# Fishing Village to Mangrove City Reinstating the Symbiotic Relationship of Mangroves and Fishing Villages for a Sustainable Future

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***Abstract*—This research mainly aims at studying the depleting fishing communities and mangroves in Mumbai and the eminence of their organic existence for a sustainable future. Firstly by understanding various approaches taken by multiple institutions globally to preserve mangroves and their impact on the fishing villages. These villages are dependent on resources from mangrove forests and fishing for their livelihood. Secondly, analyzing the contribution of mangrove and fishing communities, through their symbiotic relationship to our environment. The research includes national and international attempts to preserve fishing villages, by studying their (villagers') wisdom, and their interest, in protecting these mangroves through a traditional approach. This lead to designing various strategies and modules to preserve both the community as well as mangroves. This module can protect cities or regions like Mumbai (affected by mangrove depletion) from future threats of natural calamities, with the help of various sustainable approaches.**

***Keywords: Mumbai, mangroves, symbiotic, sustainability, fishing villagers***

## I. INTRODUCTION

Mumbai is a cosmopolitan city today but originally it was distorted into seven islands with small Adivasis and fishing communities called Kolis, completely dependent on forest and sea for their livelihood. The city invited traders and merchants from various states and Persian kingdoms increasing job opportunities. Still, the fishing community did contribute to a major percent of the economy. The villages were moved over time, making space for the migrants and helping with the development of the city.

Industrialization turned the world to the next phase, the city aspired to be a part of the same which sidelined the original inhabitants. With urbanization at its peak in the 20$^{th}$-century migration to the city was beyond measure, this lead to the reclamation of land which change the geography of Mumbai over decades. With the increasing population, there was a need for more area which then lead to cutting thousands of tons of mangrove over time. This cost about 40% depletion of mangroves today. This changes the course for fishermen from fishing amidst the mangrove to deep-sea fishing.

Urbanization had a huge impact on these fishing villages decreasing the number to a quarter of what it originally was. This impacted the city in many ways, with increasing floods over the years which hit the Koli villages first leading them to deteriorate the communities and pushing the future generation to opt to look for other opportunities for better income and livelihood. With no mangrove to act as a breeding kitchen for fishes, many species go extinct over the period of time. With increasing housing demands many villages were shifted from their original location with the influence of contractors and Politian's for better livelihood uprooting them from their traditional and cultural techniques of fishing, boat construction, and maintaining mangroves. This also leads to a major disconnect between the fisher folks and the mangroves. With rising disconnect there were no guardians for the mangrove, leaving them abandoned for dumping industrial waste and plastic heaps deteriorating the mangroves and their ecosystem.

## II. LITERATURE REVIEW

The no of fishing villages has decreased over time due to excessive fishing and depletion of mangroves. Mumbai lost near half of the mangrove it originally had in the past two decades Studies show that the sustainability of the mangroves is a crucial challenge because of the difference in interest and diverse value of resources around the ecosystem. It is therefore important to consider the larger picture, target group (which group of the community will benefit the most), and who can maintain the mangrove in the best possible manner, all these factors should be considered for the sustainability of mangroves. But who should we give the responsibility of maintaining mangroves? Who will they maintain the mangrove? These are questions one must ask! The fishing villages are aware of the kind of trees available in the mangrove forest and meet their needs through the forest and water body along the mangrove.

It's only right that they maintain and sustain the mangroves. This way we protect the mangroves and the settlement along the mangroves from high-rise floods or any other threats due to the depletion of mangroves for is it essential that they stay along the mangroves and guard them. This means that the fishermen along the mangrove can play a major role in preserving the mangrove. There might be multiple ways to preserve mangrove but maintain them are important and this is continues process, therefore, it proves essential to put the people who are aware of the information or technique required to maintain the mangroves continue to maintain them.

There are many fishing communities in Mumbai which have been shifted from their original location for urbanization

and city development. They were sidelined with time. There are many such fishing villages all over the world with similar challenges, studies show various housing initiatives to protect these fishing communities. Real estate and increasing dumping ground deteriorated mangrove in the city extensively

Many proposals and design strategies have been implied to resolve their challenges, which can be applicable for Mumbai as well. Multifunctional approach to save the fishing community and its dying wisdom of preserving mangrove and fishing (maintain the natural cycle). Through a sustainable approach will be a long-term solution for the community and encourage them to take it forward.

## III. SCOPE

Studies show many infrastructural solutions that can be ideal solutions for fishing villagers that can act as a guardian fence for the mangrove belt along the west coast of Mumbai.

There are various approaches to protect villages from future threats of mangrove depletion, pollution, and various other climate threats which will lead to rising sea levels, flooding, hurricane, and earth quacks. In order to come up with a sustainable and long term solution, it is important to study the following: Threat assessment, Local material, Local construction skills, and Organization and NGO for funding

Through international case studies, we learn that it is important to study the traditional wisdom of housing construction and the sustainable approach to maintain a balanced ecosystem by integrating both technology and traditional housing technique.

## IV. LIMITATION

There are no studies done on how to preserve the fishing villages and their traditional knowledge, in India especially in Mumbai. There are detailed studies on the technical aspects of preserving the fishing village. Therefore the initiatives, advantages, and disadvantages of fishing villages are not much known.

The study directs more towards how mangrove is important to be preserved and how can fishermen play a vital role. The threat to these villages in the future is much worse due to the threat of sea level rising. There is no preparation or future planning done to protect the fishing villages along the coast which will be completely underwater in the future, latest estimation of the Mumbai flood 2050 ( (Rising sea may put 36 million Indians at risk by 2050, 2019).

## V. SITE STUDY

Identifying fishing villages in Mumbai and studying which villagers are near mangroves was the first part of the site selection process.

Table 1. Cause Of Disconnect By Fishing Village with Mangrove

| Location | Type | Cause |
|---|---|---|
| Uran | Relocated fishing village | Navi Mumbai Airport |
| Vashi<br>Belapur | Villages with no interaction with mangroves | The mangrove exist in the location but the fishing village prefer<br>Deep sea fishing |
| Pachu Bandar<br>Panju Bandar<br>Naigoan | Active fishing village having active Interaction with Mangroves | Cutting and planting mangrove trees for wood<br>Making boats using mangrove wood<br>Crab farming<br>Mangrove fishing |
| Versova<br>Madh | Active fishing village having passive Interaction with Mangroves | Only crab farming and fish ponds along the mangroves<br>Not making use of the mangroves or cutting mangroves for resources |
| Jui Gaon | | |

### A. *Active fishing village having Active Interaction with Mangroves*

All the 3 sites are low-level areas ranging from 1m-5m, except for Naigoan which shows 12% are only under no threat. Therefore as per 2100 Sea Level Rise Projection for Mumbai and nearby region to 1m -6.5m. Pachu Bandar is under great threat because of the population and lack of mangroves to protect them from rising sea level threats. Pachu Bandar is a Locality in Vasai City in Maharashtra State, India. It belongs to the Konkan region. It belongs to Konkan Division.

Table 2. Mangrove Fishing Village with Maximum Threat

| MANGROVE FISHING VILLAGE | RISING SEA LEVELS TREAT -2100 | DEPLETION OF MANGROVE | POPULATION |
|---|---|---|---|
| PACHU BANDAR | 100% | 72% | 12000. approx |
| NIGOAN | 88% | 35% | 4000. approx |
| PANJU BANDAR | 100% | 10% | 500. approx |
| RESULTS | Pachu Bandar | Pachu Bandar | Pachu Bandar |

## VI. PACHU BANDAR

Due to the peculiar location of the site with the Arabian Sea on the south and reserved forest on the north with Vasai fort within the forest. The village was untouched by the influence of urbanization and therefore the site has a different character compared to other fishing villages. Pachu villagers are very much rooted in their traditional and cultural values. While comparing all the existing fishing villages in Mumbai most of the villages are affected by urbanization and therefore lost their core tradition and cultural value. Also, most of the fisher folks are turning away from fishing due to the lack of fish in the sea over time. This poses a great threat to not only our city but on a global scale. Therefore it is important to protect

and preserve the existing villages and their skills, also it's important to maintain and preserve their association with mangroves to protect the villages from future threats.


*Figure 1: location. Source: google earth*

## VII. ECOLOGICAL STUDY

It is very important to study and understand the geography of the site in order to understand the existing and future threats.

### *A. Contour study*

With the help of contour mapping, it was easy to analyze the area that will be affected by flooding to study the future threat that can impact the village to analyze the future need for the village. In this format, the village sinks up to 4 feet during heaving rainfall. This threat can increase with rising sea levels. Therefore it is also important to study and analyses the rising sea level threats. The global mean sea level is projected to rise by 2m at the end of this century. However, to determine local sea-level rise (SLR), one has to take into account local coastal flood levels which could be 2.8m above Mean Higher-High Water (MHHW) at extreme forecasts. These local levels bring variability to the projected SLR from 1m to 6.5m (e.g. Rio vs. Kolkata). (Owen Mulhern, 2020).

### *B. MANGROVE CONDITION*


*Figure3: section of existing mangrove in Pachu Bandar*

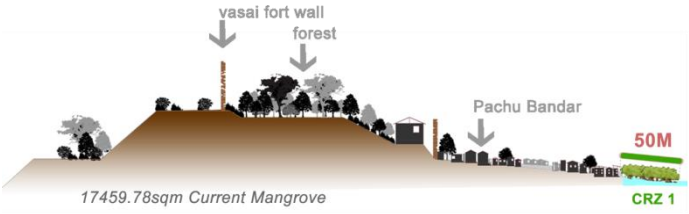



*Figure 4: section showing potential growth area*

To protect the village from future threats we must replant the mangroves, the existing mangrove is not sufficient to protect the village from future flooding and sea-level rise. It has been reported that mangroves can reduce the height of wind and swell waves by up to 66% over 100 m; and reduce the water level of storm surges between 5 and 50 cm per km of mangrove width (McIvor et al., 2012;). The diminished energy of incoming waves also lessens the risk of flooding to communities that live behind mangroves (Spalding et al., 2014). As per CRZ norm, CRZII –SHORELINE AREA: includes designated urban area that is substantially built up. Construction activities are allowed on the landward side only Minimum width required for curbing rainwater storms and flooding of 6m which is the future assessment for 2050 is 1kmTherefore to protect maximum ground cover it is essential to make use of the exiting soil conducive for mangrove growth and replant mangrove to protect the village from future threats.

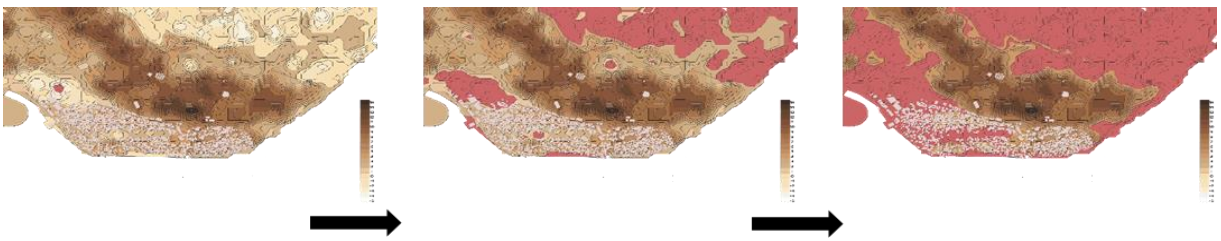
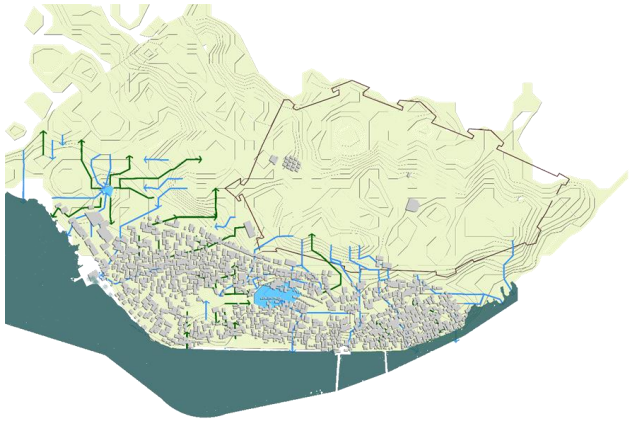


*Figure 2: flood analysis*

## VIII. TOPOGRAPHY STUDY

### *A. Ridge amd Valley*



*Map 1: Ridge Valley Map*

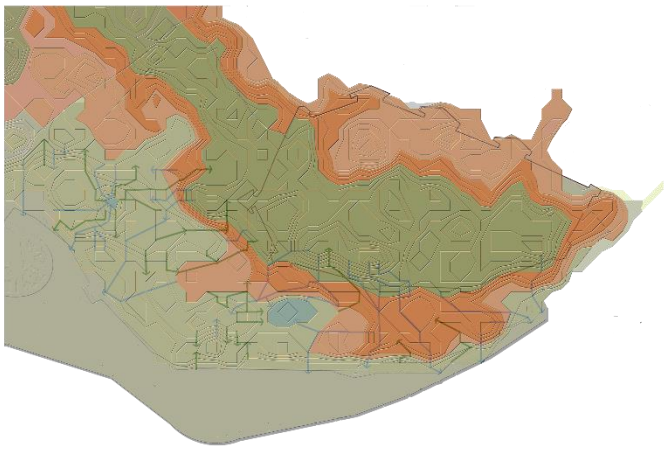
By the ridge valley map helps us to identify the valley, which should be preserved and not obstructed with any construction. The ridge valley map also inform us about the natural body and its buffer area which should be preserved and maintained to avoid flooding in these area also replacing the temporary and permanent settlement from the buffer area from future threats of sea level rise and flooding.

### *B. Terrian and Soil Study*

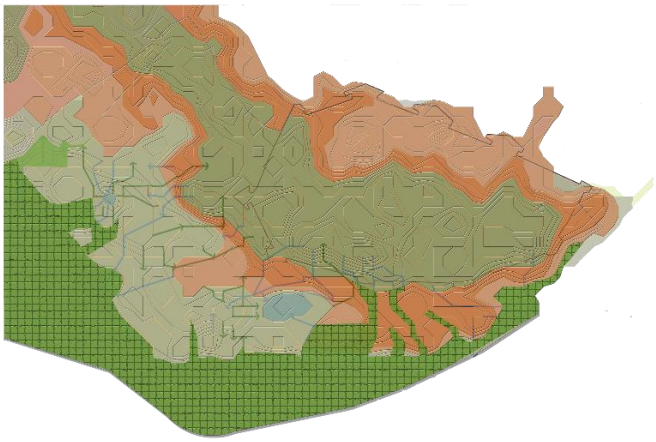
Terrain map and soil map will help us to identify which are suitable for mangrove plantation and which areas are not. Coastal plain is suitable for mangrove plantation and structural hill for forest. (Map 2)

## VIII. CULTURE AND TRADITION

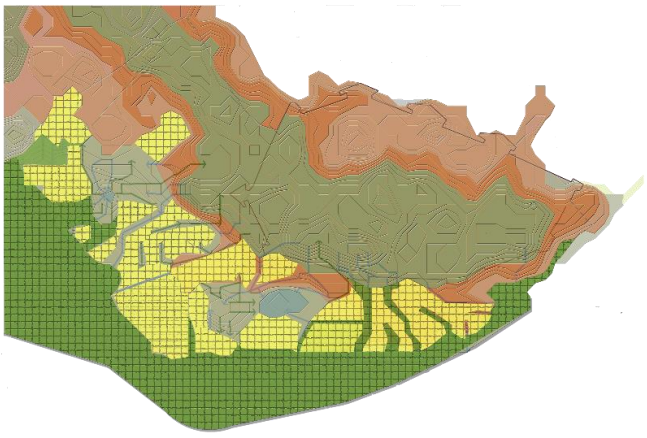
The entire village is divided into two major groups one is the Christian community and Hindu community. The work in harmony without any religious bias .initially the Hindu koli communities where the first group of people that settled in Pachu Bandar. Post the invasion Portuguese, Vasai become a very important port for fishing, many communities where converted to Christianity during this period of time. Therefore there became two distinctive settlement. Over the period of time with increasing job opportunity and growing fish business there came in multiple settlement both temporary and permanent, bridging the gap between the two communities organically. Chapel acts as a place to pray for the community. In a Chawl, Two-three houses contribute to making one chapel .The wealthy family has their own chapel in their house. This chapel becomes the Identity of the house. Even though they are owned by wealthy people it's open for all for praying. The Christian community has members with a chairperson, treasurer, and committee members, so far 12000 Christian men are part of the committee. They own 183 boats. The old market is currently used by both communities. There is no religious dispute in the village, they work together in harmony with separate bodies. A separate body helps to manage the issues within the communities.



**The overlay of terrain soil and ridge valley map**



**the green area is identified as areas with potential for mangrove growth**



**the yellow area is identified as area suitable for housing and amenities construction .**

*Map 2: Overlay of terrain and soil Map*

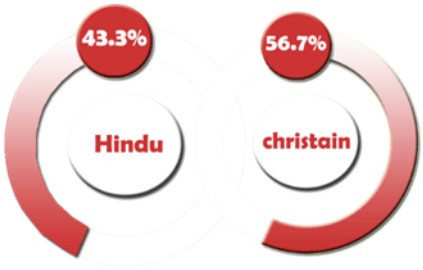



*Figure 3: Hindu -Christian percent*

The Hindu community has members with a chairperson, treasurer, and committee members, so far 750 men are part of the committee. Initially, there was only one body but post a dispute between communities in 2000, then after they act as two separate bodies. They own 73 boats now building their own market .Hindu communities visit the temple which is outside the village or they have their small prayer place inside the house. The fishermen weave their own net. They prefer doing that early morning. Weaving net is done during January to march, New Year feast, mostly celebrated on the 2nd Sunday of January. Which is a celebration of peace Offering for their god. Every family brings food prepared from their own house as an offering. 'Narali Punav'. (Fig.3)After this day, the wind and the waves favor fishing in the deep seas. The entire community celebrates this day as the onset of a new harvesting season, much like the farmers. Prayers are offered to the sea god, and boats are treated as sacred. All the village celebrate the wedding together without religious or status disparity .The village stands different from the city-rooted to their tradition.

## IX. ACTIVITY INTERDEPENDENCY

The village is divided into four parts. This division was done earlier in 2001 century by the Municipal council of Vasai region for numbering the housing. Many people from nearby remote villages here for labor and settled here in temporary settlements, forming slums and blurring the division.

The main market is in Pachu Bandar therefore all are very much dependent on that area. The government school and the drinking water is located in Killa Bandar so kids and women are more seen in that area. Rest every other amenities are divided in all four areas with equal access. Festival and other social activities are celebrate together as a village. The government school and the drinking water is located in Killa Bandar so kids and women are more seen in that area. Rest every other amenities are divided in all four areas with equal access. Festival and other social activities are celebrated together as a village.

*Figure 3: Narali Punav*

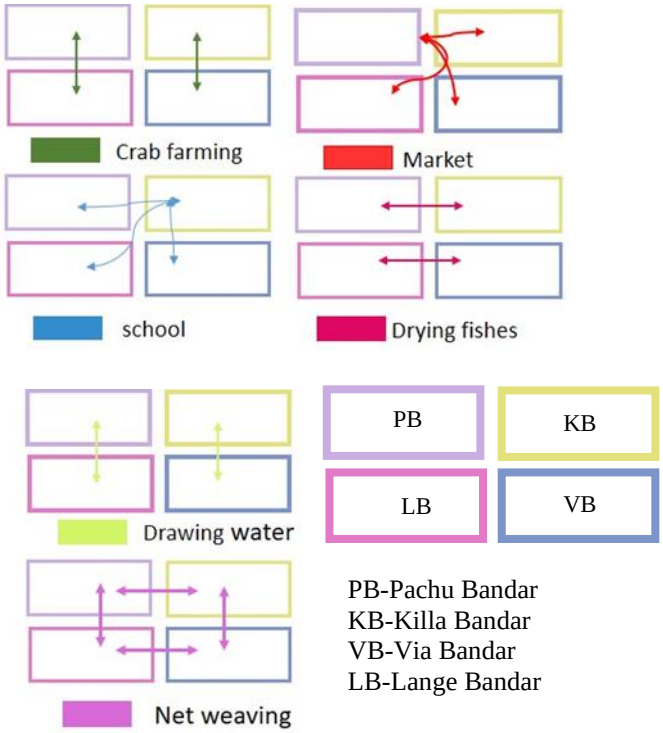



*Figure 4: Pachu Bandar divided into 4 parts*

## X. SWOT ANALYSIS

The community shares a very strong bond in all the social, cultural and traditional activities, but at the same time they maintain sub groups within the communities for daily activities like drawing water from the well, weaving fishing net, drying fishes , washing clothes ,women support group etc. The village suffers a serious concern with sanitation and poor living standards because of the informal settlement which increased over the years due to migration. Therefore the social bond and the standard of living are important factors to be considered during intervention.

Table 3: SWOT Analysis

| **Strength** | **weakness** | **opportunity** | **threat** |
|---|---|---|---|
| 1.Strong social structure<br>2.Skilled fisherfolk<br>3.Strategic location (forest –north& sea south )<br>4.Engagement with the mangroves | 1.Poor sanitation<br>2.Less mangrove<br>3.Poor housing condition<br>4.Lack of open space | 1.To Reinstate the relationship between mangrove and fishing village<br>2.Preserve and improve social structure<br>3.Replant mangroves<br>4.Scope for Stilt and floating mangrove housing | 1.Rinsing sea level<br>2.Poor health and sanitation<br>3.Flood impact on Housing |

## XI. INTERVENTION

### A. *Phase-wise development of the site.*

**1) Phase 1-3YEARS** (2022-2025) Mangrove Replantation

a) Make use of a grid to guide, mangrove plantation
b) Understand the social hierarchy
c) Make use of existing road network and desire line for platform network
d) Plan the village setting with the help of social economic and cultural functional zoning and make the grid guidance for mangrove plantation.

*Figure 5: Mangrove Plantation*

**2) Phase 2-3YEARS** (2022-2025) Mangrove Housing

a) Enhance community owners
b) Promote community employment
c) Establish nursery for training
d) Planned sustainable water supply with the help of rainwater harvesting using floating barrels and increasing freshwater ponds and artificial water bodies.
e) Planned sewage Treatment system: use of mangroves for water treatment is a sustainable approach for wastewater management.

**3) Phase 3-10 YEARS** (2040-2050) Mangrove City -Sea Housing Typology

a) Strom water storage and biogas plant

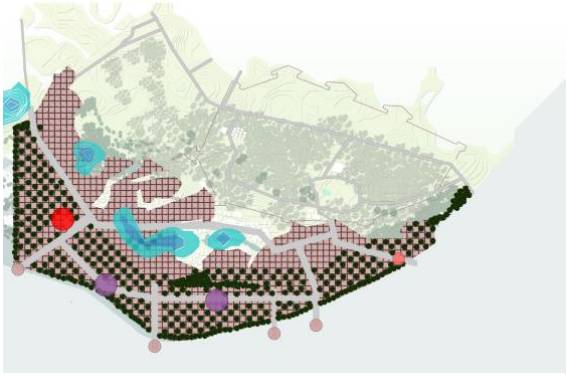


*Figure 6: Mangrove Housing*

b) Mangrove timber can be used for housing construction and the construction skill of the local community should be utilized for the same.
c) Stilt height: 6.5 meters as per the threat analysis Temporary housing and housing without plinth to be demolished and proper stilt housing should be allocated using public or government funding.
d) Bangalore with plinth can use pile House-Lifting Technique to Survive Floods.
e) Existing housing above the threat assessed level should be maintained.
f) The buffer around the water body will be no construction zone, only plantation and recreational space should be allowed.
g) Do not promote fish or crab farming in the natural water body to maintain its natural PH level and from water pollution.
h) Construction along the valley should be strictly prohibited for the proper channel of water flow from the hill to the valley.

*Figure 7: Mangrove City*

### B. CONCLUSION

Many initiatives have been put forth but not for the fishing communities dependent on mangrove fishing because they are the minority among the existing deep-sea fishing communities. Even though there are various organization that is carrying out various initiatives to preserve mangroves, we are ignoring the importance of maintaining the fishing cycle along the mangroves. This can be only done through the help of fishing communities, fishing along the mangroves from generation, with their traditional knowledge and skills. Creating an identity for this community by providing them with proper infrastructure and facilities will encourage them to continue and grow as a community and become self-sustainable. Studies show mangrove city, stilt unit typology and the concept of mangrove sustainable design can be an ideal solution for fishing villagers, to act as a guardian fence for the mangrove belt along the west coast of Mumbai. Mangrove architecture is a whole new era for which we should be acting now. Instead of using a post destruction mode, it's better to act now for the future threats and Mumbai is at its peak, and many cities will face the consequence of high sea-level rise, therefore with the help of various organizations and government aid we can act on these threats

now and protect the fishing villages which has a share contributing not only to the economy but also to the whole mangrove ecosystem.

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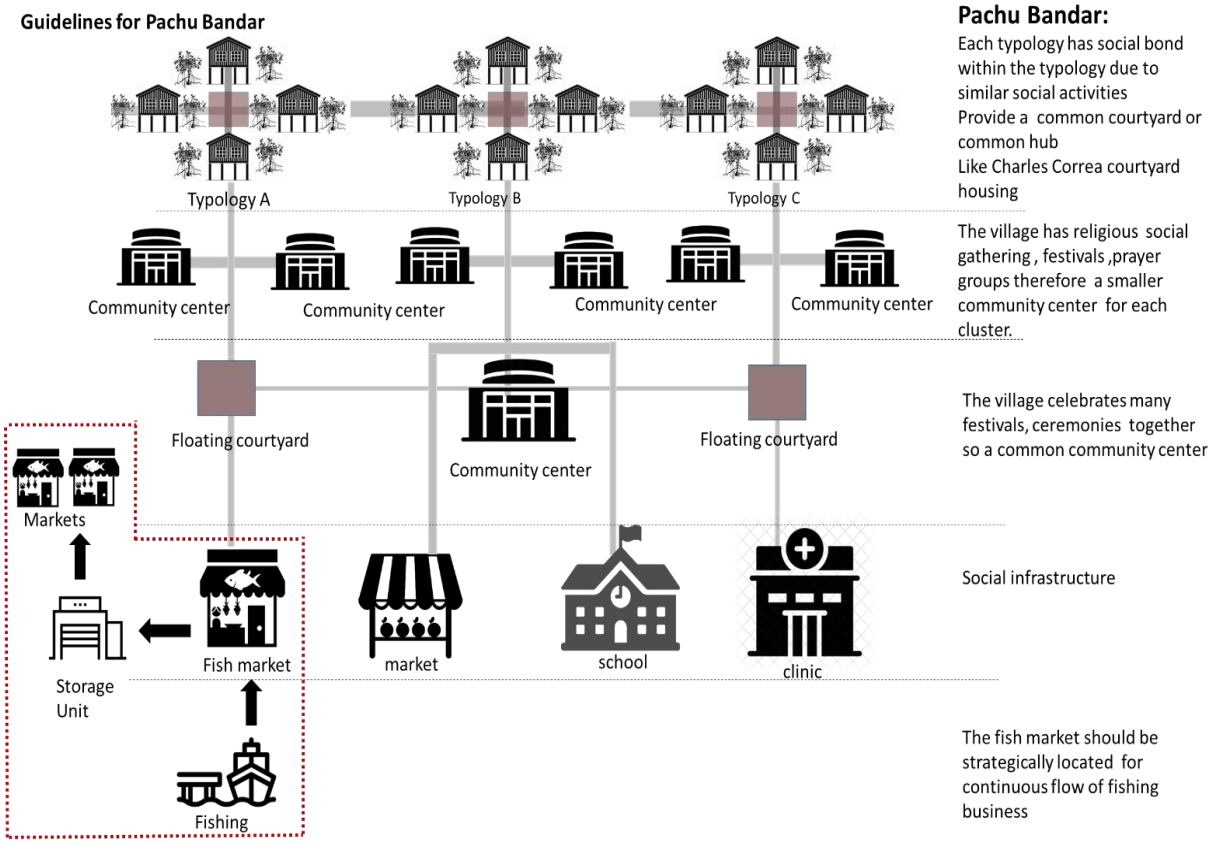


*Figure 8: Intervention Strategy*