A Seminar Paper on

Possibility of Augmenting Irrigation Facilities for Increasing Cropping Intensity in the Coastal Saline Environment of Bangladesh

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Possibility of Augmenting Irrigation Facilities for Increasing Cropping Intensity In the Coastal Saline Environment of Bangladesh[1]

by
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ABSTRACT

Salinity is a major abiotic stress that limited the growth and productivity of plants in many areas of the world. A systematic study was conducted from secondary information about salinity to know the effect of salinity on seed germination, seedling growth, plant growth and yield with irrigation and water management practices. Salinity reduces germination and seedling growth of different crops. High levels of soil salinity reduce plant growth and photosynthesis resulting low yield. With the increase of salinity Na+, Ca++, Cl- decrease and increase K+ causing nutritional imbalance in plants resulting ion toxicity. So, the developments of methods and strategies to ameliorate deleterious effects of salt stress on plants have received considerable attention. Irrigations in raised bed with mulch would be found more effective for the production of different crops in saline soil. The amount and kind of salts determine the evaluation of water for irrigation. With poor water quality, various soil and water problems may arise. Special management practices may then be necessary to maintains sustainable crop productivity From the survey findings, it is revealed that total saline area has increased to about 1.056 million hectares from 0.833 million hectares in about the last four decades. This type of data base may be very helpful for intensifying crop diversification activities and designing future research programme of ameliorative measures to minimize soil problems such as salinity, toxicity, drainage impedance as well as soil water management packages in the coastal areas of Bangladesh.

Keywords: Salinity problem, Fallow land, Coastal area, Cropping intensity, Irrigation

[1] Title of the seminar paper presented as a part of course AGR 598 during Summer 2020

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CHAPTER I

INTRODUCTION

Agriculture is a major sector of Bangladesh's economy accounting for around 21% of the national GDP. Salinity is identified as the serious problem in the coastal area in Bangladesh.

Bangladesh, a deltaic plain, features a very flat and low topography floodplains at the confluence of the Ganges, Brahmaputra and Meghna rivers,tidal floodplain and estuarine floodplain cover over 80% in the northeast and south-east area of Bangladesh.These coastal regions hardly 1–4 metres above mean sea water level (MSL). (Rahman,2001)

Out of 2.85 Mha, coastal areas 0.83 Mha are arable and 1.056 million ha of arable lands are suffering from varying degrees of salinity. The coastal belt of Bangladesh consists of 19 districts, which cover 30% of the cultivable lands of the country. Due to climate change , sea level is increasing day by day and in Bangladesh a huge portion will be affected by salinity which will have a detrimental effect in cultivation in coastal area . Salinity has increased about 26% in the coastal region of Bangladesh over last 35 years. (BBS,2010)

Poverty within the coastal region is high; 14 districts of the 19 coastal districts have poverty rates greater than the national average.The climate and fertile soils in the coastal zone offfers a wide array of crops to be cultivated, for example cereals, pulses, vegetables, fruits and cash crops like jute and sugarcane,however the cropping patterns and varieties used are dependent on the local environmental conditions.(SRDI,2010)

The monsoon wet season occurs during June to October, keeping both soil and river salinity low and thus enabling the main Kharif II season of rice production. However soil salinity increases each year in the dry season between November and May (Rabi and Kharif I seasons), limiting agricultural production during that period . Dry season agriculture is particularly difficult in Bangladesh due to the pressures caused by both drought and salt stress. These result in large areas of land that are fallow, productively until the next monsoon rainfall which dilutes and flushes the accumulated salts.(Haque

SA, 2006). Crop production of the salt affected areas in the coastal regions differs considerably from non saline areas. Because of salinity, special environmental and hydrological situation exists, that restrict the normal crop production throughout the year. In the recent past, with the changing degree of salinity of some areas due to further intrusion of saline water, normal crop production becomes very risky. Crop yields, cropping intensity, production levels and people's quality of livelihood are much lower than that in other parts of the country, which have enjoyed the fruits of modern agriculture technologies based on high-yielding varieties, improved fertilizer and water management and improved pest and disease control measures (BBS, 2001). At the same time food demand in the area is increasing with the steady increase in human population. The present paper analyze the soil and water salinity intensity, extent, constraints and possible soil and water management practices to be followed in coastal areas of Bangladesh for the betterment of the country . Land in coastal Bangladesh is used *inter alia* for agriculture, shrimp and fish farming, forestry, salt production, ship-breaking yards, ports, industries, human settlements and wetlands (Figure 2). Land use in the coastal zone is diverse, competitive and often conflicting (Alam *et al.*, 2002; Islam, 2006a).

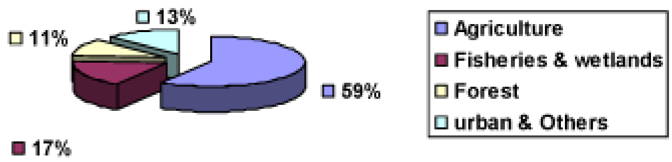


Figure 1. Major Land uses in Coastal Region of Bangladesh

Objectives :

1.To know impact of salinity in crop cultivation in coastal area of Bangladesh

2.Analyzing effect of applying irrigation for increasing cropping intensity in coastal area of Bangladesh.

CHAPTER II

MATERIALS AND METHODS

This seminar paper is exclusively a review paper so all of the information has been collected from the secondary sources.For preparing this paper ,I went through various articles of relevant books,journals , reports, publications, proceedings. Related internet web sites are also used to collect information. Findings associated with my topic are reviewed with the assistance of the library facilities of E-journals of Librabry from Bangabandhu Sheikh Mujibur Rahman Agricultural University.

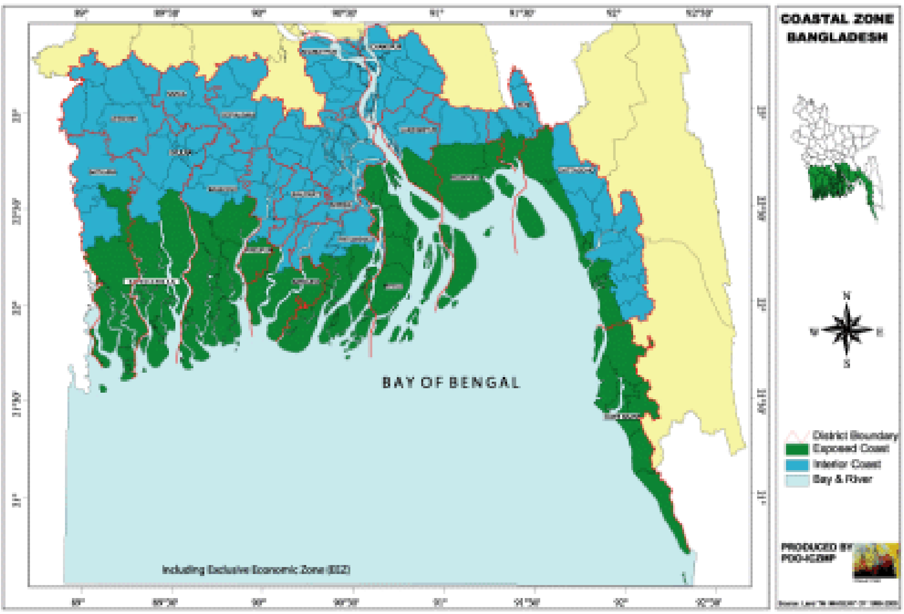
Besides I asked for constitutive suggestions and valuable information from my major professor and course instructors that helped me to improve this paper. After gathering all the available information, I personally compiled and prepared this seminar paper.

CHAPTER III

REVIEW OF FINDINGS

3.1 Coastal Area :

The total area of Bangladesh is 147,610 km^2,of which coastal zone is 47,203 km^2 and it's roughly 31% of the entire country.Again, the coastal areas of Bangladesh cover nearly 30% of the cultivable lands of the country it's 710 km long coastline running parallel to the Bay of Bengal.About 53% of the coastal areas are suffering from salinity. Out of 2.85 million ha of coastal cultivable land in Bangladesh about 1.0 million ha of arable land are suffering from varying degrees of salinity and most of those lands remain fallow in season (Karim *et al*. 1990). The coastal and off-shore area of Bangladesh include tidal, estuarine and meander floodplains. The tidal floodplain land occurs mainly in the south of the Ganges floodplain and also on large part of Chittagong coastal plains. The Ganges tidal floodplains constitute about 49% of the coastal areas. The tidal lands on the coastal plain including the Chittagong coastal floodplain and the Matamuhuri tidal floodplain occupy less than 6%. Estuarine floodplains occupy about 18% of the total coastal area .(Karim *et al*, 1982).



Source : Islam *et al*. 2006

Figure 2: Coastal Area of Bangladesh

3.2 Present Soil Salinity Status In Bangladesh

It is observed that withdrawal of fresh river water from upstream, irregular rainfall, introduction of brackish water for shrimp cultivation, faulty management of the sluice gates and polders, regular saline tidal water flooding in unprotected area, capillary rise of soluble salts etc. are the main causes of increased soil salinity in the top soils of the coastal region.

Aproximately 0.328, 0.274, 0.189, 0.161 and 0.101 million hectares of land are affected by very slight (S_1), slight (S_2), moderate (S_3), strong (S_4) and very strong salinity (S_5) respectively. This situation is expected to become worse further because of the effects of climate change (Islam, 2006). Cropping intensity can be increased in very and slightly saline areas by adopting proper soil and water management practices with the introduction of different salt tolerant varieties of crops.

Table 1: Extent of soil salinity during the last four decades (1973-2009) in coastal areas.

Salt affected area (000'ha)			Salinity class and area (000'ha)											
			S1 2.0-4.0 dS/m			**S2** 4.1-8.0 dS/m			**S3** 8.1-16.0 dS/m			**S4** >16.0 dS/m		
1973	2000	2009	1973	2000	2009	1973	2000	2009	1973	2000	2009	1973	2000	2009
833.45	1020.75	1056.26	287.37	289.76	328.43	426.43	307.20	274.22	79.75	336.58	351.69	39.90	87.14	101.92

* S_3 = 8.1-12.0 dS/m, S_4 = 12.1-16.0 dS/m. Source: SRDI,(2010)

A comparative study of the salt affected area between 1973 to 2009 showed that about 0.223 million ha (26.7%) new land is effected by various degrees of salinity during about the last four decades .

Table 2: A comparative study of the salt affected area between 1973 to 2009 in coastal areas.

Salt affected area (000'ha)			Salt affected area increased during last 9 years (000'ha) (2000-2009)	Salt affected area increased during last 36 years (000'ha) (1973-2009)
1973	2000	2009		
833.45	1020.75	1056.26	35.51 (3.5%)	222.81 (26.7%)

Source: SRDI,(2010)

3.3 Current Cropping Intensity in Coastal Area :

Cropping intensity refers to raising of a number of crops from the same field during one agricultural year; it can be expressed through a formula.

Cropping Intensity = Gross Cropped Area / Net Sown Area x 100

The range of cropping intensity value was recorded 124-293%.Average cropping intensity of Bangladesh is aproximately 190%.Whereas the **current cropping intensity of coastal area is 133 percent only now**.In Bangladesh single cropped area is 2440659.10 hectare,double cropped area is 3820637.14 hectare,triple cropped area 1637762.79 hectare,net cropped area : 7908771.50 hectare and total cropped area 15034071.60 hectare.(FAO,2013)

Table 3 : Cropping Intensity, 1980-81 to 2010-11, Bangladesh
Area in million hectares

Year	Total Land Area of the Country	Net Cultivable Land	% of Net Cultivable Land in Terms of Total Area	Net Area Sown	Total Cropped Area	Cropping Intensity (%)
2000-01	14.85	8.40	56.57	8.08	14.30	176.98
2001-02	14.84	8.48	57.14	8.08	14.30	176.98
2002-03	14.84	8.42	56.74	8.04	14.17	176.24
2003-04	14.84	8.40	56.60	8.03	14.23	177.21
2004-05	14.84	8.44	56.87	7.97	14.10	176.91
2005-06	14.85	8.29	55.82	8.03	14.20	180.00
2006-07	14.45	8.29	57.37	8.03	14.20	180.00
2007-08	14.85	9.09	61.21	8.23	16.50	179.00
2008-09	14.85	9.09	61.21	7.77	13.88	179.00
2009-10	14.85	9.23	62.15	7.69	13.91	180.88
2010-11	14.84			7.84	14.94	191.00

(Source : BADC, 2010)

3.4 Low Cropping Intensity and Salinity :

Several agricultural constraints are identified in coastal saline area. The dominant soil, land and water related constraints are mentioned below.

As we know all soils contain some water soluble salts. Plants absorb essential plant nutrients in soluble salts form, but excessive absobtion of soluble salts, called soil salinity, and this suppresses plant growth. Saline soils are common in coastal area in tropical regions, arid and semi-arid regions. Salts in the soils present as ions.Weathering minerals released this ions in the soil. Soil saturated with soluble salts due to sea water flooding.Salinity may also be produced in irrigation water or as fertilizers, or due to less rainfall in dry season. When rainfall is insufficient (December-June) to leach or wash out ions from the soil profile, salts congest by the soil and soil salinity developed in Bangladesh.
(Mahmuduzzaman et al.,2014)

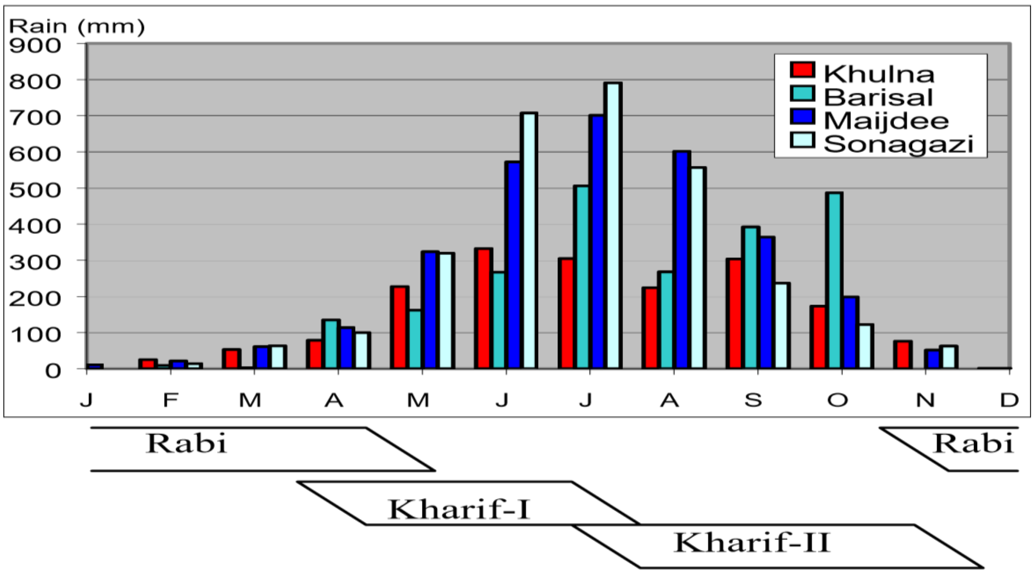


Fig. 3. Monthly total rainfall at four locations in the coastal region and its relation with the cropping seasons.

This chart shows that precipitation rate is very low at Robi season in saline areas.As saline soil contains more salt than normal soil,it becomes detrimental to crop cultivation.
The most common response of plant towards salinity is reduction in growth. In low to moderate concentration, salinity affects crop production by lowering the soil-water potential and increases concentration of salt at the root zone. Low water potential indicates that plant cannot extract sufficient amount of water from soil and maintain turgor at very low soil-water condition.(Salehin *et al*. 2014)

As salt concentration increases, water becomes increasingly difficult for the plant to absorb. A plant can actually die from water stress or drought in a moist soil if the salt concentration becomes high enough. Other effects of salts on plants are toxicities of specific salts and nutritional imbalances. Some elements, such as sodium, chlorine, and boron have specific toxic effects on plants. Plants sensitive to these elements may be affected at relatively low salt levels in the soil can upset the nutrient balance in the plant or interfere with the uptake of some nutrients. (Blaylock,1994)

3.5 Relationship between Irrigation and Salinity

It is showed that accumulation of salts on the agricultural land in the dry season is controlled by the amount and quality of irrigation water applied. An increase in the salinity of sources of dry season irrigation water will lead to increased salt accumulation in soils.Other key factors were the effectiveness of the monsoon rainfall in removing water by leaching/disposal through effective and well-maintained drainage systems. Their analysis showed that irrigating with water at up to four parts per thousand (ppt) can be sustainable, but if the dry season irrigation water quality goes above 5 ppt, the monsoon rainfall is unable to flush out the salt deposits. It was found that agricultural productivity in the Barisal, Patuakhali, and Bhola districts is likely to fall by 25 percent by 2050, with some regions expected to experience dry season crop yield reductions of 50 percent.Regions which are already experiencing severe salinity in Barisal and Khulna divisions are expected to see salinities of greater than 20 ppt by the end of the century, effectively curtailing dry season agriculture . Clarke et al. (2015)

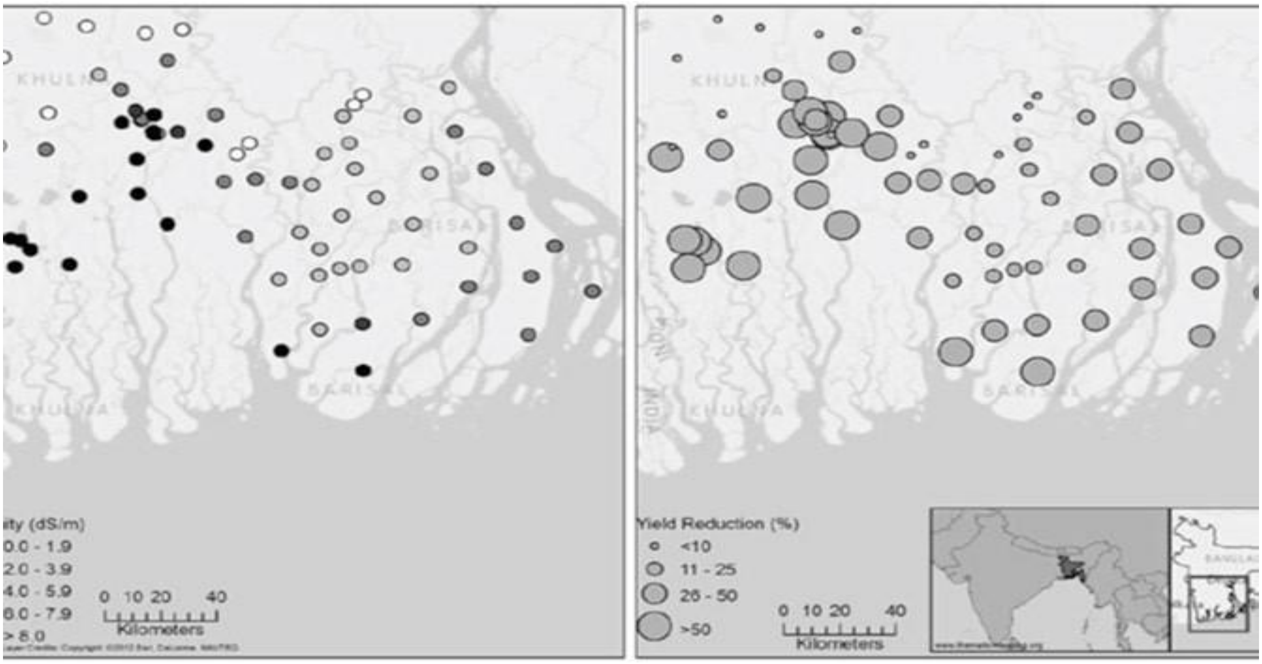


Figure 4: Projections of future 2050 river water salinities (left) and simulated crop yield reduction due to increased irrigation water salinity (right) (Source :Clarke et al. 2015)

3.6 Significance of Augmentation of Irrigation :

At present, approximately 0.25 M ha land in coastal areas remain fallow during winter, which is about 15% of cultivable land in the south (MoA-FAO, 2012). In this scenario we assumed that of this fallow land 0.10 M/ ha (40%) can potentially be brought under surface irrigation in a short time-frame (MOA-FAO, 2012, Santos Valle et al., 2014) and be used for boro rice during the winter in future. In fact, the government has already planned investment and started implementing infrastructure projects for the coastal region to increase dry season cropping intensity to increase food security (MOA-FAO, 2012). Of the remaining 0.15 M/ ha (60%), 0.075 M/ ha (30%) can be used for both wheat and rabi maize and can be cultivated under rainfed conditions in future. This scenario is based on a detailed study in southern Bangladesh which concluded that most fallow lands in the south can be used for wheat cultivation by utilizing shallow ground water or irrigation water from ponds during the rabi season (Rawson, 2011).

Moderate to low level of salinity can be managed through leaching process either naturally or artificially. Naturally, rainfall contributes to leach salt from soil surface but in dry season, when rainfall is insufficient, the artificial process or irrigation should be augmented. To manage salinity, more water needs to be applied other than regular water requirement of the crop. If soil salinity is too high comparing to the desired level of a certain vegetable in its root zone and the root is 30 cm depth, 15 cm of water is capable of leaching salinity by 50% and 30 cm of water is capable of leaching salinity by 80% and 60 cm by approximately 90% (Grattan,2002).

Irrigation method and adequate drainage also influence soil salinity. Irrigation water, containing various dissolved minerals, has a great influence on crop production as well as on soil salinity management. Simple surface water run-off cannot leach soil salinity; rather water should be drained through soil. In this regard, sprinkler irrigation provides a better control of water application rates. In plain land flood irrigation can also be used as an effective tool for controlling salinity.

Leaching is highly recommended for the saline area especially during winter. To calculate the leaching requirement for different winter crops, FAO developed following equation which is applied in the study:

$$LR = ECw / 5(ECe) - ECw$$

In Equation, LR = the minimum leaching requirement needed to control salts within the tolerance (ECe) of the crop with the ordinary surface method of irrigation, ECw = Salinity of the applied irrigation water in dS/m and ECe = average soil salinity tolerated by the crop as measured on a soil saturation extract (FAO,2011)

Leaching fraction is a percentage of water that needs to be applied in the field so that it can drain the root zone[1]. Applying the Equation, leaching requirement of some major winter crops of the study area are estimated (Table). Leaching requirement of different crops varies according to their threshold limit as well as percent of yield that a producer desires. The more percent of yield a producer desires, the more leaching is required. Therefore,

Therefore,

Table 4. Leaching requirement for different winter crops in the study area

Crop	Leaching requirements for 100% yield potential	Leaching requirements for 90% yield potential
Onion	0.27	0.168
Beans	0.35	0.20
Potato	0.18	0.116
Sweet potato	0.209	0.12
Carrot	0.35	0.18
Radish	0.27	0.149

Source : Grattan,2002

Grattan (2002) defined the leaching process as “Leaching is the process of applying more water to the field than can be held by the soil in the crop root zone such that the excess water drains below the root system, carrying salts in it.”

[1] Leaching fraction of 1/10 or 10 percent indicates that if 1 acre-foot of water is applied in 1 acre of land, the water drains below the root zone is 0.1 acre-foot

3.8 Possibilities in Using Coastal Areas :

Some special irrigation are now practiced in coastal areas of Bangladesh .This technologies are unriddled by scientific research organizations. Three different technologies are discussed below :

3.8.1 Pitcher irrigation :

Pitcher irrigation technique is very effective to check the salinity development on the soil surface through capillary pores in dry season (November to May) in salt affected coastal area of Bangladesh.

The technology is called pitcher irrigation technology because irrigation water is provided from an earthen pitcher which has several small holes on its bottom. The earthen pitcher is placed on a raised bed which is filled with fresh irrigation water having several pores on its bottom. Then jute fibres are entered into the pores.Then, the pitchers are filled with fresh irrigation water to reduce soil salinity, increase irrigation water use efficiency, increase land cover as well as soil productivity. The technology is popular in case of vegetable cultivation such as Sweet Gourd, Water Melon and Bitter Gourd cultivation in moderately salt affected area in Bangladesh.

Figure 5: Pitcher irrigation

As per the research findings of Soil Resource Development Institution (SRDI), it is expected that the soil salinity of the pits under the pilot having pitcher irrigation would be reduced by 2 – 2.5 ds/m.

All together 18 demonstrations (6 on sweet gourd, 6 on bitter gourd and 6 on water melon) in all three sites have been set in Rabi season 2016. By June 2016 the Upazila Debhata harvested 344 kg watermelon (earned Tk 8200), 220 kg sweet gourd (earned Tk 5720) and 40 kg bitter gourd (earned Tk 2200) from each demonstration (2 decimal). It has been reported that the salinity in the root zone of the crops grown under pitcher irrigation was comparatively lower than the control areas. The crops in the demonstrations are found more productive than the similar crops grown by local farmers under their traditional management. (DAE,2016)

3.8.2 Farm Pond Technology :

Bangladesh Rice Research Institute (BRRI) conducted a field experiment in a moderately saline soil at Sonagazi, Feni to study the feasibility of farm pond for irrigation of Rabi crop.

Dry season cropping caused a lowering in topsoil salinity and ploughing fallow land during the season was also found to lower the salinity build-up. The salinity of upper soil layer (0-15 centimetres) came down at the range of 1.20 to 0.69 dS per metre in wet season (July to October) due to leaching of salts by rainfall. Farmers can cultivate rice in Aman season without any salinity hazard. In Rabi season, three irrigations were applied to chilli at 20 days interval from the date of transplanting during the growing period. A farm pond storage simulation (FPSS) model was developed to simulate the water storage in the farm pond. The FPSS model optimised seepage and percolation losses for pond which was found 2.44 millimetres per day per metre. The model also showed that approximately 19 per cent of rainfall becomes runoff from the command area which could be stored for supplemental irrigation of Rabi crop. The estimated crop evapotranspiration was found 74 per cent of that of potential evapotranspiration as determined by pan evaporation method. The pond is economically profitable for irrigation in Rabi season. The command area was optimised for a given size of pond using long term rainfall and evaporation data and fitted to the normal distribution and optimum command area for desired probability of non-failure were chosen from the distribution. With these data, farm pond length-command area relationship was developed. From these relationships, the lengths of square-sized pond with depth of 2.25 metres having 1:1 side slope was estimated to be 32.30 metres for a non-failure probability of 80 per cent for a hectare farm land.

Figure 6: i. Pond in the middle of farm ii.Pond aside the farm iii.Pond outside the farm

The area occupied by pond was about 12 per cent of the command area. In the study area, 'irrigated chilli-rainfed T Aman' rice cultivation was found more profitable than that of 'rainfed chilli-rainfed T Aman' rice cultivation, the benefit cost ratio of 1.3.

Therefore, rainwater harvesting in coastal saline areas using farm pond for irrigation is profitable for growing vegetable crops in Rabi season.

In the coastal zone, about 3,47,671 ponds are scattered comprising of about 37,530 hectares of land, according to a The Bangladesh Bureau of Statistics report. Due to the lack of proper maintenance, a large number of ponds have already been abandoned. Re-excavating these large number of abandoned ponds and using the FPSS model, large amount of excess rainfall that occurs during June-September is drained out as surface runoff, this excess rainwater can be conserved in the re-excavated ponds or ditches in the crop field for Rabi crop irrigation; the ditches may also be used to drain excess water. (Rahman *et al*. 2001)

Open channels of various sizes catch rainwater but the storage of rainwater for off-season use becomes difficult due to absence of appropriate control structures.

Suitable control structure across the canal at the tail end can conserve rainwater, which could be used for Rabi crop irrigation. Also, the barren road-side ditches or borrow pits may be made deeper and wider enough to store large volume of rainwater for vegetable and pulse crops irrigation in the Rabi season. (tbsnews)

3.8.3 Drip irrigation :

For management of saline soil in different areas of Bangladesh, Bangladesh Agricultural Research Institute conducted some experiment on tomato,watermelon and chilli to find out the effective measures as well as to have better yield and their findings showed that drip irrigation in raised bed with mulch for tomato and watermelon and manual pump irrigation at an interval of seven days in raised beds with mulch for chilli was found more effective for the production of the crops.

Table 5. Effect of different irrigation and planting methods

Treatment	Yield (t /ha)		
	Tomato	Watermelon	Chilli
Ti	18.60	16.39	1.02
T2	27.18	23.38	1.28
T3	51.77	30.94	2.40
T4	71.57	36.13	3.02
T5	70.45	34.01	-

Ti= Farmers Practice, T2= No irrigation in raised bed with mulch, Ts=Manual pump irrigation in raised bed with mulch, can irrigation at an interval of seven days in raised beds with mulch for chilli, T4= Drip irrigation in raised bed with mulch,manual pump irrigation at an interval of seven days in raised beds with mulch for chilli and Ts= Drip irrigation in raised bed without mulch.

Source: BARI,(2013)

BARI in collaboration with ICBA and CDSP-II succeeded in growing crops like chilli and tomato in highly saline soils [ECe 21.7 and 29.4 dS/m in February (flowering) and March (fruits matured) respectively] using drip irrigation .

Fig. 7. Chili grown on highly saline soil with drip irrigation

3.9 Effect of Irrigation and Planting Methods :

Yields and profits achieved by 510 irrigated wheat, 550 irrigated maize, and 553 irrigated *boro* rice farmers in the coastal zone were measured over the three study seasons. Georeferenced yields and profits were categorized by land potential following Table 1, with each crop's cumulative distribution function (CDF) plotted to identify yields and gross margins in high and medium potential index classes at the 25th, 50th and 75th percentiles (equivalent to P = 0.75, P = 0.50, and P = 0.25, respectively, Figure 8). As noted above, the land upon which dry *rabi* season crops can be grown in Bangladesh is partially governed by monsoon flood inundation classes indicative of relative landscape elevation.[7] Wheat is generally suited to Medium-Highland-1 and -2 and higher classes.[4] Maize is usually established on the same elevation classes. As per the study's database maize or wheat farmers never established crops on elevation classes lower than these. Observations of *Boro* rice farmers indicated that classes higher than Medium-Lowland were used, while lower elevations were not. (Krupnik TJ *et al.* 2017).Assuming that some land that could be irrigated and double cropped will remain in rain fed low-intensity.

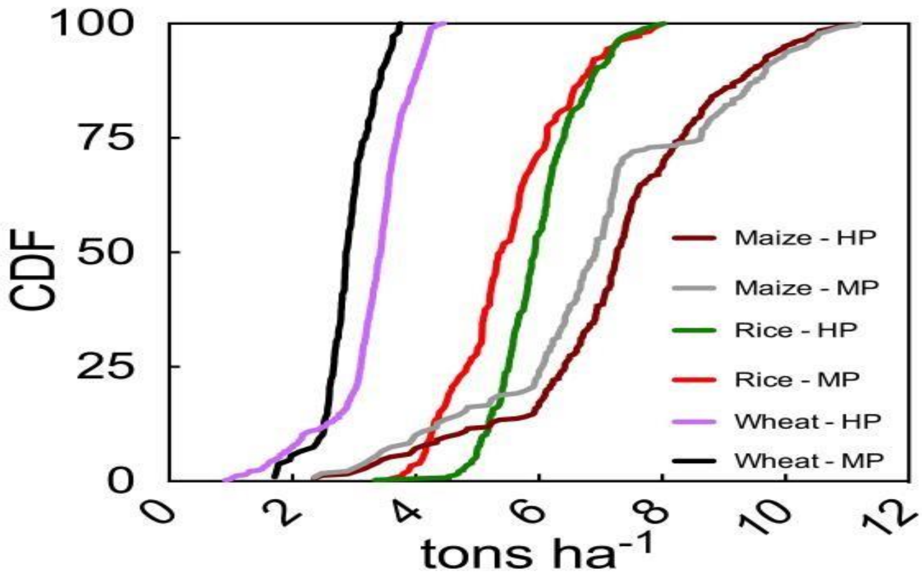


Figure 8. Cumulative distribution functions (CFD) for (A) irrigated maize, boro rice and wheat yields (t/ha) obtained by farmers on high (HP) and medium potential (MP)land. *Bottom:* Agricultural land suitable for surface water irrigation expressed as percentage of total cropland area in 100 km^2 imposed grids. Low- and marginal-potential lands were excluded.

Although 167,659 – 594,381 million tons more *boro* rice could be produced on the land suitable for surface water irrigation in the FtF zone, the potential contribution to national production is unlikely to exceed 3.2 percent unless yield gaps are diminished. Cultivation of maize on one- to three-quarters of the area identified as suitable for surface water irrigation would conversely contribute between 10 – 29 percent more maize nationally at the 75th probability level, or 14 – 42 percent at P = 0.25 (Figure 2). Between 9 – 26 percent more wheat could be produced from the same area at P = 0.75, or 10 – 31 percent at P = 0.25.

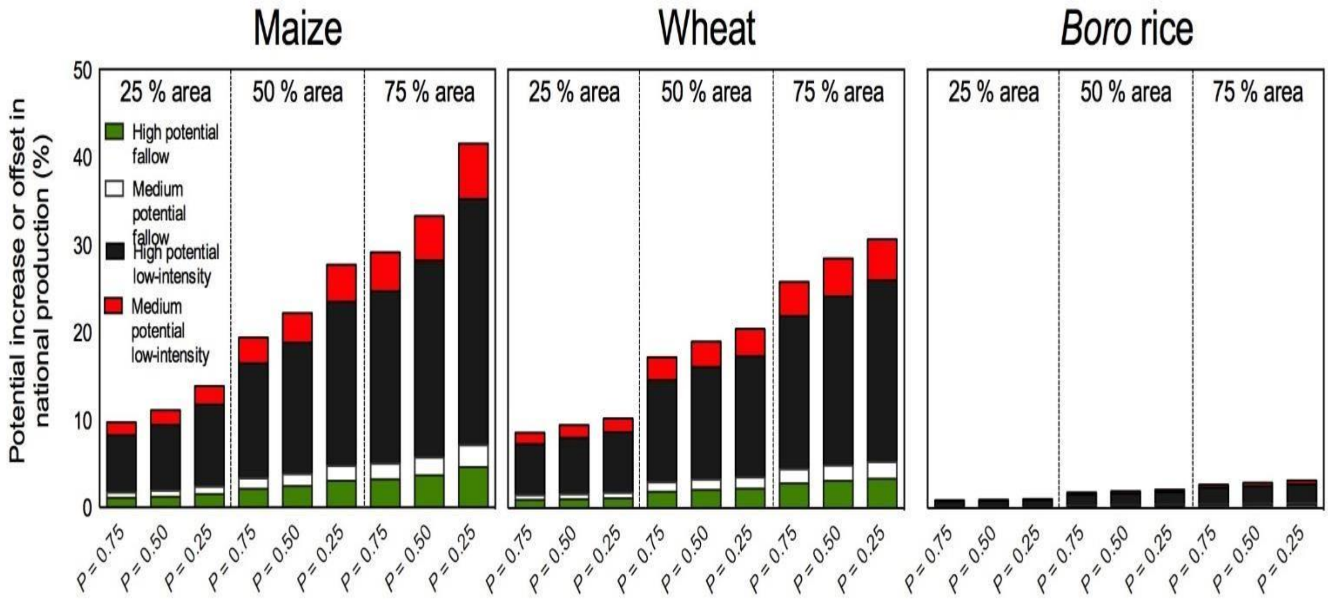


Figure 9: The potential contribution of surface water irrigated *boro* rice, wheat, and maize to national aggregate production in Bangladesh. Data depict three high and medium suitability land coverage scenarios with respect to the index shown in Table 1, including projections using one-quarter, one-half, and three-quarters of all fallow and low-intensity cropland identified within riparian buffers. Probability values indicate the probability of contribution from surface water irrigated cereals at the probability (P) of 0.25, 0.50, and 0.75 derived from the CDFs (Figure 1 Top). Sourse :Krupnik TJ *et al*. 2017

CHAPTER IV

CONCLUSION :

In Bangladesh, salt affected area has increased 2,22,810 ha during last 36 years. In 2000, six districts were recently affected by salinity besides 12 districts of 1973. Since large proportion of the cultivable land in coastal saline area has become saline, it is not possible to neglect all the area High levels of soil salinity can significantly reduce seed germination, seedling growth, plant growth, photosynthesis and increases grain sterility which ultimately reduce yield due to the combined effects of high osmotic potential and specific ion toxicity. Different crops and varieties response varies in various degrees of salinity. Conservation/storage of rain water in the re-excavated dead/dying river channels for more efficient water harvest. Development of 'Farm pond technology' through minimizing flooding depth, improving drainage condition and providing fresh water source for crop production. Monitoring of coastal river water salinity to find out safe period of water to be used for irrigation of specific crops. Farmers of this country generally do not irrigate monsoon rice and more so the farmers even when facilities for this practice exist, perhaps due to some socioeconomic factors. In the coastal areas drought related development of soil salinity is another factor sometimes poses threat to monsoon rice production. Only one or two supplemental irrigation can save the crop from these disasters.

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