

Sustainable Agriculture in Saline Coastal Belt of West Bengal.

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ABSTRACT

In recent times Sundarbans along with parts of South and North 24 Parganas are severely facing the crisis of fresh and suitable water required for agriculture. Factors like the frequent occurrence of cyclones over the Bay of Bengal, inundation of saline water from the sea, narrowing of river bed, and improper drainage system are all contributing to agricultural difficulties in southern deltas. Agriculture is the main and the only mean of survival for the rural people of Sundarbans, but the farmers are facing serious challenges in cultivating high yielding crops due to soil salinity, entrapping them in financial loss. Hence the purpose of this project is to find out the threads and challenges that are hampering the livelihoods of the people of Sundarbans and look for alternative studies which are sustainable to provide alternative agricultural sources for the farmers of Sundarbans and coastal areas of Bengal. This will help to increase financial gains and also will give ways to sustain the lives of the farmers. Preliminary it was found that river embankment and inundation of oceanic waves in coastal lands had lead to saline ingression in the mainland and thereby increased the soil salinity. Salt build up on agricultural land has lead to crops damage by preventing them from absorbing water and stunting its growth. For example yielding of boro rice has been severely affected by increased soil salinity in groundwater impacting the livelihood of the boro farmers. We looked for traditional methods of agriculture practiced in ancient India to analyze its importance in promoting soil tolerant cultivation in southern deltas of West Bengal and a sustainable agriculture.

সম্প্রতি সুন্দরবন ও উত্তর এবং দক্ষিণ ২৪ পারগানা তবস্তীর্ণ অঞ্চলে চালের উপল াগী তিতি জলের অকাে দদখা তদলেলো ঘন ঘন সৃতি হওে সাইললান, দনানা জলের খাতরলি প্রলবশ, নদী বলি গভীরা হ্রাস পাওে ও অনুপল াগী দসচ দববস্থা সিহ তবপদ সৃতি করলে সুষ্ঠ চাে বালস. কৃতে দববস্থা সুন্দরবলনর আতদবাসীলদর িে জীবকা, তকস্ত উপতরউক্ত তবপ সৃতির ফলে, োভ দােী শসয ফেন আজ তবপ্ন া িালদর অর্ ণ ননতিক অবস্থালক দশাচনীে কলর িুলেলো এই প্রলজলের িে উলদশয হলো দসই সব কারণ অনুসন্ধান করা া িালদর সুষ্ঠ জীবকা অজলনর পলে বযাঘাি সৃতি করলে, এবং তবকল্প অজলনর দববস্থা পতরকল্পনা করা আপাি দৃতিলি চালের জে এবং জতিলি নুন এর উপতস্থতি জতির উবগরি কতিলে দদোর প্রোন কারণ বলে রা হলে. া শসয ফেলন দবঘাি ঘটালে. দ িন দবালরা র্ান এর চাে আজ ভীেণ ভালব তবতপ্নি. িাই আরা উপাে তহলসলব গিানুগতিক এবং প্রাচীন কাে দেলক প্রচতেি চাে দববস্থার বযবহালর ও িার িাটির উবগরি বাড়ালি িার প্রাসতিগা তনলে গলবেগা করতে

SUMMARY

The study was based on the land of southern deltas of west Bengal situated both in India and Bangladesh. It was in existence since the Mauryan era. It was a ruin of an abandoned city in Baghmara forest. The northern parts of sundarban in Bangladesh had ruins of Urban settlement of early middle age. It is dominated by Hooghly, Padma, Meghna, Brahmaputra rivers. It was formed by upstream sediment

deposition. With the climate change and rise in temperature has lead to the rise in the sea and soil salinity effecting the flora and fauna. According to UNESCO report nearly 40% of the land of sundarban was affected by the landfall from cyclone Sidr in 2007. With repeated occurrence of natural and manmade hazards the problems related to agriculture started to show up. Agriculture is the main occupation and the mean of livelihood for the locals of sundarban but with the increased soil salinity they were not being able to cultivate certain salt intolerant crops and High Yielding Variety paddy.

The study finds that there are alternative methods that are traditional and also there are indigenous variety of rice that are salt tolerant and other salt tolerant crops that could be used and which are suitable in the challenging atmosphere of sundarban. The project was based on the agricultural problem in sundarban due to varies factors like cyclonic disturbance and inundation of sea water, drying of river beds and reduced availability of fresh water due to scanty rainfall which lead the land and people of southern deltas of west Bengal suffer severely from agricultural loss and threats to survival of life.

The purpose of this study was to find out the cause to such massacre and disaster that affecting the life of the locals of sundarban and possible traditional remedies to it The project was done on the basis of report from field survey and information from various agricultural institutes and departments like ICAR (Agricultural Technology Application Research) institute situated in Kolkata and in Canning, Bidhan Chandra Krishi Viswa Vidyalaya situated in Haringhata and irrigation department of West Bengal(Saltlake, Kolkata) respectively.

The study gives a brief introduction that speaks about the purpose scope and justification of the project. It gives a description of the location background with proper objectives and literature review and the methods used here. It gives a concise result and a discussion with challenges that could have affected the outcome of the result and possible remedies to conclude in detail. The project also has a conclusion and recommendation at the end that could be followed. There are total four recommendations that could be followed in order to sustain the agriculture. At the end the appendices there are few images and data that we got from the respective institutes and departments

The objective of this project was to find out the causes for the agricultural problems and remedies to such problem by using traditional variety and methods. The result and discussion chapter contains measurements of the parameters of soil and water which clearly states the reasons for agricultural problems in sundarban as the parameters for salinity both in water and soil was higher than the normal limit and a comparative study with graphical representation of traditional variety of rice that are salt resistance and high yielding variety, where it was found that though the average productivity of the traditional variety of rice was lower than High yielding variety still the traditional variety was much more suitable for the land of sundarban due to its high capability to withstand salinity. Another major reason is the cost of production is also low compared to the high yielding variety. Apart from these as these traditional varieties are cultivated using organic manure it is quite beneficial for health as well. In particularly for traditional salt tolerant varieties of rice there were few which even gave the same market value as the High yielding variety. The comparison clearly states that the use of traditional variety of rice has more benefit than High Yielding Variety. It again fulfils the second objective of this report.

After the cyclone Aila in May 2009 the land got overflowed with salt water which completely destroyed the agricultural fields. The farmers are not being able to cultivate at all which is affecting their financial income. This report was done to increase Farmer's realization that preserving and practicing local salt

tolerant variety and using traditional methods were the main strategies to overcome such misfortune and the most suitable remedy against such threats in future and increase agricultural sustainability.

সীমিত ভারি ও বাংলাদেশ উভে অঞ্চলে অবতস্থি পতিবিলির দতিগ ব-দ্বীলপর জতির উপর তভতত্ত কলর করা হলেতেো দৌ গ ুগ দেলকই এর অতস্তত্ত তেো এটি তেে বাগিারা বলনর একটি পতিরিয়ত্ত শহলরর ধংসাবলশো বাংলাদেশলদলশর সুন্দরবলনর উত্তরাঞ্চলে প্রােতিক ির্য ুলগর শহলর বসতির ধংসাবলশে তেো এটি হুগতে, পদ্মা, দিঘনা, ব্রহ্মপুত্র নদী দ্বারা প্রভাতবি এটি উজালনর পতে জির ফলে গঠি হলেতেো জেবােু পতরবিনন এবং িপিাত্রা বৃতির ফলে সিলের বৃতি এবং িটির েবণান্তি উতিদ ও প্রাণিজগিলক প্রভাতবি করলো ইউলনলকর তরলপাটগ অনুােী ২০০৭ সালে ঘূতগণঝড় তসডলরর আঘালি সুন্দরবলনর প্রাে ৪০% ভূতি িতিগ্ৰস্ত হো প্রাকৃতিক ও িনুেযসৃি তবপ গলের পুনরাবৃত্তর ফলে কৃতে সংক্রান্ত সিসযা দদখা তদলি শুরু কলরা কৃতেকাজই সুন্দরবলনর স্থানীেলদর প্ররান দপশা এবং জীতবকার িারি তকস্ত িটির েবণান্তি বৃতি পাওেে িারা তকে েবণ অসতহষ্ণু ফসে এবং উচ্চ ফেনশীে জালির র্ান চাে করলি পারলে না।

গলবেগাে দদখা দগলে দ তবকল্প পিতি রলেলে া ঐতিহয়গি এবং াড়াও দদশীে জালির র্ান রলেলে া েবণ সহনশীে এবং অনযানয েবণ সহনশীে ফসে া বযবহার করা দ লি পালর এবং সুন্দরবলনর চযালেতজং পতরলবলশ উপ ুক্ত প্রকল্পটি সুন্দরবলনর কৃতে সিসযার উপর তভতত্ত কলর নিতর করা হলেতেে দ িন ঘূতগণঝড়র তবল্ল এবং সিলের জলে প্লাতবি হওো, নদীর িেলদশ শুতকলে াওে এবং স্বল্প বৃতিপালির কারণ তিঠা পাতনর প্রাপযিা হ্রাস া জতি এবং পতিবিলির দতিগ ব-দ্বীলপর িানুেলদর িতির সম্মখীন হো িারাঅকভালব কৃতে িতি এবং জীবলনর দর্বেলচ োকর হিতক দেলকাু

এই গলবেগার উলেশয তেে সুন্দরবলনর স্থানীেলদর জীবন াত্রালক প্রভাতবি কলর ঐন গণহিয়া ও তবপ গলের কারণ খুেঁলজ দবর করা এবং এর সম্ভাবয ঐতিহয়গি প্রতিকার িাঠ জতরপ এবং তবতভন্ন কৃতে প্রতিষ্ঠালনর িলেযর তভতত্তলি প্রকল্পটি করা হলেতেো এবং তবভাগগুতে োক্রলি কেকািাে অবতস্থি ICAR (কৃতে প্র ুক্ত অযাতপ্লকশন গলবেগা) ইনটিটিউট এবং কযাতনংলে, তবরান চন্দ্র কৃতে তবশ্ব তবদযােে হতরগঘাটাে অবতস্থি এবং পতিবিলির দসচ তবভাগ (সল্টলেক, কেকািা)।

অর্ধেটি একটি সংতিপ্ত ভূতিকা দদে া প্রকলল্পর উলেশয এবং নযা যিা সম্পলকণ কো বলে। এটি সঠিক উলেশয এবং সাতহিয় প গালোচনা এবং এখালন বযবহাি পিতিগুতের সালে অবস্থালনর পটভূতির একটি তববরণ দদে। এটি একটি সংতিপ্ত ফোফে দদে এবং চযালেজগুতের সালে একটি আলোচনা া ফোফলের ফোফেলক প্রভাতবি করলি পালর এবং সম্ভাবয প্রতিকারগুতে তবস্তাতরিভালব উপসংহালর দপৌেঁোলি পালরা প্রকলল্পর দশলে একটি উপসংহার এবং সুপাতরশ রলেলে া অনুসরণ করা দ লি পালরা কৃতেলক টিতকলে রাখার জনয দিট চারটি সুপাতরশ অনুসরণ করা দ লি পালরা পতরতশলির দশলে তকে

েতব এবং িেয আলে া িারা সংতিি প্রতিষ্ঠান এবং তবভাগ দেলক দপলেতো

এই প্রকলল্পর উলেশয তেে ঐতিহয়গি নবতচত্রয় ও পিতি বযবহার কলর কৃতে সিসযার কারণ খুেঁলজ দবর করা এবং এ র্লনর সিসযার প্রতিকার করা। ফোফে এবং আলোচনা অর্যালে িটি ও পাতনর পরাতিগুতের পতরিপ রলেলে া সুন্দরবলনর কৃতে সিসযার কারণগুতে স্পিভালব বণগনা কলর কারণ জে এবং িটি উভলের েবণান্তি পরাতিগুতে স্বাভাতবক সীার দচলে দবতশ তেে এবং ঐতিহয়গি নবতচলত্রয়র প্রাতফযাে উপস্থাপনা সহ একটি িুেনািুে ক অর্ধে। র্ালনর দ গুতে েবণ প্রতিলরারী এবং উচ্চ ফেনশীে জি, দ খালন দদখা দগলে দ ঐতিহযবাহী জালির র্ালনর গড় উৎপাদনশীে িা উচ্চ ফেনশীে জালির িুেনাে কি, িবুও ঐতিহয়গি জিটি সুন্দরবলনর জতির জনয অলনক দবতশ উপল াগী তেে এর উচ্চ িিার কারণ েবণান্তি সহয করলি আলরকটি বড় কারণ হে উচ্চ ফেনশীে জালির িুেনাে উৎপাদন খরচও কি। এগুতে োড়াও এই ঐতিহযবাহী জিগুতে নজব সার বযবহার কলর চাে করা হে বলে এটি স্থালস্থয়র জনযও দবশ উপকারী। তবলশে কলর ঐতিহযবাহী েবণ সতহষ্ণু র্ালনর জালির জনয ঐন তকে তেে া উচ্চ ফেনশীে জালির িলা বাজারিেযও দদে িুেনাটি স্পিভালব বলে দ ঐতিহয়গি জালির র্ালনর বযবহার উচ্চ ফেন জালির দচলে দবতশ উপকারী। এটি আবার এই প্রতিলবদলনর তদ্বীে উলেশয পূরণ কলরা

২০০৯ সালের দি িালস ঘূতগণঝাড় আহৌর পর জতি দোনা পাতনলি িতেলে াে া ক্তেলিত্র সম্পূগণরুলপ ধ্বংস কলর দদো ক্তেকরা দিলটও চাে করলি পারলে না া িালদর আতেনক আলের উপর প্রভাব দফেলো এই প্রতিলবদনটি ক্তেকলদর উপেতি াড়ালনার জনয করা হলেতেে দ সংরিণ এবং অনুশীেনা স্থানীে েবণ সহনশীে নবতচত্রয় এবং ঐতিহযগি পিতি বযবহার করা তেে এই র্লনর দুভগাগয কাটিলে ওঠার প্রর্ান দকৌশে এবং ভতবেযলি এই র্লনর হ্তিকর তবরুলি সবলচলে উপ ুক্ত প্রতিকার এবং ক্তের দটকসহী ব্তি

INTRODUCTION

There has been quite a few projects and research work conducted on the challenges and problems currently prevailing in Sundarbans and its adjoining areas. Sundarban is a mangrove area, where 62% of its land belongs to Government of Bangladesh and remaining 38% to Indian Government. It is at the confluence of Padma, Brahmaputra and Meghna river in the Bay of Bengal. Lately it was found that Sundarban is tremendously suffering from various difficulties. The frequent occurrence of cyclones over Bay of Bengal has left the land in utter disaster. Cyclones like Alia, Amphan etc. Has lead to inundation of sea waves in lands leading to increased soil and water salinity beyond permissible limits ultimately affecting the agriculture. Analysis of weather parameters over Indian Sundarbans also suggest that the rainfall has decreased at a rate of

0.94mmyr-1. Due to the drying up of river beds even after being traversed by numerous creeks and rivulets it is also facing scarcity of fresh water. In fact various studies suggest that the Farakka barrage has caused reduction in flow of river water leading to salinity ingress and drying up of the Indian Sundarban deltas. Not only this but also the tilting of Asian plate towards Burma side has caused water diversion towards east. Apart from such natural phenomena human activities like discharging industrial effluent with heavy toxicities also have influence on soil and water leading to shortage of availability of fresh water for agriculture and cultivation. The inadequate dredging operation which does not occur in time and is less frequent has caused barrier to the flow of sweet water of the rivers. Hence finding out remedies to such problems are quite justifiable. This report contains ways and methods that will help the farmers to overcome soil salinity by using traditional variety of seeds and alternative traditional methods for agriculture. It will also promote sustainable agriculture and help the farmers to earn money and resources for the basic survival and livelihood of the people of Indian Sundarban in southern deltas of West Bengal. With the help of both secondary data from books and internet and primary data based on experiments and field survey the result was achieved.

BACKGROUND

India is a country of distinct and diverse cultures that varies from region to region. India has one of the oldest civilizations started around 4500 years ago. It is a country of social norms, ethical values and traditional customs. Indian traditions originate from old ancient scriptures and texts which are thousands years old. Though now India has many scientific inventions it has not forgotten its root. Along with its modernization it has kept hold of its ancient traditions and practices. In this paper we discuss about the traditional methods that has been used for sustainable agriculture. Indian traditional agriculture is about 4000 years old. Indian traditional agricultural practices has the potentiality to mitigate adverse effect of various aspects like climate change that are affecting the cultivation, with the help of adequate utilization and implementation of knowledge and information from local resources and by developing site specific agricultural practices which are compatible with the regional climatic and soil conditions. Double cropping, mixed cropping, crop rotation, ploughing, Agro forestry, use of local varieties and resources are

some of the prominent traditional agricultural practices of India. Sundarbans that lies in the Eastern zone of India is currently suffering from agricultural loss due to soil and water salinity. According to Rig Veda saline soil is known as Ushara soil that contains a larger profile of sodium potassium and magnesium and thus they are infertile and support no vegetation growth. In summers Salts from capillary tubes comes out leading to salt build up on agricultural land, traditional methods suggest that ploughing can help in breaking such capillary tubes and resist salt build up. Again using of organic manures from natural waste composting can not only fertilize the soil but also act as a buffer to reduce soil salinity. Opting for alternative use of salt tolerant rice variety and cultivation crops like cotton, coconut, barley, date palm etc. can be done. In order to dilute the salt in water for irrigation traditional leaching methods could be used.

Problems

Agriculture and paddy cultivation that has stopped in unfavorable condition in Sundarban is the main Problem raised in this project report.

Objectives and scope

There are mainly two objectives-

1. To find out information from the farmers of Sundarbans about the main causes of the agricultural challenges faced by them.
2. To find out alternative measures and remedies to such challenges by methods using traditional practices.

With the help of this project cultivation will be easy in saline soil through traditional methods and livelihood of the people of Sundarban will be sustained.

Literature review

- Atanu Kumar Raha et al. (2013), 'climate change and sustainable livelihood program: a case study from the Indian Sundarbans', *The journal of ecology*. This paper states that due global warming and climate change people of Sundarbans are struggling to survive. The paper speaks about alternative methods to sustain the lives of the people and farmers of Sundarban. It concludes by saying adaptation is more important than mitigation strategies.
- Z. Plautet al. (2013), 'overcoming salinity barriers to crop production using traditional methods.' *Taylor and Francis*. This paper states that soil salinity has become major hindrance for plant growth and development. It leads to agricultural loss. The paper speaks about traditional methods and ways to reduce the salinity of soil and water.
- Sunando Bandhopadhyay et al. States that Sundarban is one of the largest mangrove forests which is currently facing severe misfortune due to natural and manmade causes. It is ultimately affecting the flora and fauna of Sundarban. This paper suggests that taking adaptive measures are the only remedies to such miserable conditions in order to sustain livelihood.

DESCRIPTION

Sundarban lies in the Eastern zone of India and southern part of West Bengal. It is one of the largest mangrove forests in the world and is situated in the confluence of Padma, Brahmaputra and Meghna river in the Bay of Bengal. It is divided into two parts where 62% of the land lies in Bangladesh and remaining 38% in India. It belongs to the saline coastal zone of West Bengal. It comprises North 24 Parganas and

South 24 Parganas.(21.57°N, 89.11°E). Its total area in West Bengal is 1,40,000 ha. It is a home to many tidal streams. It is mainly used for agricultural purposes. Recently it is suffering from threats like land loss from frequent storm surge, Increased salinity in soil due to rising sea levels due to climate change and reduced freshwater supply. This project is based on the increased salinity of soil and irrigation water and its effect on agriculture. Finding alternative traditional methods for sustainable agriculture is the main purpose and discussion of this project.

METHODOLOGY

In order to fulfill the objectives of this project we have collected primary and secondary data by using intensive field survey. We have visited to Bidhan Chandra KrishiViswaVidalaya, and irrigation department of West Bengal for all the research work carried out by the various scientists and researchers regarding these problems faced by the farmers in parts of South 24 Parganas. We have visited adjoining areas of Sundarbans and ICAR institute in Canning and Kolkata for information and data collection, through field survey and experiments carried on soil and water.

We have also taken the help of journals, published papers and electronic media for different research work related to this topic.

RESULT Table 1- graphical representation of data accumulated

PARAMETERS	VALUES
Salinity as per chloride	0.66 PPT
E.C	4.08
P.H	8.7
TDS	688 PPM
ambient temperature	32.6

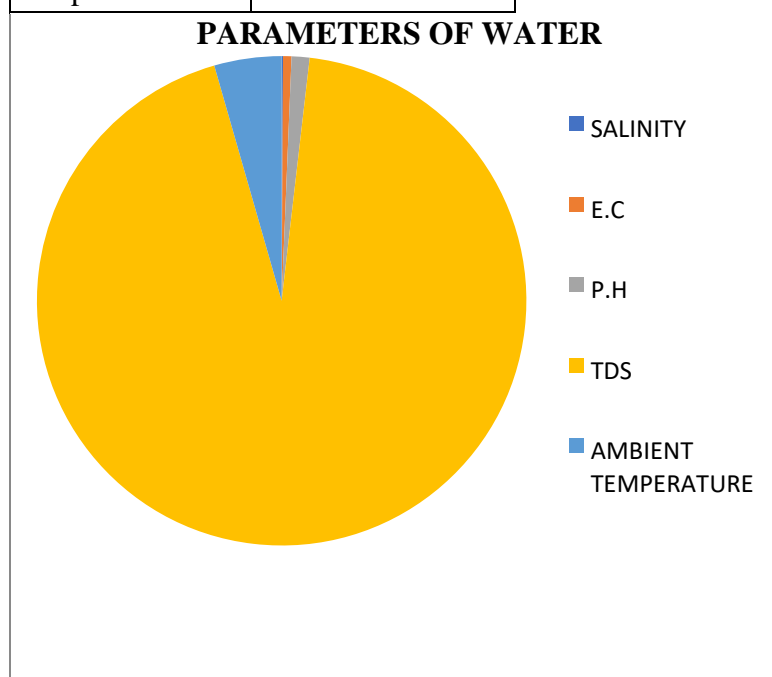


Table 2- graphical representation of data accumulated from canning

PARAMETERS	VALUES
P.H	6.6
Salinity	0.42 PPT
Moisture	77%
E.C	1.4

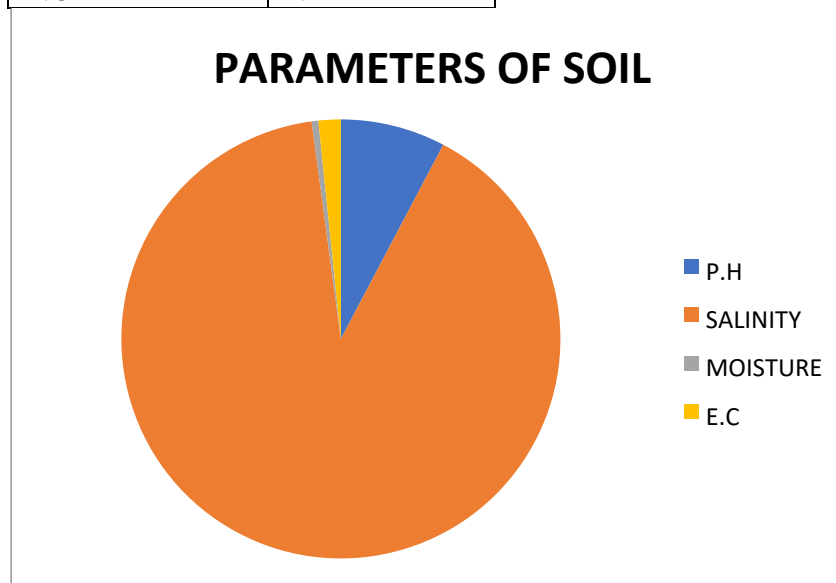


Table 1 and 2 from the result section explains the findings of the parameters of water and soil respectively that clearly shows the salinity of water and soil are beyond the limits for the growth and tolerance of highly sensitive crop groups. The P.H of water was a bit high where as the P.H of soil demonstrate the land to be a drier area receiving less rainfall (most soil have P.H value between 3.5 -10, P.H in higher rainfall areas ranges between 5-7, and in drier areas ranges between 6.5-9). EC level in soil is within the normal range and water is high. Moisture level is a bit high in soil (normal range 20-60). TDS of water indicates to be in a slight to moderate range (dissolved inorganic salt).

Table 3- Comparison between traditional variety and high yield variety

PARAMETERS	ADDITIONAL RICE VARIETY	HIGH YEILDING VARIETY
Cost of cultivation		
Seeds cost	Less	More more
Fertilizers pesticides	Less	
Health benefits	More	less
Salt tolerance	More	Less
Labor required	Less	More
Maturity period	More	Less
Productivity	Less	More

Market value	Almost same	Almost same
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Table 3 from result section shows the comparison between traditional and high yield variety of rice where it was found that the advantage of using traditional variety was more. It was also found to be suitable for cultivation in saline land of sundarban.

DISCUSSION

From the parameters of water and soil we could clearly relate the result of this report with the objectives i.e. the challenges faced by the farmers of sundarban for agriculture. From the result we could observe that the level of salinity in water and soil are beyond permissible limit which ultimately restrict the growth of crops. rainfall also plays an important role in draining out the excess salt from the soil but the PH of the soil clearly states the land to be a drier area as sundarban is not receiving the exact amount of rainfall required. Not only this but also It was found that there was a moderate amount of dissolved inorganic salt present in the irrigation water. All these factors again contribute to the increased salinity condition in soil leading to difficulties in cultivation of crops and paddy in sundarbans

The second objective of this project was to find out alternatives to such problem and by analyzing the result from table 3 we could clearly affirm that using traditional variety of paddy that are salt tolerant with the help of organic manures we can manage the situation of agricultural difficulties in southern deltas of west Bengal. Dudhersar, basmati, khejurchori, gheus, Nona khetchori etc are some of the traditional salt resistance variety.

Difference in input use

As the traditional variety of rice that are salt tolerant requires no or few amount of pesticides and chemical fertilizers in comparison to high yielding variety it saves the cost of input and To compensate partly the loss from lower productivity. Again seeds of such variety are stored by the farmers from their previous year cultivation and hence the cost of seeds is very less or nil. This makes the total input cost for cultivation less than HYV.

Difference in health benefit and salt tolerance

The traditional variety cultivated by organic manure has much more health benefit than HYV cultivated by chemical fertilizers and pesticides. Also it is highly salt tolerant than HYV.

Difference in maturity period

Although the maturity period is less for the HYV than the traditional variety but on doing a peer survey it was concluded that the period difference for maturity between the traditional and HYV was not much.

Difference in productivity and market value

Although the productivity of HYV was more than traditional variety which is one of the major reasons for the farmers to shift from traditional varieties to HYV but it was interesting to note that some traditional varieties like basmati, khejurchori were cultivated by the farmers in spite of their lower productivity. This is because of their high market value.

Uncertainties and Assumptions

Factors that could influence the result are as follows-

- The testing of soil and water salinity was done during monsoon season, the salinity of soil and water varies from season to season.
- Lack of awareness among farmers about the benefit they can get from cultivating traditional varieties and the lack of proper soil testing institute and official body in the remote areas.

CONCLUSION AND RECOMMENDATION

India is a land of agriculture that depends on rainfall. About 78% of small householders rely on agriculture for their livelihood. Lands of Southern delta of West Bengal lies under the saline coastal zone category where climatic condition, unawareness, unpreparedness, shortage of irrigation water and using unsuitable crops and paddy variety and techniques for cultivation has made the agriculture vulnerable to challenges and raised difficulties in survival. Traditional agriculture is much more resilient to the prevailing challenging condition in sundarban and its adjoining areas. Some of the traditional remedial measures that can be adopted to fight soil salinity in sundarban and promote sustainable agriculture are as follows-

- Not only traditional variety of paddy that are salt tolerant could be cultivated but also crops like coconut, cotton, sapodilla, water chest nut could be grown that can contribute in the economy.
- Practicing Agro forestry and livestock integrated agriculture and aqua culture that can provide organic manure instead of chemical fertilizers. This would also help in improving soil quality and act as a buffer to reduce salt.
- Using traditional techniques like ploughing can break the capillary tube where salt formation takes place.
- As the agriculture mainly depends on rainfall and the rainfall is quite scanty in sundarban practicing traditional rain water harvesting can provide water not only for irrigation but also for washing out excess salt from the soil.

Cultivation of traditional variety of rice and crops though can be less profitable however as sundarban is suffering from agricultural problems and major crop failures due to high soil salinity these traditional methods could be useful for them in order to survive and promote sustainable agriculture.

ACKNOWLEDGEMENT

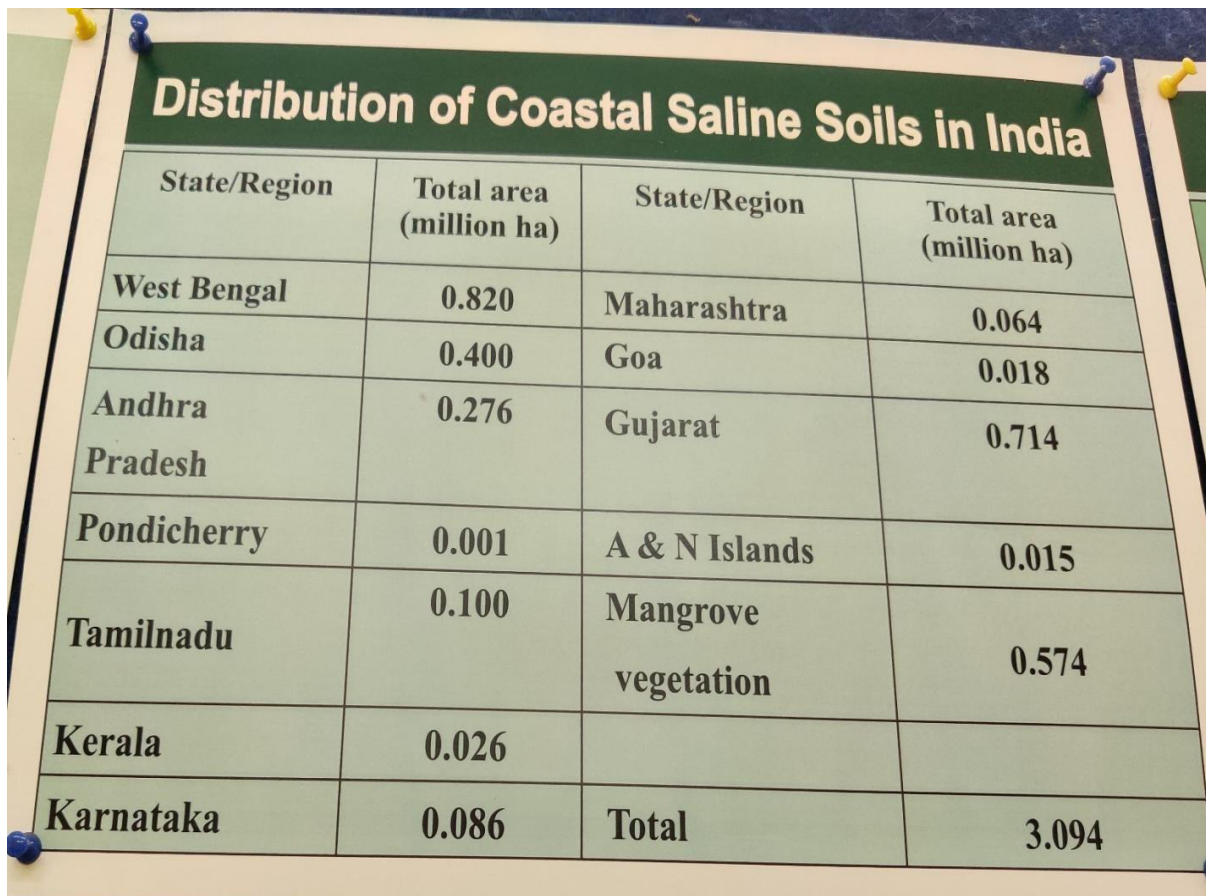
First of all I would like to thank IKS for giving me this opportunity to accomplish this project. I would also like to express my special thanks of gratitude to my mentor Dr. Bhaskar Sengupta for giving me guidance throughout. Without his help and guidance I would have not been able to complete this project. I also sincerely thank Mrs. Swati Chatterjee and Mr. Sudipta Bhattacharjee (faculties of department of environmental studies, Rabindra Bharati University), Mr. Kalyan Chakraborty (faculty at Bidhan Chandra Krishi Viswa Vidyalaya), Dr. Feroze Hasan Rahman (principal scientist of ICAR), Dr. D.D Barman (researcher at irrigation department of West Bengal), Mr. Mustafa (Chairman of Sundarban dream, NGO), for their immense help and cooperation. Lastly I would like to thank my family and friends for helping me to complete this project in the given period of time.

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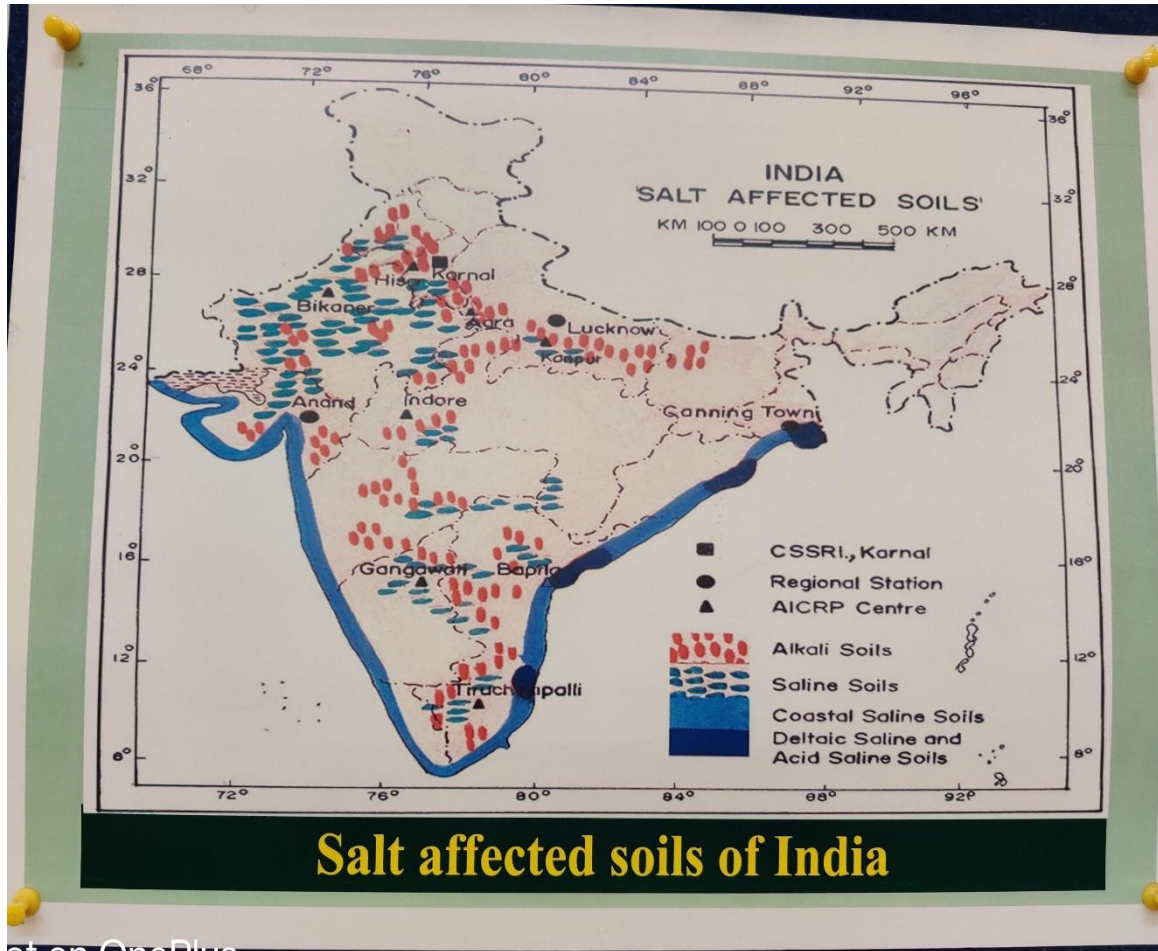
APPENDICES

Distribution of coastal saline soils in India



State/Region	Total area (million ha)	State/Region	Total area (million ha)
West Bengal	0.820	Maharashtra	0.064
Odisha	0.400	Goa	0.018
Andhra Pradesh	0.276	Gujarat	0.714
Pondicherry	0.001	A & N Islands	0.015
Tamilnadu	0.100	Mangrove vegetation	0.574
Kerala	0.026		
Karnataka	0.086	Total	3.094

SOURCE-ICAR CANNING



Salt affected soils of India

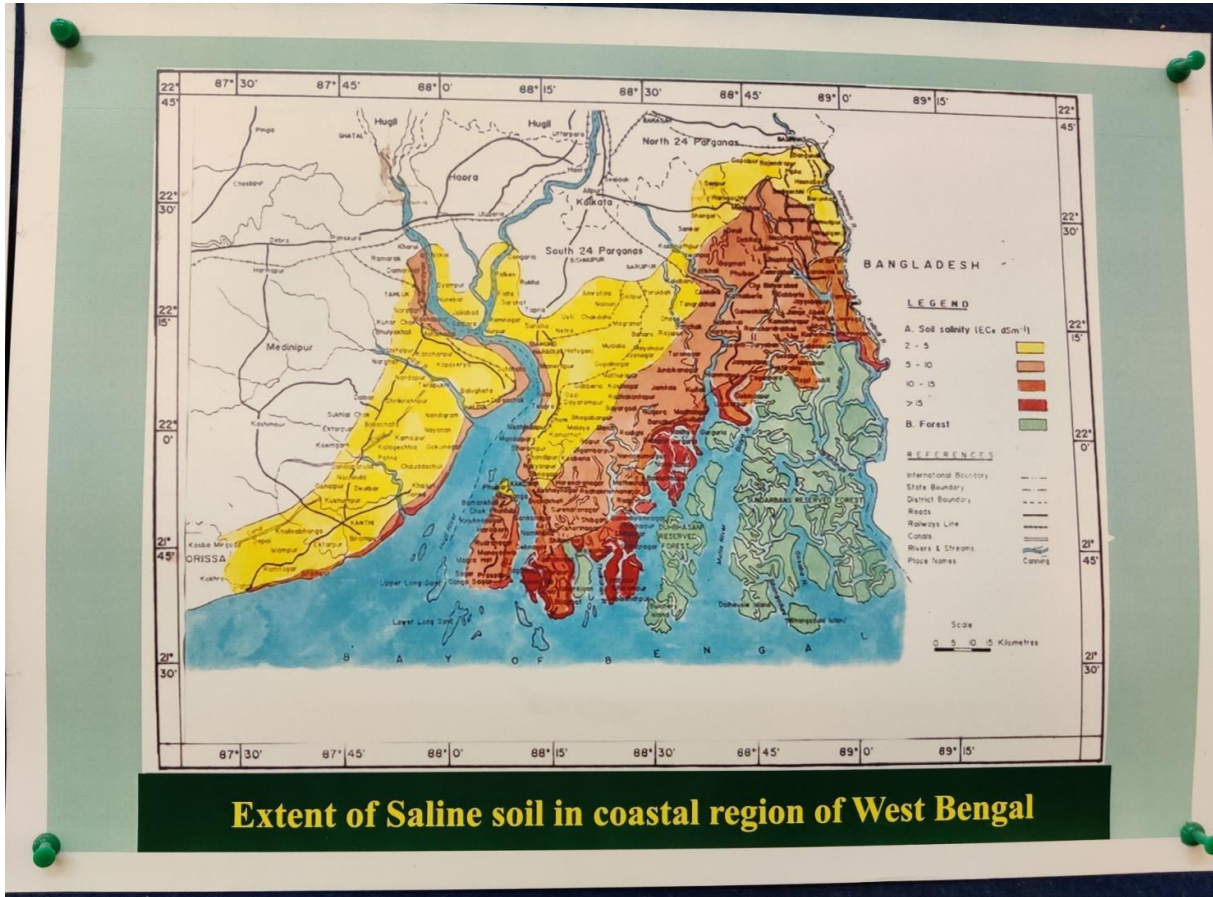
SOURCE- ICAR CANNING

Distribution of coastal saline soils in different districts of West Bengal

Distribution of Coastal Saline Soils in different districts of West Bengal			
Districts	Cultivable area (ha)	Saline area (ha)	Cultivated Saline area (ha)
North 24 Parganas	269942	147112	95097
South 24 Parganas	408359	350625	237911
Haora	92196	57599	43474
East Medinipur	372058	265112	181948
Grand Total	1142555	820448	558430

SOURCE- ICAR CANNING

Extend of saline soil in coastal region of West Bengal



SOURCE-ICAR CANNING

Salt tolerant paddy



