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Organic Farming in the Tropical, Disaster-Prone Coasts: Interventions, Major Challenges and a Success Story from Sundarban Biosphere Reserve, India

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Abstract. Organic agricultural practices are sustainable alternatives to chemical methods. This article highlights the major challenges faced by environmentalists, social workers in popularizing organic agriculture as well as its positive field application. The primary soil parameters (pH, alkalinity, electrical conductivity, soil, organic carbon, soil texture, and available N, P and K) are compared between global coastal agricultural soils. Organic farming practices adopted in different regions were also focused in this article. Sundarbans is the world's largest contiguous mangrove ecosystem, largest delta, abode of mangrove dwelling tigers and Indian part is the home of 4.6 million natural disaster vulnerable populations. This work showcases success story of organic farming by 84 families of Indian Sundarbans since 2012, with use of vermicompost, biopesticides (neem oil) and natural microbe augmentations (*Trichoderma sp*), as a part of a socio-environmental intervention project. This intervention resulted in increased yield in both kharif season (10-12%) and rabi season (5-10%) by 2017.

Keywords: Organic agriculture; Sundarbans, Delta, Coast; Self Help Groups, Sustainability

1. Introduction

With increasing climate change problems like inconsistent rainfall and worsening soil quality, organic agriculture is being promoted as a sustainable solution to ensure food security and maintain the agricultural economy [1]. In developing countries, the rising population demands more agricultural yield. India is known for its large agricultural output [2]. At the same time, the country is also facing numerous problems from soil degradation. This is caused by poor agricultural practices and natural factors like salinization, waterlogging and droughts. This threatens the future food security of countries like India and also causes huge economic losses.

The repetitive use of chemical fertilisers and pesticides has rendered acres of soil infertile [3]. This also leads to water pollution, loss of plant biodiversity and is unhealthy for consumption due to the bioaccumulation of chemicals in the crops. As the production of food increased since the Green

Revolution, the nutrient deficiency in the soil also increased simultaneously. Cultivating crops beyond the capacity of the land has depleted the groundwater in many fields (water used for irrigation). Nitrates enter the groundwater because of excessive nitrogen fertilisers. Burning residual crop waste returns some of the nutrients to the soil, but it is lesser when compared to the nutrients used up to increase the yield and it cause air pollution. Thus, the nutrient imbalance leads to soil infertility. Added to this, poor agricultural practices like extensive tilling worsen soil texture. It decreases the soil organic matter, which is essential for soil productivity [2]. Overall, continuous application of chemical fertilisers for a long period of time leads to acidification degrades soil structure and makes the land vulnerable to soil erosion [3].

Sundarbans is The United Nations Educational, Scientific and Cultural Organization (UNESCO) world heritage site, largest RAMSAR site across India and is largest mangrove forest of the globe. Indian Sundarbans covers 102 islands, in which 54 are inhabited with human and rest are reserved forest. In these inhabited islands there are about 4.6 million people live. The major source of income is farming, aquaculture, tourism and honey collection. The agricultural land is continuously decreasing due to frequent cyclone surge [4]. In the 17 years from 2010 to 2017 the agricultural land decreased about 3.1% from 52,148 ha to 50,508 ha [5]. Climate change, sea water intrusions, and depleting fresh water resource are other major challenges in these regions. The uses of chemical fertilizers and pesticides are ruining the conditions as well. The increased soil salinity inhibits the ammonia oxidizing bacteria, and thus decreases the ammonia sorption capacity of soil. This phenomenon resulted in the conversion of ammonium to free ammonia in form of N_2O [6]. N_2O is the one of the greenhouse gas, which leads global warming. Thus the organic farming can be effective for the farmers in order to reduce soil salinity and improve soil fertility of these unique coastal lands.

Organic agriculture is being promoted by environmentalists to remediate manage soil degradation and infertility. This method refers to farming without the use of chemical pesticides and fertilisers. There is no excessive irrigation because only crops suited to the region (endemic crops) and soil type are cultivated. It has numerous environmental and social benefits like remediating degraded soil, sustaining agricultural economy, and food security. Farmers become more self-reliant and use their indigenous knowledge [7]. Organic farming still remains unpopular as farmers feel discouraged by the lower yield. They find it complex to maintain the fields without using pesticides or fertilisers. This also involves high labour costs and organic farming techniques may not be widely known. However, the global economic share in organic food production is rising because of the health and environmental awareness of consumers, which has increased the demand for organic food. Organic agriculture has been successful in developing countries like Bangladesh and some parts of India, like Sikkim [7]. Thus the research question arises to what extent is organic farming a sustainable and economically viable solution to recover coastal, saline soils?

The objective of this study is to understand the importance of organic farming in soil recovery and the challenges of organic farming in coastal areas. The latter will be explored through the case of Sunderban delta, where organic farming was promoted, to generate livelihood and food security in the disaster-prone area.

2. Agricultural soil parameters

In order to measure whether the soil fertility is improving after agriculture, soil parameters are the major indicators. These indicators are based on the physical and chemical properties of the soil necessary for plant growth. For coastal soil, the natural conditions will be different from inland soil, so the indicators help us compare coastal soil to fertile soil. The soil health indicators used in this paper are pH, alkalinity, and electrical conductivity (EC), nitrogen, phosphorous and potassium (NPK), soil organic carbon (SOC) and soil texture.

2.1. pH

Soil pH affects microbial activity and the nutrient solubility. The pH of a soil conveys whether there are enough nutrients to support the growth of plants. It depends on the native soil conditions, because some crops in tropical regions prefer slightly acidic soils while others might prefer alkaline soil [8]. We can see that the coastal soil in Bangladesh is slightly acidic, with a pH of 5.39-6.02 (Table 1). The pH values in fertile soils were found range of 6-8 referred in Table 1.

2.2. NPK

Nitrogen (N) is the most important nutrient for plant growth- found in different forms like nitrates. Phosphorus (P) is essential for agricultural yield and determines the soil quality [8]. Phosphorous play a crucial part in the enzymatic pathways of the crops. This is very important for the photosynthesis, biosynthesis process such as ADP, ATP, NADP. Potassium (K) takes part in the enzymatic pathways and very important for the plant growth. These nutrients are measured as Total and Available N, P, K.

2.3. Soil structure

Soil structure influences the soil texture. It was found that upon long-term recovery of coastal soil in China, the soil particle size gradually decreased and the soil had higher percentage of clay particles and lesser sand [9]. Coastal soil retains a lot of moisture, which was reduced upon introducing agriculture in China; because seawater intrusion was prevented using dikes [9]. In saline soils, excess sodium ions cause clay particles to separate and repel. This results in a loose texture that cannot retain much water [10]. Similarly, in Bangladesh, coastal areas had higher percentage of sand and silt, when compared to its inland soil (Table 1). Soil structure is also quantified through bulk density. Lower bulk density indicates better soil texture.

2.4. Alkalinity

Coastal soils are alkaline due to the presence of salts. The pH and salt content in the soil decreases with agriculture [9]. In Egypt, it was seen that alkalinity reduced when the soil is farther from the coast [11].

2.5. Electrical conductivity (EC)

Electrical conductivity is a measure of soil salinity [10]. When agriculture is practised in saline soils, the cations are displaced because other nutrients in the soil increase, and electrical conductivity seems to decrease over time [9]. Adding too many nutrients could lead to acidification of soil, as is the case in many agricultural lands in India. Overuses of chemical fertilisers have caused this acidification [3]. Table 1 compares the soil parameters between coastal soil and fertile soil across various regions. The information is based on experiments conducted in different regions of tropical, developing nations.

Table 1. Comparison of soil parameters of agricultural soils with special focus to coastal zones.

Parameter	Countries	Values		Remarks	Reference
		Coastal soil	Inland soil		
pH	Bangladesh	Topsoil= 5.39-6.02; Deeper soil sections= 8.1	6.5 - 7.5	Coastal topsoil was slightly acidic and became more alkaline in the deeper sections. Higher pH indicates lesser nutrients while acidic pH is caused by soil	[10]

				pollution through chemicals in Bangladesh.	
	India (Bihar)	8.38 (coastal sandy soil)	6.0 - 6.5	Indian coastal soils are slightly alkaline. This could lead towards nutrient deficiency. Alluvial soil in Bihar is very fertile, and is extensively cultivated. However, excessive uses of chemicals in certain parts of Bihar have led to soil acidification with pH 4.4.	[24-25]
	Egypt (45km from sea)	8.14	8.11	Throughout Egypt, there seems to be less variation in pH between inland and coastal soil.	[11]
Alkalinity	Egypt	12.76	8.86	Alkalinity decreases when the land elevation increases- because this raises the level of groundwater and lowers the capillary intrusion of saltwater. So, inland soil is less alkaline.	[11]
EC	Bangladesh	2.1 - 15 dSm^{-1}	2.4 dSm^{-1}	Salinity increases EC. A value that exceeds 4 dSm^{-1} is considered very saline. It increases during the dry season due to tidal intrusion or poor agriculture practices.	[10]
	India	1.12 dSm^{-1}	0 - 1 dSm^{-1}	According to the study, 0 - 1 dSm^{-1} is considered the ideal range for Indian coastal soils. EC that is too low indicates the lack of nutrients in the soil.	[24]
	Egypt	Topsoil: 5.61dSm^{-1} Deeper section: 13.26dSm^{-1}	2.94 dSm^{-1} (45km from sea)	The high salinity is caused by saltwater intrusion due to low land elevation. The water level is low, so EC is higher in deeper sections of the soil in both coastal and inland soil.	[11]
Soil Organic Carbon (SOC)	Bangladesh	0.55% (at Kalapara)	0.85-2.8% (at Assasuni)	SOC indicates the health and productivity of the soil. Inland soil seems to be healthier because of high SOC concentration.	[10]
	China	5g kg^{-1} (North China)	8.58g kg^{-1} (South China)	Wang et al.'s study applied organic amendments to the saline soil to improve its fertility. Compost, sludge peat, etc. were added to the coastal soil in 2010-2012. The SOC increased with the supplements. The SOC of 8.58g kg^{-1} is of an agricultural area in South China.	[26-27]
	Aceh, Indonesia	<12g kg^{-1}	>12g kg^{-1}	SOC level for crop production should ideally be greater than 12g kg^{-1} for the tropical soil in Aceh. However, according to the study, most of the	[28]

				samples showed SOC levels below the critical value. Aceh is seen to have low fertility and overall, an acidic soil.	
Soil Texture	China	Bulk density = 1.55g cm^{-3} Soil porosity = 0.38% (North China)	Bulk density = 1.15g cm^{-3} (East China)	High soil porosity and low bulk density indicate fertile soil. In Wang et al.'s study, the same organic amendments were used to improve coastal soil texture. Soil recovery in the coastal soil in East China reduced the BD to 1.15g cm^{-1}, suited for crops.	[18, 26]
	Bangladesh	Clay- 37% Silt- 51% Sand- 12% (Kalapara)	Clay- 42% Silt- 52% Sand- 6% (Assasuni)	Clay minerals help in holding soil particles together, which increase when salinity reduces. Assasuni has more clay particles than coastal Kalapara and half the concentration of sand particles. This indicates that Assasuni soil is more fertile.	[10, 26]
Available N	China	44.33mg kg^{-1}	79mg kg^{-1}	In Wang et al.'s study, the values for available N, P and K significantly increased in two years (2010-2012) after the organic inputs. These are initial values. The soil in east China had an ideal amount of NPK after recovery from organic farming.	[26-27]
Available P		5.38mg kg^{-1}	10.8 mg kg^{-1}		
Available K		143.33mg kg^{-1} (North China)	122mg kg^{-1} (East China)		
Total N	Aceh, Indonesia	< 2.0g kg^{-1}	2.0g kg^{-1}	According to McLeod et al, the amounts of nutrients in the soil in Aceh varied widely, but were below the critical amount needed for cultivation.	[28]
Total P		< 8.3mg kg^{-1}	8.3mg kg^{-1}		
Total K		< 166mg kg^{-1}	166mg kg^{-1}		
Total N	India	0.10-0.35g kg^{-1}	141-474kg ha^{-1}	The soil in Punjab, an intensely cultivated region had turned acidic and infertile due to overuse of fertilizers. The alluvial soil in Bihar is still suitable for cultivation and is important to India's agricultural economy.	[25-29]
Total P		0.03-0.084g kg^{-1}	2.2-68.2kg ha^{-1}		
Total K		1.118-1.436g kg^{-1} (Punjab)	107-903kg ha^{-1} (Bihar)		

Less NPK is available for plants in saline conditions. At Kalapara (coastal Bangladesh) this could be due to salt intrusion, over cultivation, improper soil management. At Assasuni (inland Bangladesh), N was much higher than in coastal soil. The NPK can be maintained if organic additions like manure are used as required.

3. Organic and Conventional Farming

According to Roos et al. [1], increasing crop yield through unsustainable inorganic processes has several negative impacts on ecosystem, and human health [1]. Nowadays, farmers are highly

dependent on inorganic fertilizers, for increasing short term yield. However, there are many processes which can increase crop yield through organic agriculture. This work also sheds light on the strategies for sustainable agriculture through organic farming and other risk free opportunities to increase crop yield. The advantages of organic agriculture over conventional methods are debated over environmental, economic and social factors. There is not enough research in this field to conclude that one method is better than the other. However, we can weigh the advantages and disadvantages of the two methods to decide which is best suited for the location and people.

There is more demand for organically grown food given the spread of awareness regarding its expected health benefits. But, there is also a rising demand for food due to the growing world population. Organic agriculture has proved to be more profitable and sustainable as compared to conventional farming methods. Though the yield is lower in this method, the high economic value for organically produced food compensates for the low yield and brings in profit. It also consumes lesser resources because chemical fertilisers/ pesticides are not used.

3.1. Feasibility

However, given that land resources are scarce and demand for food is high, the sustainability per unit product is questioned because more land is needed to maintain or increase the yield [12]. It is estimated that yield is lower by 19-25% [13-14]. This varies according to the crop type and growing conditions. The yield is lesser in legumes but higher in cereals [1]. If organic products did not have such high economic value, farmers would incur losses due to low productivity of organic farms [1].

However, according to a study conducted by Schrama et al., the yield gap between organic and conventional farms reduces over time. In the 13 year study, lower yield was recorded from organic farms at the beginning [15]. Then, yield increased to almost the same level as conventional farms, with an average gap of 13% across the 13 years [15]. In fact, the yield was achieved even with lower N inputs.

Crops in an organic farm are more susceptible to pests and diseases due to the absence of chemical pesticides [1]. This again puts yield at risk. Organic fertilisers are low in nitrogen as plant wastes do not contain much nitrogen in available state. To overcome this, farmers rotate crops- legumes can fix nitrogen in the soil for the crops grown in the next season. However, this might not be feasible if certain soils are not favourable to grow legumes. Organic farms are vulnerable to weeds. Farmers need to invest in weed removal technology or manually remove weeds, which increases the labour costs. Excessive tillage to remove weeds can damage the soil structure and loss of organic matter [13]. In spite of these drawbacks, organic agriculture can have numerous benefits on the soil, if organic fertilisers and farming methods are managed properly.

3.2. Sustainability

Studies have shown that microbial diversity is higher on organic farms. The soil ecosystem is healthier due to the presence of these microbes. Soil Organic Carbon (SOC) is also higher in organic farms; potentially contributing to carbon sequestration [1].The organic amendments used in this type of farming makes the soil fertile in the long-term. The soil texture allows for water retention as well as prevents soil erosion. So, crops have more probability to survive extreme conditions like droughts [13]. Using organic manure improves the SOC from the decomposing matter. There is also a lower risk of nutrient leaching because of lower fertiliser use. This ensures that the soil ecosystem thrives for a long duration [15].

Organic farms have higher yield stability. This means that production can be sustained over a longer time period for the same patch of land. Crop diversity ensures nutrient recycling to maintain a balance of nutrients in the soil [13]. One concern is nutrient losses (N and P, for example) during crop rotation because the rate of uptake varies between plants [1]. Also, organic farming is heavily dependent on

external inputs of organic matter. Farms could suffer from a shortage of organic inputs because of the slow decomposition [15]. These two concerns can be overcome by undertaking more research on this topic to implement necessary agricultural techniques.

3.3. Cost-effectiveness and social aspects

Organic agriculture is becoming more commercialised as it is seen as a 'commodity for the elites' rather than a basic food product because of the high purchase cost associated with them. 75% of the organic farms are located in developing countries while most of the produce is exported to developed nations in Europe and North America, causing food security concerns [13]. This process involves large corporations and certification processes which may be tedious and expensive for small scale farmers. However, there are cases in developing countries where farmers and consumers form their own network to buy/sell organic food. This has positively helped local farmers [13]. Organic agriculture is also reducing a farmer's economic dependence on a single crop [13]. This way, the negative environmental impacts of monoculture, like unsustainable use of water, can be mitigated [12].

In Bangladesh, self-help groups were formed between farmers to share information and resources for organic agriculture. This has increased the organic farming percentage in the country and helped farmers find social and financial support when required [16]. Thus, organic farms create better working conditions for farmers where the exposure to chemicals significantly decreases. For customers too, though higher nutrient content is not proven in organic food, there is lesser risk of ingesting chemicals through plants grown using synthetic pesticides and fertilisers [13]. This reduces the negative externalities posed by conventional farming. One drawback is that, to increase yield, sometimes, farmers use high-yielding variety crops. This makes the processes similar to conventional agriculture, so the environmental benefits will not be long-term [12].

Government policies play a huge role in promoting organic agriculture. They set targets to increase the percentage of farms practising organic agriculture. They can incentivise organic agriculture and enter into trade agreements to exchange organically produced food, due to the profits involved. It is also important that they regulate labour laws so that small farmers are not exploited for manual labour in certain organic farms [12].

4. Environmental and Economic impacts

Organic farming has been implemented in many regions across the world. The results have been diverse, depending on various factors like location, crop choices, socio-economic conditions, etc. While many cases have shown positive results (Such as Egypt and Indonesia Table 1, organic farming does not seem viable in certain agricultural practices. It is common for coastal farmlands to include aquaculture beside their farms for additional economic gain [17, 18]. Table 2 provides a review of some organic farming initiatives.

Table 2. Adopted organic farming methods across various regions and their impacts on soil and crop production

Region	Organic farming method	Impact on soil and livelihoods	References
Karnataka, India	The state government decided to introduce organic farming to counter agricultural problems. Manure is obtained from	*Economic Impact:* Dry area: Food crops like millet and rice had higher yield under organic methods, so higher profit. Low input costs helped farmers reduce their debts. During crop failures, net loss was lesser by upto 40%.	[21]

	cows and crop residues. If this is not sufficient, farmers purchase vermicompost from the market. Crop rotation was practiced. The soil type in this region is red, sandy and loamy. The dry areas in the state were impacted positively by organic farming but wetter, more fertile areas had a slightly negative impact.	Wet area: Commercial crops had lower yield. Farmers had to spend on vermicompost and additional labour. Profits were lower for most crops. <u>*Environmental Impact:*</u> Dry area: N leaching was reduced by about 50%. Soil water retention capacity had improved. However, there was nutrient imbalance, which could cause deficiency in future. Wet area: Not much change was observed apart from lower yield. There was no nutrient imbalance.	
Eastern, Coastal China	Reclamation of coastal saline soil was done over 30 years. <u>*The process followed*</u>*:* - Initially, abandoned coastal soil is put under mariculture. Or, plants that grow in saline conditions are allowed to grow, to reduce the salinity. - After 10 years, salt tolerant crops like cotton, corn and wheat are grown. - Mariculture gradually changes to freshwater culture because salinity decreases. The soil also becomes conducive for crops. - Currently in this soil, rapeseed, wheat, paddy, corn etc. are grown along with practising aquaculture. Changing the land use patterns was an important process for the recovery- whether land was abandoned, used for aquaculture, or under organic agriculture, type of crops like rapeseed or beans, etc.	The climatic conditions in the eastern coast of China are extreme. It is humid, receives a high amount of rainfall and sunshine throughout the year. These conditions make it ideal for agriculture, but its proximity to the sea makes the soil saline with marine deposits. This also makes this soil sensitive to over cultivation beyond its capacity. <u>*Environmental impacts:*</u> Bulk density decreased over the years to reach 1.15g cm^{-3}. The soil water content did not change significantly. The pH decreased from an alkaline state to 7.97. EC ranged from 0-1dSm^{-1} after recovery. The SOC, total N and total P followed a trend of increase and decrease based on the crops grown. Overall, there was an increase. Aquaculture farms showed the opposite trend- higher soil water content, pH and EC, lower in nutrients and SOC. However, it suited the requirement for aquaculture farms.	[18]
Andaman Islands	Raised bed and furrow system, along with organic inputs.	The Andaman Islands are located near the equator. The land has a low elevation, and is vulnerable to climate change. High evaporation during the summer	[17,22]

	Raised beds were created on coastal farmland to prevent tidal intrusion and improve the soil's drainage. The dug-out area surrounding the raised bed is the furrow, used for rainwater harvesting or aquaculture. Organic supplements prepared from previous crop residues and other farm waste were applied to the soil, to improve its fertility. Importing fruits and vegetables makes it expensive for the residents of the island due to the transportation costs involved. Increasing profit from organic farming could help the locals increase their household income.	causes water scarcity and high rainfall during monsoon causes waterlogging. This method helped improve soil fertility and agriculture in this region. Adding organic matter increased the SOC concentration. The soil texture improved as the bulk density decreased. The initial EC of 10.9dSm^{-1}, indicating very saline soil, was brought down by 87%, to 1.40 dSm^{-1}. The nature of the coastal soil and limited land area hinder any major crop cultivation. Even subsistence needs are not met, as grains are imported from mainland India. However, plantation crops like coconut can grow organically and can be exported for economic gain. The residues can be used for vermicomposting.	
Bangladesh	Due to the global market for organic products, and increasing popularity for organic food among Bangladeshi customers, government and NGOs are promoting organic farming in this country. Farmers are given training programs. Women are also trained separately to raise awareness and to convert household waste into compost. Integrated pest management is a part of their training. NGOs plan to set up more support groups among farmers for any technical, social or economic difficulties they face. As per literature organic farming seems to work well	0.1% of cultivable land in Bangladesh is under organic farming, and its global importance in this field is growing. Generally, farmers welcome organic farming as it has fetched them more profits. However, certain small farmers have not benefited much by organic farming. There are lesser support groups in rural areas. They are unable to cope with food insecurities during extreme conditions as organic inputs are not as efficient as chemical fertilizers for their small plots. They can't afford vermicomposting equipment either. Livestock possession seems to improve their economic situation because of the organic waste for farms and dairy products they can sell.	[7, 23]

	in Bangladesh's humid, saline and tropical conditions.

5. Case study

This is the successful case study on the organic farming practice at Indian Sundarbans (Figure 1) initiated in 2012. Where, 84 families were facilitated to using organic method of agriculture with vermicompost, biopesticides like neem oil and natural microbe augmentations such as Trichoderma, Phosphate Solubilizing Bacteria (PSB). This was an achievement to motivate them to adapt the organic method, leaving their age old process using eco-destructive chemical fertilizers and pesticides. The improved seeds with bio-pesticides have proven benefited for the farmers and yield is significantly increased for the both Kharif season (10-12%) and Rabi season (5-10%) by 2017.

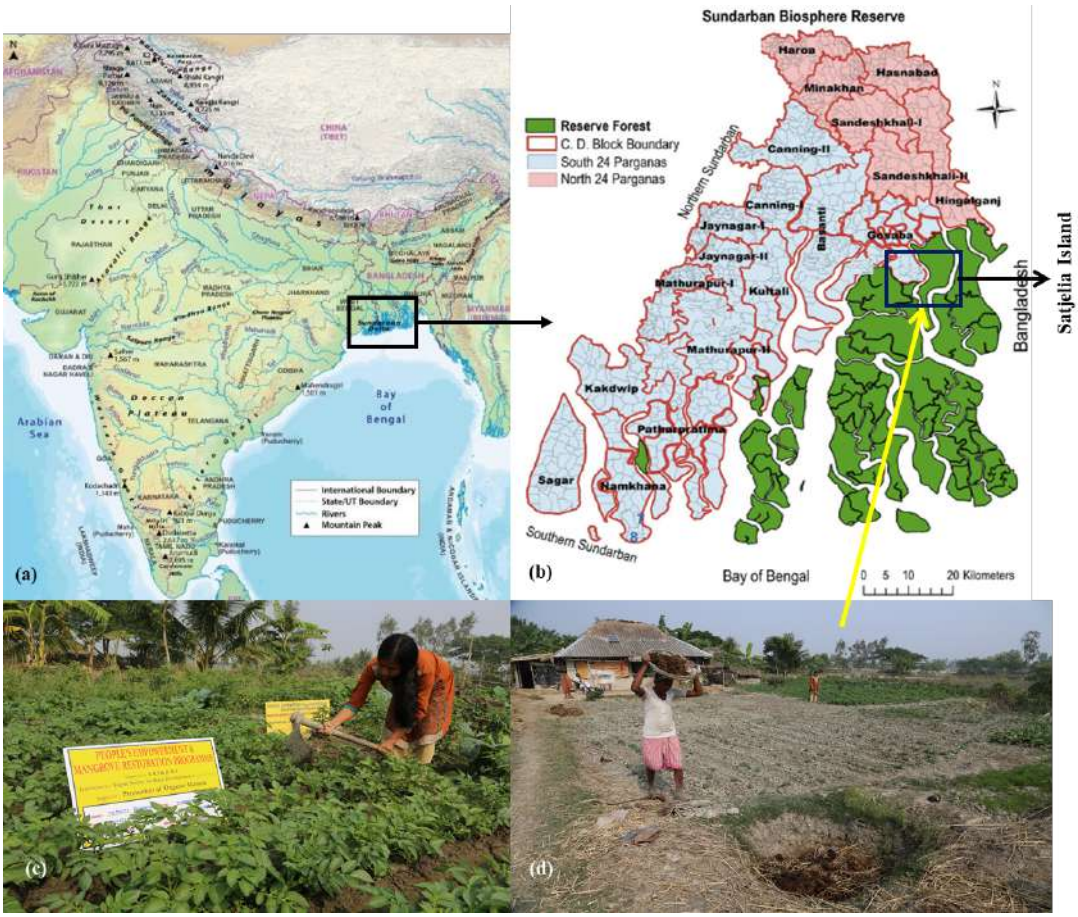

Figure 1. (a) The map of India showing the region of Indian Sundarbans, (b) The area of Sundarbans zoomed out focusing on Satjelia Island where the intervention has taken place and the sustainable agricultural practices are implemented by local community as a part of the project. Two pictorial representations of the agro-practices from the project are represented by the black coloured arrow, (c) Beneficiary has been seen to be working in the kitchen garden cultivated in their back yard through organic sustainable agricultural practices, (d) Beneficiary is seen to be collecting cow dung for composting to be used later at fertilizer in their agricultural fields.

Organic farming and plantation of indigenous variety trees helped to save nature as well as to reduce environmental pollution. Thus, out of 84 families, 10 families have started producing Vermicompost,

after receiving adequate training. Two families of Sudhangsupur and Hamilton Abad Hamlet villages have trained to prepare demonstration plot using only organic methods and indigenous seed, and they stand as an example amongst the entire populace of the Satjelia Island, practically highlighting the benefits of Organic Agriculture. The other beneficiary families have trained for household Plantation programme focused on the production of fodder, fuel, small timber, minor forests produce to meet the local need [18]. Dry timber used as fuel, fruit trees produced a fruit which adds up the nutrition value of the household, where mal-nutrition is a reality and this burden is borne by the children and the women.

Awareness, organic farming skill and perspective building among the target people have proven beneficial for the locals and helped them to become resource person, developing healthy attitude & practice. This helped them to take leadership of the society for betterment. Infant mortality rate were also reduced through nutritional fruits and vegetables cultivated through organic methods. This project also helped in the renovation of ponds which further being used by beneficiaries' in plantation works and aid in agricultural activity as intended in the project objective.

This was an example of Sustainability and financial independence of the beneficiaries, which was the prime target of the project. Farmer were also encouraged to create 'Farming companies' where they can directly dictate the sale of the products to the local market without getting dependent on middle man.

5.1. Challenges

One of the major challenges faced by the farmers in the region is their socio-economic vulnerability [20]. Organic farming practices takes times to make the soil fertile whereas chemical based methods give immediate productivity boose [14]. In case of Indian Sundarbans, most of the farmers are marginalized with very limited land holdings. Hence, they are reluctant to dedicate whole of their farming land holdings for organic agriculture. Only through training, awareness and initial monitory support the issue can be addressed.

Organic certification process is a time taking matter with lot of bureaucratic red tape regulations. These make the certification process difficult for the farmers to comply or pursue. Though such certifications can improve the selling price of the product and indirectly motivate farmers to go for organic practices. Organic agriculture in the case study has been supported by the social initiative in the region. Otherwise, both the certification and organic processes are economically taxing for a marginalized farmer which makes it unpopular to marginalize.

6. Conclusion

Organic farming is attracting the attention nowadays. The chemical based farming practices not only destroy the human health but also proven unsustainable for soil fertility. Coastal areas of India are facing huge challenges in the soil fertility as well as the lower yield. To achieving high yield through organic farming process can improve the soil health with providing sufficient nutritional crops. This work shed light on the feasibility of organic farming in the vulnerable, saline and infertile coastal agricultural belt. This work also highlighted the challenges faced by the farmers in the way of organic farming in remote coastal belts of tropics. This work concludes with the way to overcome with the major challenges in organic farming in the coastal belt of India. Case study of the Indian Sundarban villages, where 84 families of different coastal villages were provided financial support through a foreign funding explains the successes story of skill development, and organic farming.

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Acknowledgement
We acknowledge the support and funding of KKS (Karl Kübel Stiftung für Kind und Familie, Germany) and BMZ (Federal Ministry for Economic Cooperation and Development, Germany) through project entitled “Peoples Empowerment towards Restoring Mangrove Vegetation and Resource Conservation” implemented in the island of Satjelia by Tagore Society for Rural Development (TSRD) between 2012 and 2017. First author was the ‘Programme coordinator’ of this project in its inception years and continued as a consultant for the project till its completion.