Aquaculture of Native Alga in Inundated Coastal Farmlands: A Pro-poor Climate Adaptive Intervention for Restoring Ecosystem Services

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Geographic and demographic information

Country	INDIA
Province	West Bengal
District	24 Parganas (South)
Size of geographical area	296.4 km^2 (Gosaba Community Development Block)
Number of indirect beneficiaries	Gosaba CDB has total rural population of 246,598. There are 125,901 males & 120,688 females.
Dominant ethnicity	Scheduled ethnic group makes 62.65% (154,484 heads) while scheduled tribes make 37.35% (23,343) of the total populace.

Size of project area	14 km^2
Number of direct beneficiaries	2570 persons (Men: 1020 persons) (Women: 1550 persons)
Geographic coordinates (longitude and latitude)	22°12′44″N 88°46′42″E
Dominant ethnicity	Mostly ethnic (62%) and local tribal (28%) and rest (10%) migrants from other parts of the state

Ecosystem Types

	Forest X		Grassland		Agricultural X		In-land water X
	Coastal X		Dryland		Mountain		Urban/peri-urban

Important species in the site

English common name (*Local name*)	Scientific name	Description
Algae *(Shaola)*	*Enteromorpha intestinalis*	Green filamentous algal flora that grows profusely in saline water, used as feed fodder fertilizer and fuel. Local phytoplankton significant for sustaining primary productivity and carbon capture as well.
Algae *(Pana)*	*Ulva compressa*	Same as above. This is also a biological indicator for salinity and reduced dissolved oxygen.
Mangrove *(Sundari)*	*Heritiera fomes*	Important mangrove flora, dominant species and significant for the habitat. Supports local livelihood.

General introduction

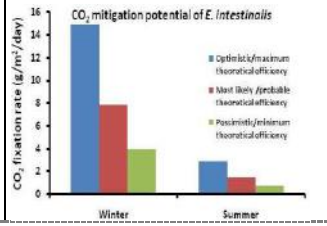
The intervention area is in the deltaic villages within Sundarban World Heritage site in India, which is highly vulnerable to climate impacts owing to sea level rise, coastal catastrophe and salinity ingression leading to loss of mangrove habitat and biodiversity, inundation of farmlands and fall in primary productivity. This directly impacts life and livelihood displacing marginal farmers.

The main aim of this action-research was to build capacities in the locale and promote algaculture as a community based adaptive mitigation strategy for sustainable alternative livelihood in coastal villages of Sundarbans in India. The underlying principle was to demonstrate algaculture integrated with fisheries in brackish and trapped storm surge waters in inundated coastal areas as a promotional capacity building programme for marginal farmers, who have lost their farmland in saline water ingress owing to sea level rise. Another important rationale behind the programme was to disseminate this cultivation technology amongst local stakeholders and enrich scientific knowledge in regard to carbon sequestration potential of local algal species as a strategic mitigation measure for climate change resilience and as well species conservation.

The programme envisioned the development of a scientific aptitude in abating climate change impact with low cost conservation paradigm and place-based restoration of habitat through community intervention. This built capacities among farmers on low-cost *in-vivo* aquafarming, management and monitoring of algaculture, harvesting of algal biomass and its commercial usage for food fodder feed fuel and fertilizer.

IPSI-7 Homework template

Contribution to Aichi Biodiversity Targets' Strategic Goal D

		Breakdown Target	How did you measure the outcome?	Result
Strategic Goal D	TARGET 14	Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded …	The outcome was measured through strategic social impact assessment indicators like enhancement in food security of inhabitants and livestock, increase in beneficiary payments through creation of alternative livelihood opportunities, reduction in internal displacements and migration etc which were directly dependent on the ecosystem services of this coastal habitat and revived with the sustainable intensification of the nature services.	Perusal of results showed that enhanced primary productivity due to integrated aquafarming in inundated farmlands enhanced food security of inhabitants and livestock by 40-44% on average while per head payments of USD 32-35 could be assured in lean periods to each beneficiary. Farmer migration reduced drastically with intensification of productivity and betterment of habitat health, as evidenced from diversity indices and limnological data.
		… taking into account the needs of women, indigenous and local communities, and the poor and vulnerable	Outcomes were measured through sociometric study and analysis, livelihood vulnerability indexing (LVI) and need assessment surveys (NAS) in the local community inhabiting the area of intervention.	Analytical results revealed that 86% of the beneficiaries with LVI below 0.3 (highly vulnerable) could be supported, who were victims of climate impacts and habitat loss. Post intervention, in 30 months the index shifted to 0.74 (stable). 60-65% of the beneficiaries were female and nearly 97% were indegenous ethnic community members, who adopted the aquafarming practice in coastal area.
	TARGET 15	Ecosystem resilience and the contribution of biodiversity to carbon stocks have been enhanced through conservation and restoration	Ecosystem resilience could be measured through geospatial mapping of ecosystem services and its intensity indices (IWMI 2016), while impacts of conservation and habitat restoration could be measured from biodiversity indices of the planktons (Simpson's Species Richness Index - **D**) and change detection studies on carbon capture and storage potentials in algal flora through aquafarming (Total CO2 fixation = K × biomass productivity X fixation efficiency; wherein K is the rate constant with value 1.89) .	Species richness enhanced by 17% in the first two years of intervention (D = 0.469 to 0.549) while 8 significant provisioning and supporting ecosystem services could be rejuvenated in the area. **Carbon capture& storage potential** 
		At least 15 per cent of degraded ecosystems are restored, contributing to climate change mitigation and adaptation, and to combating desertification	The results were estimated on the percentage of area brought under sustainable aquafarming through this intervention over the total inundated area in the Gosaba Community Development Block (GCDB) and as well total area of mangrove vegetation conserved through this intervention.	Total area of inundation in GCDB was almost 32% of the habitable land that is 948 hectare of which arable land (coastal agro-ecosystem) was nearly 270 hectare that was inundated. Out of this, 48.5 hectares (18%) could be restored through aquafarming, while alga culture alone was done in 27 hectares. Similarly almost 30% mangrove vegetation could be conserved through this intervention.
	TARGET 16	The Nagoya Protocol is in force	This could be measured through equity in access to biological resources, ecosystem services and socio-economic benefits based on sociometric survey assessments and FGDs and following LNOB (Leaving No One Behind) principles.	An overall 85-87% increment was observed on the equitability in access to biodiversity resources and ecosystem services and as well there have been a 68% growth in participation and conservation efforts in the locale as evidenced from a 7-point attitude scaling survey in the community.
		The Nagoya Protocol is operational, consistent with national legislation	This was assessed by the impacts of ratification of Nagoya Protocol by the Ministry of Environment, Forest and Climate Change, Govt. of India on coastal conservation in general and to this intervention in particular.	Post 14th July 2014, when Nagoya Protocol was ratified in India, it has been duly incorporated in the coastal zone management policies. MoEF&CC also supported for scaling up in Sundarbans.

Relations to other Aichi Biodiversity Target & SDGs

Use "●*"and"*■"to indicate the "direct" or "indirect" contributions to the targets.

CBD Aichi Biodiversity Targets (https://www.cbd.int/sp/targets/)

Strategic Goal A				Strategic Goal B					
●	●		■	●	●	●		■	
1	2	3	4	5	6	7	8	9	10
Strategic Goal C			**Strategic Goal D**			**Strategic Goal E**			
■			●	●	■	■	●	●	■
11	12	13	14	15	16	17	18	19	20

UN Sustainable Development Goals (SDGs) (https://sustainabledevelopment.un.org/sdgs)

●	■	■		■			■	
1 NO POVERTY	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	4 QUALITY EDUCATION	5 GENDER EQUALITY	6 CLEAN WATER AND SANITATION	7 AFFORDABLE AND CLEAN ENERGY	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
●		●	●	●	●		■	
10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	13 CLIMATE ACTION	14 LIFE BELOW WATER	15 LIFE ON LAND	16 PEACE, JUSTICE AND STRONG INSTITUTIONS	17 PARTNERSHIPS FOR THE GOALS	

Any difficulties you found during your assessment

The main difficulties in assessments were due to highly dynamic ecology of the area of intervention that was often disturbed with anthropogenic interferences and standardizing the strategic assessment tools were a great challenge. Further, erratic weather conditions and geographical remoteness were to some extent a bottleneck in working in this area. Social dynamics is also very complex owing to vulnerability and resolving conflicts of interests of stakeholders have been an issue in itself. However, more potential works are needed to address such multifaceted paraphernalia for conservation in areas under direct impact of climate.

Key messages for the CBD in planning for the post-2020 Targets

1. Enterprise-oriented community-ecosystem based conservation approach can be viable and contribute more to local economies, diversify income streams and generate multiple social benefits.
2. Local institutions can take on non-traditional products and services including ecotourism, carbon sequestration, water, and agro-forestry as well as traditional bio-energy resources, as in case of bio-fuels from algae, but they must be duly formalized.
3. Conservation policy framework should be place-based and needs to be developed through participatory approach so as to incorporate TEK and resource budgeting principles for sustainable production and consumption.