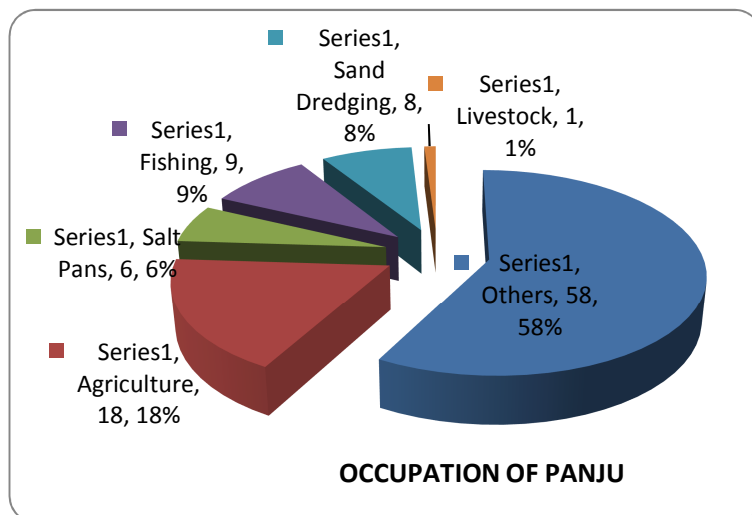
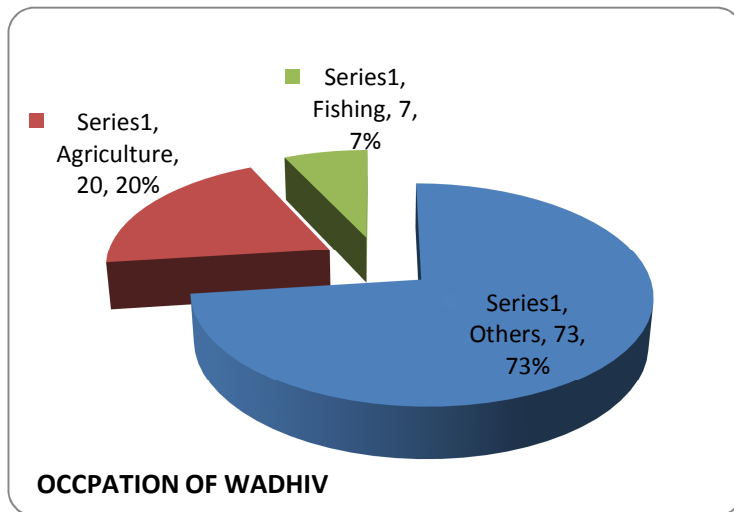
The survey revealed that job, business, medical treatment and education constitute the major reasons for Panju residents for travelling to mainland. The data indicates that Panju has more traders traveling to mainland for business activities. The frequency of travel is very high, with 70% of the members of surveyed households traveling 5 to 7 days per week. The average earning of Panju residents is Rs. 14000 per month, which is moderate by Indian standards.



**Results & Discussions:**

In Wadhiv, a large proportion of population goes to Mumbai suburbs for work, and has no other allied activity than paddy cultivation. The conditions do not favour salt manufacturing since River Vaitarna brings sweet water into the estuary. Until recently, sand dredging was a very lucrative option to the village. The river-sand brought from landward side by Vaitarna, had a high demand in the construction business. However, as sand dredging has been declared illegal, most of the local youth has been rendered unemployed. With only seasonal paddy cultivation and jobs in nearby towns, the per capita earning of Wadhiv is only Rs. 10000 per month.

**Fig. 5: Occupational Structure of the Islands**



### 3.4. Problems of Islands:

#### 3.4.1 Problems of PANJU Island:

The ferry service can hardly meet the rapidly increasing requirements for traveling to the mainland. There are only ten households who own boats. It was confirmed during the survey that the only means to travel to the mainland during monsoon and at night is by walking along the old defunct railway bridge which can be quite hazardous. (Fig. 6)

**Fig. 6: Old defunct railway bridge, used as the only means for traveling at night, and during monsoon when ferry operations get suspended.**



Lack of various service infrastructures primarily owing to absence of transport connectivity was reported as the major difficulties faced by the inhabitants. Responding to a different set of questions probing the single most perceived benefit of a road bridge connecting to the mainland and/or rail station, 92% of the total surveyed families indicated that healthcare needs would be best served. Proper medical facilities are not available in Panju Island, with one primary health center offering only basic services. The people of Panju always have to travel to mainland for their treatment. This leads to acute problems in arranging medical attention during emergencies occurring at night when ferry operation is not available. Apart from accidents, criminal and unsocial activities were rated by 70% of the surveyed households as major difficulties for communicating to the mainland by the old bridge at night. For child bearing mothers, prior arrangements are required to be made to accommodate them in the mainland. All the surveyed households expressed the need for either road or railway connectivity, or both (78%). It was clear that with the passage of time, the requirements will keep increasing. Many in the surveyed population expressed deep apprehensions that in future without road and rail services their survival will be a major problem.

#### 3.4.2 Problems of WADHIV Island:

The most serious problem affecting every household in Wadhiv is the water availability. The island has no source of water, since there is no rocky outcrop. The entire island is made up of sand and silt. Vaitarna estuary has brackish water which is useful neither for drinking, nor for salt production. A small, 3 inch-diameter pipeline running along the railway bridge was the only source of water to this remote island. However, as the trains pass over the bridge, the vibration of the bridge causes frequent loosening or cracks in the pipes. Most of the water, thus, is lost into leakage. As mentioned earlier, the two shallow wells on the island do not provide any potable water. As a result, the biggest challenge to the 2400-odd population is struggle for their daily need for water. Like Panju, there is no means of transport to the village, except a 45-minute walk over the old railway bridge. However, during the survey, 97% of the respondents cited water availability as the most serious problem, rather than the absence of connectivity. Womenfolk from each household, walk over the railway bridge to Vaitarna every day, carrying a 15-litre container of water on their head. Each trip takes about 1.5 hours. For a major part of the day, the women are busy only in fetching water. Moreover, this exercise is extremely risky. While walking over the bridge, if trains from both the sides, they have to balance themselves within a narrow gap between the two rails. There have been many instances where these women have fallen off from the bridge into the river 250 ft. below.

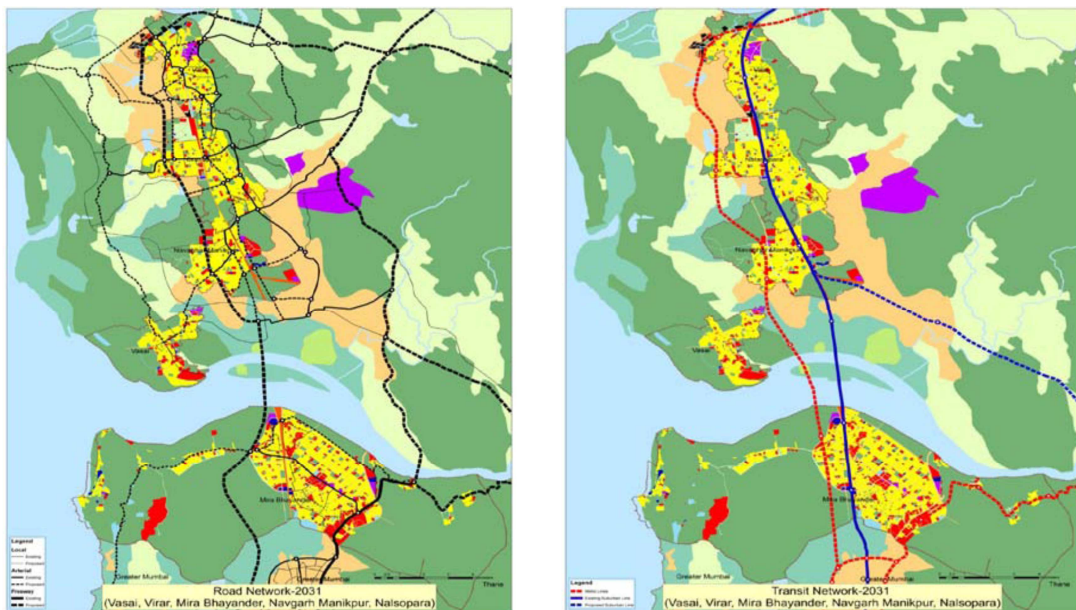
Another perennial problem this island faces is the salt water intrusion during monsoon rains. The high discharge from the river raised tidal levels and high wind speeds carry a large amount of salt water into the paddy fields on the island. Every year, acres of paddy are ruined by the sea-water. The protective walls made around the island get breached every year.

Unlike Panju, there is no ferry service from the Wadhiv to the mainland as it is not commercially viable. During the rains, walking over the narrow slippery bridge also is very difficult. Hence, at least for a few days in the rainy season, Wadhiv is cut off from the outside world. The residents have to collect the rainwater for their survival.

### 3.5 External Socio-Economic Forces:

The MMR (Fig.1) is the fastest growing metropolis of India and is likely to become the largest metropolitan region of the world by the year 2031. The mother city of Greater Mumbai acts as a powerful engine driving the growth for the whole region. The Government of Maharashtra has initiated a project study through a Comprehensive Transport Strategy (CTS) [10] to construct a coastal highway and railway system by 2031 to address the requirements of transport and also help reduce pollution and generate recreational spaces in the city, in turn enhancing the quality of life in the city. A major component of the MMR development plan envisages laying of roadways and additional railway lines across Vasai creek connecting Panju island with both sides of the creek (Fig.7)

**Fig.7: Map showing proposed roadway (black dot) and railway (red dot), and, along with existing railway (solid blue) over Panju island**



This scheme of development suggests significant urbanization along the coastal region that will act as a major external driving force pushing for semi-urbanization of Panju island. It is clear that the roadway/railway will provide a rapid access to Panju island meeting not only the urgent need of the villagers, but also enable population influx in the island region. Such influx would be driven by high turnover industries such as coastal or island tourism for which Panju island offers an ideal location. The possibility of inclusion of the two islets close to Panju island also cannot be ignored.

Results & Discussions:

As these highways shall run close the other two islands, i.e. Wadhiv and Jhow, these also may convert into a semi or fully urban settlements. Road connectivity or a local railway halt over these islands shall completely change the present geographical, social and economic picture of these islands. Easy availability of land near the MMR shall invite large-scale construction activity, and land prices may sharply rise to be at par with the MMR. Jhow, which is an uninhabited and virgin island as yet, may become an ideal location for high-end secluded residential or an entertainment complex. All these changes are bound to happen within a time period of a decade or two.

**3.6 Threat to mangrove ecosystem of Panju island:**

Based upon the outcome of our studies on the internal socio economic forces in Panju island influenced by the urban lifestyle and infrastructure in its immediate neighbourhood, as well as, on the external forces that would be generated with the implementation of the MMR development plans in a not so distant future, it is postulated that Panju, Wadhiv and Jhow islands will tend to evolve into an urban out growth. In turn, this may create a major threat to the virgin, highly bio-diverse, estuarine and mangrove-ecosystem of these islands, but the small sister islets nearby.

The estuarine eco-system, as observed during the surveys, was found to consist of dense vegetation and mangrove forests comprising mainly of *Avicennia marina* , commonly found in the inter-tidal regions of estuarine areas. Close to the shorelines several species of organisms were identified, such as, mudskippers, various species of crabs including fiddler crabs, and numerous types of oysters and snails. In comparison to the other polluted coastal regions of MMR, the mangroves of these island are still fresh and un-polluted.

4. Conclusion:

In conclusion, the study brings out for the highly probable conversion of Panju, Wadhiv and Jhow islands from their non-urban status owing to geographic isolation & absence of transport connectivity, to an urban outgrowth in about a decade. This would be driven by both internal socio economic forces as well as external mechanisms arising from extensive transport connectivity planned in the future. Island tourism and construction are the most likely causes that would intensely drive urbanization of these fragile environments. The threats to the estuarine ecosystem that such urbanization and commercial use might create, that emphasizes the need for suitable planning to minimize the adverse effects on the environment.

Conclusion :	<p>These unique pockets within the MMR, are socio-economically backward, but very significant in environmental terms. They offer a diverse and further scope of research study on its geographic features, demographic features including more penetrating study of the socio-economic condition and its evolution, historical evolution of the habitation, and most importantly on the environment and ecosystem of a virgin estuarine island. It is expected that the environment and eco-system preservation of these islands would stand to gain substantially from future studies focusing on these aspects.</p>
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