

**STRATEGIC FRAMEWORK AND ROAD MAP FOR  
BUILDING RESILIENCE OF COMMUNITIES IN SUNDARBANS**

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# **STRATEGIC FRAMEWORK AND ROAD MAP FOR BUILDING RESILIENCE OF COMMUNITIES IN SUNDARBANS**

## **Contexts**

1.1 Sundarban is the largest river delta in the world, spread over 200 islands, separated by nearly 400 interconnected tidal rivers and creeks, at the confluence of Ganga, Meghna and Brahmaputra in the Bay of Bengal, spanning across India and Bangladesh. It is the habitat of world's largest contiguous mangrove forest and abode for nearly 500 wildlife fauna including the enigmatic Royal Bengal Tiger. The Sundarban reserved forest areas of the two countries have been designated as Ramsar Wetland and further enlisted as World Heritage Sites in the late eighties and early nineties. The legal, institutional and operational frameworks for conservation of mangroves and bio-diversity and protection of wild life protection have been well established in both the countries with reasonable measures of success despite the adverse impacts of climate change and extreme climatic events.

1.2 Sundarbans is also the habitat of about 13 million people of which about 5 million people live in 19 development blocks of the twin districts of North and South 24 Paraganas of West Bengal in India. Human settlements in the islands of Sundarbans had existed long before the advent of the British, but it was the British policy of leasing land to Zamindars and small cultivators that encouraged large scale migration of poor people from Orissa, Mednipore and Chota Nagpur who cleared the jungles for agriculture, raised embankments for protecting agricultural fields and dug ponds for conserving rain water for drinking. Such settlements took place on the west of Sundarbans towards Calcutta that were connected by new built road and railways. Gradually such settlements spread over towards the islands on the east, mainly after the partition of India and further after the emergence of Bangladesh. Population of Indian Sundarbans have multiplied from 11.50 lakhs in 1951 to 44.86 lakhs in 2011 with average density of 987 per sq. km.

1.3 Although population of all the 19 blocks of Sundarbans are mostly marginal farmers and share croppers, many of them living below poverty line, there is marked disparity in the standard of living of the people of 3 million people living in the 10 development blocks that are well connected by road and rail, and 2 million people living in isolated islands. The Human Development Reports of North and South 24 Paragana districts prepared in 2009

highlighted these ‘layers of intra-district disparities in development’ in terms of education, health, employment, connectivity, access to banking and income. While the connected 10 development blocks of Sundarbans are fully integrated with the mainland, the isolated 9 blocks are living in a different world altogether, struggling to survive daily in hostile environment marked by rising tides, sinking lands, intruding saline water, without the basic services of decent living, often migrating to other districts and States in search of livelihood. The cumulative impacts of these physiographic and climatic changes and the rising frequencies and intensities of extreme and slow onset natural hazards will make the conditions of these poor and marginal people living on the edge even more difficult in the coming years. This will create an existential crisis for about 2.5 million people with enormous human tragedies unless there are serious deliberations for building resilience of the communities of these isolated island blocks through well planned and coordinated initiatives for reducing risks of disasters and adapting to climate change.

1.4 In this context a three day international symposium was organized by the School of Environment and Disaster Management of Ramakrishna Mission Vivekananda Educational and Research Institute, in collaboration with the School of Oceanographic Studies of Jadavpur University and Department of Sundarban Affairs of Government of West Bengal, to bring together scientists and researchers from various disciplines, policy makers from various sectors and practitioners from the fields to discuss and develop a strategic framework and road map for building resilience of local communities during the next two and half decades - from 2025 to 2050.

### **Challenges**

2.1 A strategic framework on future development of Sundarbans must respond to the multi-dimensional challenges faced by the isolated islands. There has been an upsurge of research on these challenges based on scientific evidences on the patterns, trends and likely scenarios in physiographic, climatic, socio-economic, environmental and other related areas in the isolated island blocks of Sundarbans.

2.2 **Physiographic challenges:** There are five clear trends in the physiographic changes of Sundarban delta and these include a consistent loss of landmass and loss of mangroves in habited islands, increase in land subsidence, rise in river sedimentation and salinization of soil and water.

- a) **Loss of landmass:** Tidal waves, storm surges and massive volume of water drained into the Ganga-Bhagirathi-Hooghly channel during monsoon have combined to cause continuous erosion of landmass in Sundarbans, particularly on the western side. The rivers have also deposited silts at some location creating new landmass, but rate of land erosion has been more than three times that of land accretion. During 1993-2000 net land loss was 283.58 sq. km, averaging 2.85 sq. km per year. This has sharply increased to 4.5 sq. km a year after 2000, due largely to frequent breaches in embankments. A few islands – Bedford, Lohachara, Kabagadi and Suparibhanga – have submerged completely, and a few others – Ghoramar, Jambudwip and Bhangaduani – are eroding at a rapid pace. Unless the embankments are made strong enough to withstand tidal waves and storm surges through structural measures and bio-shields the rate of land loss will increase.
- b) **Loss of mangroves:** Around 110 sq. km of mangroves have disappeared in reserve forest area due to erosion, and a large chunk of mangroves outside the forest areas have been lost due to encroachments, while 81 sq. km was gained in the inhabited area through plantation and regeneration, showing both the problems and prospects for mangroves in Sundarbans.
- c) **Land subsidence:** Landmass of Sundarbans is sinking gradually due to the combined effects of the natural tectonic tilting of the Bengal basin towards the east and the anthropogenic process of compaction of loose deltaic deposits due to human settlement cultivation. Land subsidence in Sundarban is taking place at an average rate on 2.4 mm per year, with some areas showing much higher subsidence of 6.9 mm per year, making the area extremely vulnerable to flooding as well as sea level rise.
- d) **River sedimentation:** Silt deposits in the river beds and along the river banks of Sundarbans have increased as most of the rivers are no longer connected to large upstream river sources due to the construction of Farakka barrage. This has simultaneously reduced the water holding capacity of the rivers and raised the water levels of rivers, making the habited islands more vulnerable to floods and sea level rise.
- e) **Salinisation:** Sea level rise, rise in tidal waves and storm surges, breaches in embankments and reducing flow of sweet water in the rivers, particularly on the eastern side have combined to raise the level of salinity in soil and sub-soil in southern parts of Sundarbans. In some areas, salinity has increased beyond the safe

threshold for agriculture. Soil tests carried out post cyclone Aila found saline infiltration beyond a depth of 1.5 meters in most areas.

2.3 **Climatic change:** Climate of Sundarbans is changing like in other parts of the country and the world, but such changes are much more pronounced in Sundarbans and are clearly visible in all four parameters – rise in temperature, uncertainties in precipitation, rise in sea levels, and increase in frequencies and intensities of extreme climatic events

- a) **Rise in temperature:** Sea Surface Temperature (SST) in Bay of Bengal has been rising at the rate of 0.5°C per decade since 1980, which is much higher than the global average. Warmer sea water causes more evaporation, condensation and depression leading to increasing frequencies of cyclonic storms. Warmer sea further causes thermal expansion of water, leading to sea level rise. Land temperature in
- b) **Uncertainties in rainfall:** Various studies have indicated that increase in SST beyond a threshold impacts rainfall negatively. This is leading to longer but drier monsoons where single rainfall events are becoming more intense. Such erratic rainfalls are not distributed evenly through the monsoon season leading to patches of dry monsoon during Kharif season which is affecting agriculture in Sundarban which depends almost entirely on monsoon.
- c) **Sea Level Rise:** Sea Level Rise in Sundarban has also been higher than the global average – 5 mm/year compared to 4.4mm/ year globally. This is due to the combined effect of thermal expansion of sea water due to rise in SST, river sedimentation at the confluence due to silt load and land subsidence due to compaction of loose deltaic deposits. Geological Survey of India has estimated that one meter rise of sea level may inundate about 1,000 sq. km area of Sundarban delta. The islands of on the seaward side are most vulnerable to seal level rise. Other islands are also vulnerable as sea level rise will make tidal waves and storm surges even higher, posing higher risks to embankments and human settlements.
- d) **Cyclonic storms:** Rise in sea surface temperature has resulted in increasing frequencies and intensities of cyclonic storms in northern Bay of Bengal. Historical average of one cyclonic storm in a year and one severe cyclonic storms in five years has given way to five cyclonic storms and one severe cyclonic storm every year. Sea level rise and river sedimentation has compounded the impacts of cyclones in Sundarban delta.

2.4 **Socio-economic challenges:** The cumulative impacts of the physiographic and climatic changes have adversely impacted on the life and economy of Sundarbans and these are clearly visible in the declining income from agriculture and fisheries, loss of livelihoods, rise in level of poverty, rise in distressed migrations, and worsening conditions of women and children.

- a) **Dwindling agriculture:** Nearly 70 percent of population of Sundarban depends primarily on agriculture for their livelihood. Agriculture in the deltaic islands is inherently constrained by marginal landholdings of the farmers and near absence of irrigation facilities, which means that multi-cropping cannot be practiced extensively. Agriculture is further constrained by lack of institutional support of credit and essential inputs and infrastructural support of storage, transportation and marketing. Climate change and its associated parameters of rise in temperature and uncertainties in rainfall is adversely impacting on agriculture. Extreme climatic events like cyclonic storms and slow onset events like sea level rise and salinization are further precipitating the crisis of agriculture.
- b) **Declining fisheries:** Fishing is the main source of protein for the islanders and is the primary occupation of about 17 percent of the population of Sundarban. Diminishing returns from agriculture has prompted many farmers to shift to fishing. Over exploitation, increasing level of salinity in estuaries and unsustainable fishing practices are the main causes of the dwindling fisheries resources of the delta. Prawn aquaculture (*bhedis*) in paddy fields that had flourished in some islands have collapsed in most places, and *bhedis* converted into illegal brick kilns. Inland fisheries have suffered setback due to saline water ingress and poor state of maintenance of ponds.
- c) **Loss of livelihoods:** Declining agriculture and dwindling fisheries have forced people to look for alternate avenues of livelihoods such as collection of honey, bees wax, tannin bark and fuel wood from the mangroves at grave risks to their lives. Collection of tiger prawn seedlings from their breeding zones in river banks and mangrove fringes is another alternate source of livelihood due to high demand of such seedlings. Unscientific harvesting of such seedlings, especially during the breeding seasons, have led to the dwindling stocks of fries.
- d) **Distressed migration:** Migration has emerged an important option for alternate livelihood and coping with distresses caused by failure of crops and fisheries. Various studies have established that post-Aila more than 75 percent of the households in

Sundarban had one or more male member who migrate every year for working in construction and other sectors in various parts of South and West India and some of them have managed to migrate to West Asia, Singapore and Indonesia to work as labourers in various projects. The remittances sent by them have significantly boosted the income of the families. The migration has also its flip side in child labour, semi-bonded labour and trafficking of women and children. Covid-19 caused reverse migration of thousands of workers back to Sundarban raising doubts on the efficacy of migration as an effective tool for livelihood and adaptation.

- e) **Unequal burden of works of women:** Migration of male workers have had discriminatory impact on women as their burden on work increased immensely. In addition to their normal household work of cooking, looking after children and elders they have also to cultivate the fields, look after cattle, and go for fishing for sustenance. These additional burdens of works have adversely impacted on their health and wellbeing. More than 50 percent women of Sundarbans are anaemic, about 58 percent girls are underweight and 18 percent malnourished.
- f) **Rising levels of poverty:** Poverty in Sundarbans is multi-dimensional. More than 47 percent of the households do not own any land; more than 95 percent of those who own land are marginal farmers; about 52 percent households are landless agricultural workers, surviving on wages earned on their labour. An overwhelming 87 percent of population have no food security; close to 21 percent do not get food even once a day. Fragmentation of land holding is further accentuating marginalization of the work force. More than 50 percent population of the island blocks are living below poverty line; in some of the blocks like Basanti more than 68 percent of the households live in abject poverty.

### **Strategic approach**

3.1 The geographical isolation, ecological sensitivity and socio-economic backwardness of the region called for an area specific strategic approach for development of the region. Unfortunately, such strategic thinking for development of the region has been missing altogether. The constitution of the Sundarban Development Board (SDB) in 1973 under the aegis of Development and Planning Department, with specific mandates of formulating integrated development programmes for the region and coordinating implementation of such programmes, provided opportunities for developing such long-term development plan for Sundarban region. This does not seem to have been ever done; on the contrary, the

coordinating role of SDB was slowly given up, allowing line Departments to function independently with their own plans, projects and activities, often leading to avoidable duplication of activities and resources. SDB practically lost its role of planning and coordination and monitoring in 1994 when it was placed directly under the newly created Sundarban Affairs Department (SAD) to function as its Directorate or implementation agency.

3.2 Almost every line department of the Government of West Bengal – Forest, Irrigation and Waterways, Public Works, Power, Public Health Engineering, Agriculture, Fisheries, Revenue, Tourism, Education, Environment, Panchayats and Rural Development – have their own programme and activities in Sundarban, often working at cross purposes, without the knowledge and intervention of SAD. The role of SAD has remained confined to implementation of a few minor projects on connectivity (culverts, jetties and bridges), agriculture, fisheries and social forestry that are not attended by other departments. During the financial year 2024-25 total budgetary allocation of SAD was Rs. 600 crores of which an amount of Rs. 76.32 crores could be utilized till ending December 2024. No consolidated information on budgetary allocation and expenditure of line departments on Sundarbans are available with any agency.

3.3 Cyclone Aila in May 2009 and the massive devastations it caused triggered strategic thinking on the future of Sundarbans. World Wild Life Fund India pioneered the discussion with its *Indian Sundarbans Delta: A Vision*. Published in March 2011, the vision document provided a long-term perspective of 40 years in the future in four phases. In the Phase I, it was proposed that all the 19 CD Blocks of Sundarbans be identified as a single administrative unit instead of being part of two separate districts and people living in six island blocks of Patharpratima, Kultali, Basanti, Gosaba, Sandeshkhali II, and Hingulganj within the Sundarban Biosphere Zone be supported to make a living from non-farm/secondary or tertiary production activities for their eventual shifting to non-biosphere zone of the districts. In phase-II, physical infrastructure shall be developed in these identified non-biosphere zone for absorption of the emigrating population. In Phase III, the emigrated population shall be provided counselling, and financial inducements including compensation for their resettlement in the new areas. The vacated 6 blocks shall be returned to nature for regeneration of mangroves and development of eco-tourism.



3.4 In 2014 the World Bank came up with its strategy report on *Building Resilience for Sustainable Development of the Sundarbans* through estuary management, poverty reduction and biodiversity conservation. The report classified the Sundarbans in three zones – Stable, Transition and Core – and recommended that 1.54 million people living in 9 blocks of transition zone should be shifted to the stable zone of remaining 10 blocks and beyond in Kolkata metropolitan region, as ‘their best and safest prospects for improving their plight are outside this zone’. The report recommended four pillars of interventions – vulnerability reduction, poverty reduction, biodiversity conservation and institutional changes.

3.5 The twin reports of WWF and the World Bank generated some debates in the academic world, but unfortunately failed to trigger any serious thinking in policy making and governance circles, which continue to follow the business-as-usual approach to development. It is high time that a strategic framework is developed that factors all the physiographic, climatic and socio-economic challenges that will provide guidance for building the resilience of local communities in short, medium or long terms, in realistic, feasible, time bound and sustainable manner.

3.6 Communities should be placed at the centre of any discourse regarding their future. They have been living with the nature for generations, have intimate knowledge about the forces, its resources and hazards, and have developed indigenous capacities for coping with the adverse conditions of nature. Their lives and livelihoods, hopes and aspirations are organically connected with their lands and surroundings and every effort shall be made to find solutions to the challenges within their habitats.

3.7 Large scale evacuation of people from their habitats must be avoided at any cost as this will cause unimaginable human sufferings as there is hardly any land available in the hinterland or anywhere in the state of West Bengal for rehabilitation of about 2.5 million people, socially and economically. This will lead to social strife, communal tension and ethnic clashes and disturb peace and harmony of the region at grave cost of the life economy of the region.

3.8 Compulsory evacuation of people should be restricted as a last resort for only those hamlets that have the imminent danger of submergence. Such areas shall be identified through comprehensive assessment of risks, based on irrefutable scientific evidences. The process of resettlement of such at risk population shall be carefully planned in consultation with the affected communities to ensure that they are fully rehabilitated.

3.9 Voluntary migration of people, particularly of the young and aspirational generation, should be encouraged for better opportunities of livelihood, through an appropriate incentive structure, skill development, and facilitation, while strengthening necessary regulatory mechanism to ensure that migration does not lead to human trafficking and exploitation.

3.10 Resilience of the local communities can be developed through four pillars of interventions.

- a) Estuary management
- b) Mangrove regeneration
- c) Livelihood generation
- d) Disaster risk reduction

### **Estuary Management**

4.1 Seven main tidal river systems or estuaries flow through the Indian Sundarbans into the Bay of Bengal - *Hooghly, Muriganga, Saptamukhi, Thakuran, Matla, Bidyadhari and Harinbhanga*. Barring Hooghly all other tidal rivers are getting disconnected from upstream supply of water. River beds are getting silted and channels are getting diverted breaching embankments and increasing salinity of soil and sub-soil.

4.2 In the upper delta, a basin wise approach may be adopted jointly with Bangladesh for rejuvenation of tidal rivers of Sundarbans that would be beneficial for both the countries. This will increase the flow of sweet water into tidal rivers, reduce the level of salinity in rivers and facilitate both agriculture and fisheries, while increasing flow of sediments that can partly neutralize overall loss of land due to sea level rise. The options for re- establishing the links of the tidal rivers with upstream wetlands that have been encroached for human settlements or converted into shrimp farming should also be explored for enhancing the supply of fresh water into the rivers.

4.3 In the lower delta, availability of fresh water may be expanded by re-excavation of creeks and the excavated materials may be used for strengthening the embankments. The stalled projects on construction of new embankments and improvement of existing embankments can be completed through a rehabilitation policy that will compensate the villagers for acquiring land under occupation. Innovative design and technology for construction of embankments can be adopted, wherever possible, that will allow trapping of sediments between two layers of embankments facilitating natural growth of mangroves. Bio-

fortification of embankments can also be considered through plantation of vetiver grasses that are acclimatized in saline conditions.

### **Mangrove Regeneration**

5.1 Mangroves in forest areas affected by erosion and salinization and human ingress can be relatively secured by better management of estuaries to increase the flow of fresh water and supply of sediments; and innovative practices such as rainwater harvesting in areas affected by saline blanks and trapping of sediments through measures like terracotta rings and porcupine traps.

5.2 Mangroves outside the forest areas can be regenerated through active participation of local communities. There are successful models of community-based mangrove management that can be further improved through innovative practices. Communities understand and appreciate the ecological services of mangroves better than others and they can become the main stakeholders in new mangrove plantations and better management of existing mangroves outside the forest areas. MGNREGA and other funds can be used extensively for community-based mangrove plantations. Mangrove nurseries can be created involving women self-help groups, providing a regular source of income for such groups. The plantations can be maintained and protected by the local community who can be trained for creating a value chain in such plantation. Integrated mangrove cum aquaculture farming can be practiced generating additional income for the community. Carbon sequestration capacity of such community-based mangroves can be estimated and these can be traded in the emerging carbon markets.

### **Livelihood generation**

6.1 Agriculture and pisciculture are the main occupations of the people of Sundarbans and both are badly affected by the physiographic and climatic changes. There are tested and successful models of climate resilient farming and fishing practices in Sundarbans and these should be promoted and replicated on a large scale through infrastructural, extension, credit and marketing support on a mission mode. A time bound integrated plan for development agriculture, inland fisheries and animal husbandry can be drawn up for each block for initial five year for creating value chains that can substantially augment income and livelihood opportunities for the people of Sundarbans. Based on the lessons learnt these plans can be revised and further improved on an ongoing basis.

6.2 Under the National Innovation in Climate Resilient Agriculture (NICRA), Indian Council of Agricultural Research through their twin organisations of CRIDA and ATARI and field agencies of Krishi Vigyan Kendras, have developed various innovative climate resilient agricultural technology and practices that can be adopted by the farmers suitable adjustment according to their conditions. These include land shaping and rain water harvesting, land embankment and ail cultivation, broad bed cum trench system, submergence tolerant and soil tolerant rice varieties, floating and staggered seedbed of rice etc. A handful of enterprising farmers have adopted these technologies and practices with amazing results, but most the farmers with marginal landholdings are unable to follow due to constraints on initial capital investments. Interventions of State Agriculture Department are needed to hand hold the farmers with support through existing or new schemes to facilitate large scale application of these new technologies and practices in a time bound manner. Cooperative farming can be encouraged to economise the cost of application of these technologies.

6.3 Organic farming and nature farming can also be promoted for growing exotic vegetables and fruits that have a captive market in Kolkata and other urban hinterland. Good quality of watermelon is already grown in Sagar and Kakdeep, chillies in Patherpratima, spinach, bitter gourd, coriander and capsicum that are salt tolerant are grown in most of the villages. Sunflower cultivation is also gaining momentum in many islands. Creation of cold chain for vegetables and fruits can boost the income of farmers from these crops.

6.4 There are incredible traditional knowledge on farming, which needs to be documented with full details regarding the science behind such knowledge. Traditionally grown salt tolerant varieties of paddy (e.g., *Swarna*, *Dudher swar*, *Matla*, *Hamilton*, *Baktulsi*, *Talmugur*, *Velki*, *Nonabokhra*, *Asfal*, *Najani*, *Tilak Kanchari*, *Getki*, *Kanasol etc.*) can be scaled up. Similarly, various local grown weeds that have medicinal values (e.g., *Kulekhara*, *Thankuni*, *Telakucho*, *Gime*, *Jolkolmi*, *Shushni*, *Brhami*, *Purul*, *Punarnaba*, *Gnadal*, *Malancha*, *Kalkasute*, *Giriya*, *Bathua*, *Gumukh*, *Chikni etc.*) can be scaled up.

6.5 Every household or a group of households in Sundarbans have a pond which were dug by the settlers for conserving rainwater for irrigation and drinking as well as for growing varieties of fishes for consumption. Over the years most of these ponds have decayed and natural slopes for draining rainwater to the ponds have also been blocked. These traditional rain water harvesting structures should be rejuvenated and new ponds excavated wherever required so that most of 1900 mm of rainfall that the island receives can be harvested for

agriculture and fisheries. An appropriate scheme can be designed for rejuvenation of existing ponds and excavation of new ponds by way of providing technical guidelines and financial incentives to the farmers owning such ponds, and linking such ponds for development of agriculture and inland fisheries.

6.6 Central Institute of Freshwater Aquaculture of ICAR has successfully implemented a project on enhancement of pond aquaculture productivity through adoption of better technology and management practices in Chunakhali island of Basanti Block and Bali Island of Gosaba Block in Sundarbans. The project has successfully demonstrated that pond aquaculture productivity can be enhanced by three to four times with minimal investments thereby significantly boosting income and livelihood opportunities for farmers. This tested project needs to be replicated throughout the Sundarbans in a time frame of 5 years. Drawing lessons from the project the Fisheries Department of Government of West Bengal may design a project for developing inland fisheries in Sundarbans whereby necessary infrastructural, technical, extension, credit and marketing support may be provided to the farmers for an initial period of three years till they are able to adopt it sustainably.

6.7 There are tremendous potentialities for development of canal, estuarine and marine fisheries in Sundarbans. Shrimp and crab farming that have very high returns may be promoted in a regulated and scientific manner through saline mapping to determine the appropriate varieties that can be reared. *Venami* rearing may be shifted to *Tiger prawn* in saline areas and *Scampy* in fresh water with polyculture. Box fishing is another innovative option that may have game changing potentialities. Organic farming should be encouraged in areas adjoining water bodies to preclude leaching of pesticides into shrimp tissues. Integrated mangrove-shrimp farming may be promoted in saline ponds near embankments. Disease diagnostic centres and related protocols needs to be developed, cold chain (e.g., refrigerated vans) needs to be established, value chain created with involvement of women self-help groups so that local communities are benefited. Fisheries Department may make arrangements for aggregation of produce and establishing linkages with exporters for maximum value addition to the local fishermen communities.

6.8 Estuarine fisheries are regulated by the archaic colonial practices of Boat Licence Certificates that are traded with a premium while genuine local fishermen are deprived of their traditional fishing rights. The entire system needs to be reviewed to make the system more transparent

6.9 Eco-tourism has opened up opportunities of livelihood generation in tertiary sector and marketing of locally produced agricultural and allied commodities and handicrafts, but such opportunities have been offset by unregulated tourist traffic and creation of unplanned tourist infrastructure that have adversely impacted on local environment and stressed critical local resources like safe drinking water etc. This calls for development of comprehensive guidelines on eco-tourism that would discourage large and unsustainable tourist resorts and focus on more on eco-friendly accommodations with involvement of local communities.

### **Disaster Risk Reduction**

7.1 Comprehensive Hazard Vulnerability Exposure and Risk Assessment (HVERA) of all development blocks and villages of Sundarbans may be developed on a dynamic GIS enabled platform. HVERA shall deliver the following products:

- a) Hazard maps of Blocks, Gram Panchayats and Villages on various layers (cyclone, flood, earthquake, drought, river and coastal erosion, land subsidence, river sedimentation, sea level rise) based on latest available hazard zonation maps prepared by the concerned scientific and technical agencies superimposed on 1 cm resolution of maps captured through drone photography;
- b) Vulnerability maps of similar resolution on Blocks, Gram Panchayats and Villages in different layers (housing, physical infrastructure, and social, economic and environmental conditions) based on data collected from authentic sources and field surveys;
- c) Risk maps of Blocks, Gram Panchayats and Villages, integrating hazards, vulnerabilities and exposures (population and economy).
- d) GIS enabled platform in vernacular which will enable communities and other stakeholders to select the layers of hazards, vulnerabilities and exposures for assessment of disasters and climate

7.2 Block, Gram Panchayat and Village Disaster Management Plans may be prepared with participatory approach in a comprehensive manner identifying the local level issues for risk prevention and risk mitigation and for disaster preparedness for response and recovery. While local level disaster prevention and mitigation plans may be integrated with the development plans of line departments, Community Based Disaster Preparedness Programmes (CBDP) may be designed to develop capacities of local communities to respond to disasters in to save lives and assets.

7.3 There should be paradigm shift in post-disaster reconstruction of houses and infrastructure with a focus on Building Back Better so that these withstand the shocks of climate change, inundation and cyclonic storms. Locally available building materials can be used to design climate and disaster resilient houses integrating scientific and scientific knowledge. Location of cyclone shelters should be need based with access to surface communication.

### **Road Map**

8.1 This strategic framework is prepared for a time horizon of twenty-five years - 2025-2050 to inform and guide designing of appropriate projects, programmes and activities in consultations with stakeholders for short (0-5 years), medium (0-15 years) and long-term period (0-25 years) depending on the mobilization of resources from state and central government and other sources.

### **Implementation Mechanism**

9.1 Sundarban Affairs Department may be the nodal department for the planning and monitoring of the projects, programmes and activities to be taken up under the strategic framework in consultation with all stakeholders. The Department shall get these projects and activities implemented through the line departments. The budgetary allocations of all line departments may be the consolidated as the budget of the Sundarban Affairs Department to ensure there are coordination of the activities of all department and there is no duplication of activities.

### **Monitoring and Evaluation**

10.1 Appropriate mechanism shall be developed for monitoring and evaluation of the implementation of the strategic framework