

## Effects of Soil Salinity on Crop Production rate of the South West Zone of Bangladesh

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### Abstract

*Bangladesh is a small country with total land area of 147,570 sq. km. and the major part (80%) consists of alluvial sediments deposited by the river Ganges, Brahmaputra, Tista, Jamuna, Meghna and their tributaries. The coastal region covers almost 29,000 sq. km or about 20% of the country area. Moreover, the coastal area covers more than 30% of the cultivable lands of the country. About 53% of the coastal areas are affected by salinity. Agricultural land use in these areas is very poor, which is much lower than country's an average cropping intensity. Salinity causes unfavorable environment and hydrological situation that restrict the normal crop production throughout the year. The severity of salinity problem in Bangladesh increases with the desiccation of the soil which affects crop production depending on degree of salinity at the critical stages of growth, which reduces yield and in severe cases total yield is lost. Therefore, assessment of the present scenario of soil affected by salinity on crop production of the study area namely south west zone of Bangladesh (selected four sites of four upazilas under greater Khulna district) is very important. It is found from the study area that salinity level increased in April - May and decreased in October-November in every year. It has effect on crop yield in dry season due to salinity level increased. If Ganges water supply has increased in dry season, it reduces the salinity effect in crop production in Khulna. Rainfall also reduces the surfaces soil salinity.*

**Keywords:** salinity, coastal region, cultivable lands, cropping intensity, hydrological situation, south west zone of Bangladesh.

### 1. Introduction

The coastal area covers about 20% of the total area of Bangladesh is 147,570 sq. km the country and over 30% of the net is cultivable area. It extends inside up to 150 km from the coast. Out of 2.85 million hectares of the coastal and offshore areas about 0.83 million hectares are arable lands, which cover over 30% of the total cultivable lands of Bangladesh. A part of the coastal area, the Sundarbans, is a reserve natural mangrove forest covering about 4,500 sq. km. The remaining part of the coastal area is used in agricultural purpose. The cultivable areas in coastal districts are affected with varying degrees of soil and water salinity. The coastal and offshore area of Bangladesh includes tidal, estuaries and river floodplains in the south along the Bay of Bengal. Agricultural land use in these areas is very poor, which is roughly 50% of the country's average. Salinity causes unfavorable environment and hydrological situation that restrict normal crop production throughout the year. The factors which contribute significantly to the development of saline soil are, tidal flooding during wet season (June - October), direct inundation by saline water, and upward or lateral movement of saline ground water during dry season (November-May). The freshly deposited alluviums from upstream in the coastal areas of Bangladesh become saline as it comes in contact with the sea water and continues to be inundated during high tides and ingress of sea water through creeks. People in the southwest region are highly dependent on the natural resource base in sustaining their livelihoods. Agriculture and fisheries are important economic sectors, employing a large proportion of the population, and aquaculture is increasingly being pursued as an alternative livelihood option for rural households (Islam, 2003). The main aim of this study is to achieve the following specific objectives: Assessment of soil salinity condition in south-western zone of Bangladesh as well as its

effect on crop production rate. A major agricultural crop includes rice, betel leaves, fruits and vegetables, mustard and oilseeds, coconut and sugarcane. The region is densely populated, and most farm families cultivate the scarce land resources intensively, resulting in land degradation and reduced productivity. Increasing salinity and water logging are further reducing the availability of cultivable land. In addition to its contribution to the major economic sectors, the natural resource base provides coastal people with materials for building houses, cooking fuel, raw materials for handicrafts, etc. It is clear that people in this region are highly vulnerable to saline water disaster. The predicted impacts of water disaster will only increase the difficulties coastal people face in securing their livelihoods, maintaining health and safety, and achieving sustainable development.

**Saline Soil:** Saline soil contains an excess of soluble salts, especially sodium chloride. In other words, soils that develops under the influence of the electrolyte of sodium salts, with a nearly neutral reaction. Dominant salts are sodium sulphate and sodium chloride, but seldom sodium nitrate, magnesium sulphate, or magnesium chloride. They are non-sodic soils containing soluble salts in such quantities that they interfere with the growth of most crop plants. The pH of the saturated saline soil is usually less than 8.3. These soils are geographically associated with arid, semi-arid, sub-humid and humid areas as well. The estimates indicate that Bangladesh has about 2.8 million ha (Chanratchakool, 2007) of land affected by salinity and poor quality water. The total area includes deltaic floodplains and offshore islands. This comes to about one fifth of the total areas of Bangladesh and lies around the northern apex of the Bay of Bengal. The saline soils are mainly found in Khulna, Barisal, Patuakhali, Noakhali and Chittagong districts of the coastal and offshore lands. Due to a number of environmental factors the coastal soils are slightly too moderately saline on the surface, and highly saline in sub-surface layers and substrata.

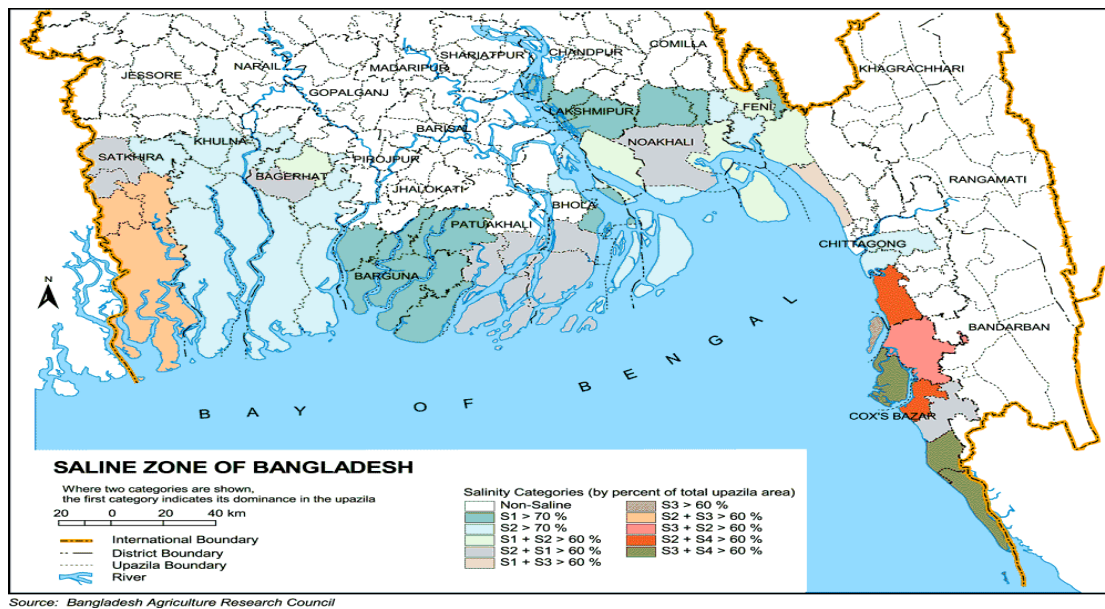


Figure 1: Saline Zone of Bangladesh

## 2. The study area:

### 2.1. South West Zone of Bangladesh:

The south western coastal zone is covered by the Sundarbans mangrove forest, covering greater Khulna and part of Patuakhali district. Greater Khulna district consists of nine upazilas. Out of them four land sites of Jalma (Batiaghata), Krisnanagar (Dumuria), Kismat (Fultola), Bajua (Dakop) selected as the study area. These areas were selected to investigate the top soil salinity and its effects on crop production. The study area is highlighted in figure 2. The area lies at 0.9 to 2.1 metre above mean sea level. Soil characteristics of the western coastal zone are silty loams or alluvium.

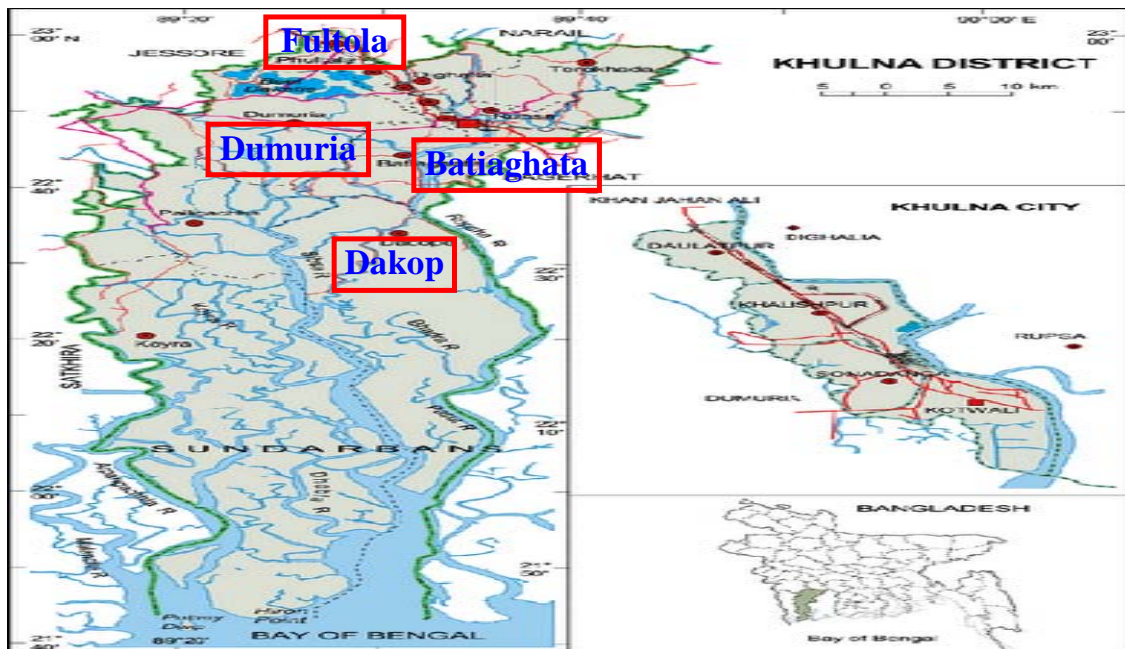


Figure 2: Map showing the study area of South West Zone of Bangladesh (**Highlighted zone**)

### 3. Data collection and analysis

The study area as stated above is south western part of Bangladesh. More specifically the study area is the Khulna district. In these study two types of data has been used. The soil and river water salinity data of year 2004-2009 for study site has been collected from “Soil Resources Development Institute (SRDI, 2009), Khulna”. The crop yield data of 2004-2009 for Khulna has been collected from “Agricultural Extension Institute (AEI), Khulna”. From the soil salinity data, monthly salinity of 2004-2009 has been calculated and used for showing graphical pattern. The graph will help to understand the top soil salinity pattern of the study area of Jalma (Batiaghata), Krisnanagar (Dumuria), Kismat (Fultola) and Bajua (Dakop), under greater khulna district.

#### 3.1 Analysis of Topsoil Salinity (ECe: ds/m) Conditions

Monthly variation of topsoil salinity of four sites within the study area in different year has been shown from figure 3 to figure 6.

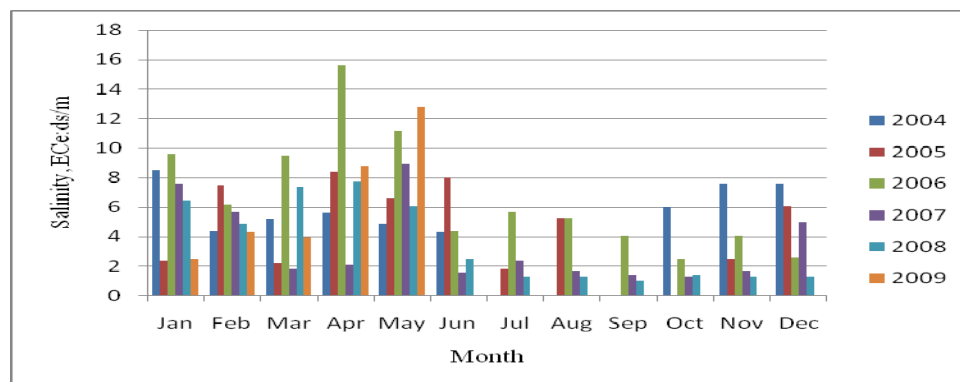


Figure 3: Monthly variation of top soil salinity rate in different year at **Jalma** (Batiaghata Upazila), Khulna.

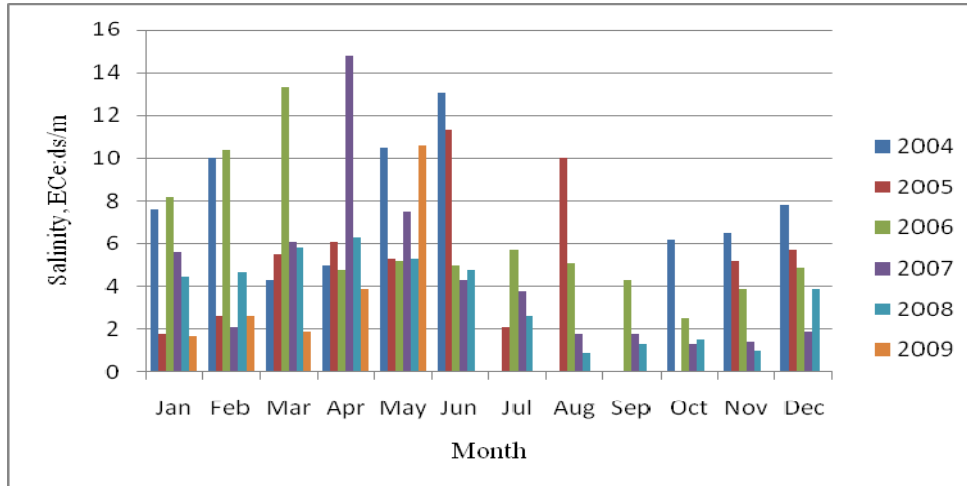


Figure 4: Monthly variation of top soil salinity rate in different year at **Krisnanagar** (Dumuria Upazila), Khulna.

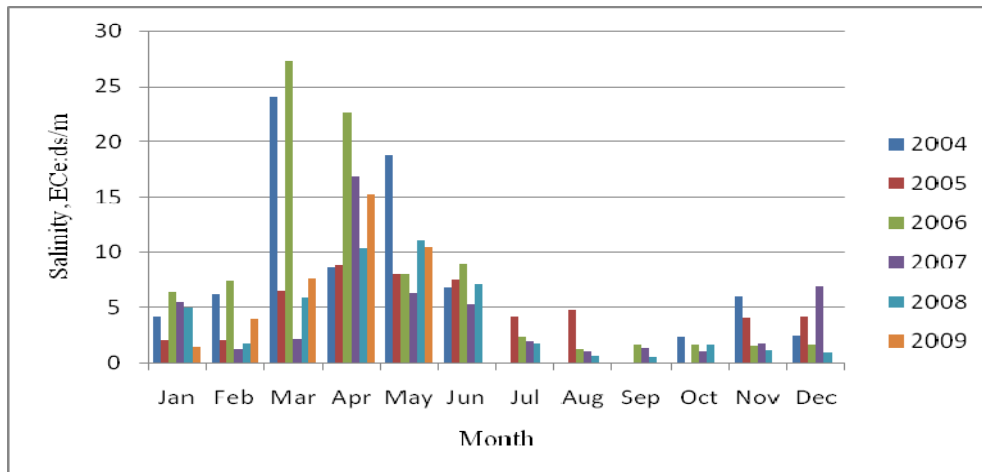


Figure 5: Monthly variation of top soil salinity rate in different year at **Kismat** (Fultola Upazila), Khulna.

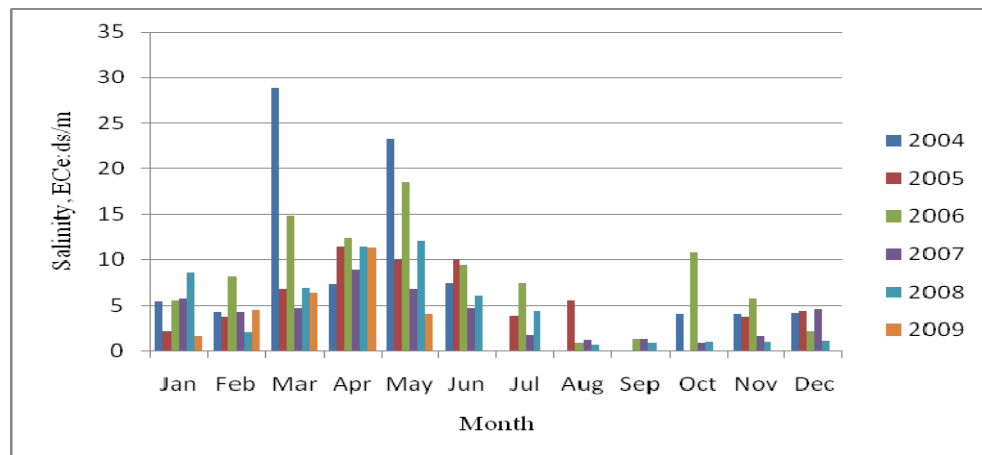


Figure 6: Monthly variation of top soil salinity rate in different year at **Bajua** (Dakop Upazila), Khulna.

## 4. Impact of salinity

### 4.1 Impact of salinity of soil on crop production

Rising of salinity level will decrease agricultural production by unavailability of fresh water and soil degradation. Salinity also decreases the terminative energy and germination rate of some plants (Rashid et al., 2004; Ashraf et al., 2002). (Ali, 2005) investigated the loss of rice production in a village of Satkhira district and found that rice production in 2003 was 1,151 metric tons less than the year 1985, corresponding to a loss of 69 percent. The production rate of different types of crops in different upazila in khulna districts is shown from figure 7 to figure 10.

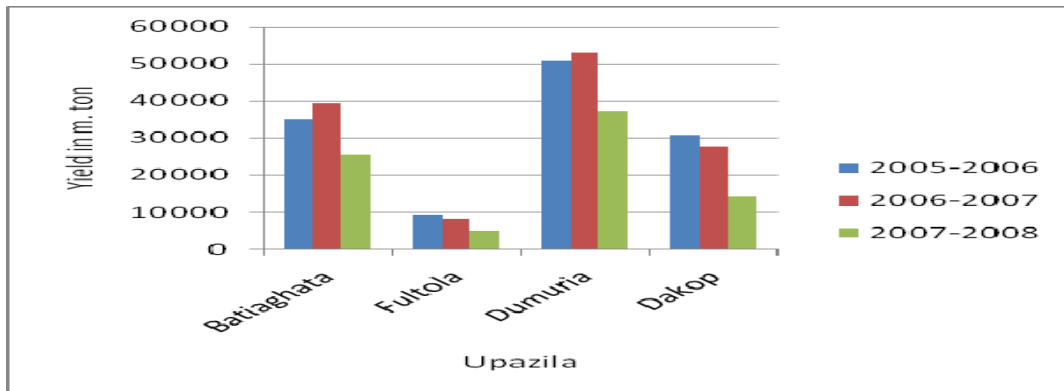


Figure 7: Rupa Aman yield rate at different upazilas in greater Khulna district (in metric ton)

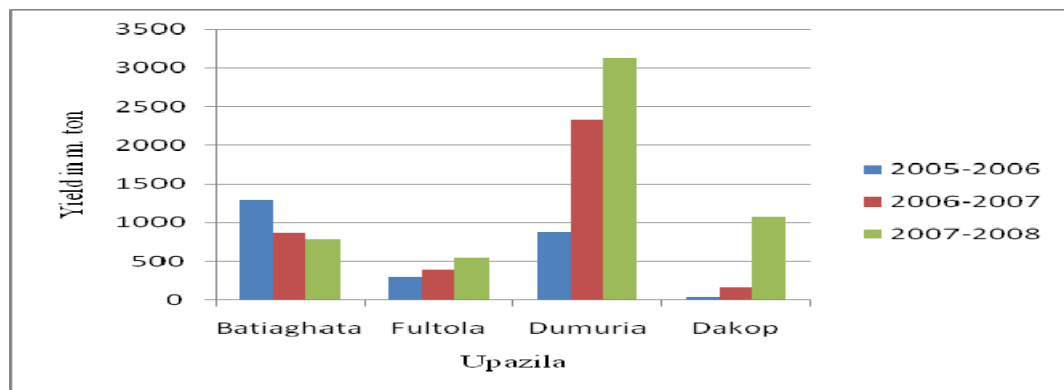


Figure 8: Aman yield rate at different upazilas in greater Khulna district (in metric ton)

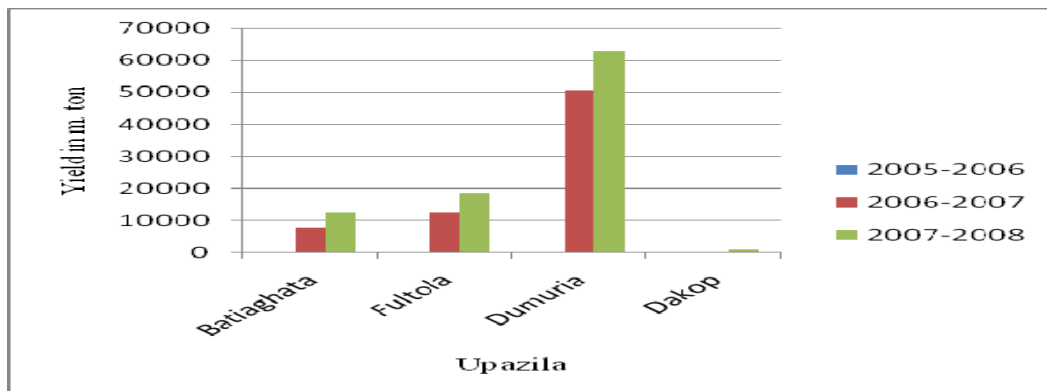


Figure 9: Boro yield rate at different upazilas in greater Khulna district (in metric ton)

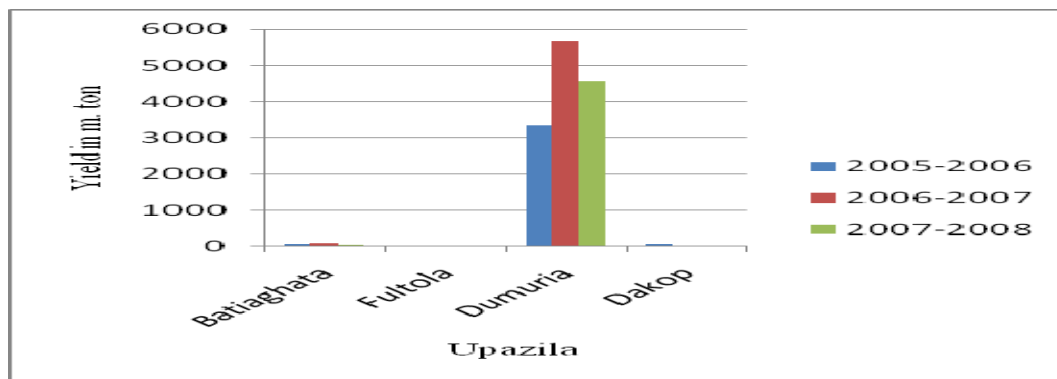


Figure 10: Jute yield rate at different upazilas in greater Khulna district (in metric ton)

## 5. Discussions and conclusions

### 5.1 Discussions

Out of 2.85 million hectares of coastal and off-shore land, about 1.5 million hectares are affected by varying degrees of salinity. The coastal saline soils are distributed unevenly in 64 thanas of 13 districts, covering portions of 8 agro-ecological zones (AEZ) of the country. The larger portions of saline land fall in the districts of Shatkhira, Khulna and Bagerhat. Large fluctuations in salinity level over time are observed at almost all sites in these regions. The common trend is an increase in salinity with time, from November - December to March - April, until the onset of the monsoon rains. The electrical conductivities (ECs) of the soil were lowest in July - November and highest in January - May at all sites. Soil salinity, at any time, is maximum in the surface layers (0 - 15cm), the salinity gradient being vertically downwards. Subsoil salinity is usually much lower than topsoil salinity. Moderately to strongly saline underground is found within 1 - 2 meters below the soil surface at all locations in the dry season. The spatial and temporal variations in soil salinity indicate the need for crop production planning separately for different locations in the coastal areas. No generalization can be made in this regard.

### 5.2 Conclusions

It is found that the soil salinity, at any time, is maximum in the surface layers (0 - 15cm), the salinity gradient being vertically downwards. Subsoil salinity is usually much lower than top soil salinity. Soil salinity indicates the need for crop production planning separately for different locations in the coastal areas. Development and implementation of adaptation policies and taking initiatives for mitigation measures are the right ways to respond to salinity level rise impacts. From data analysis it is found that Dakop, Dunuria and Fultola are badly affected by soil salinity in the month of January to May. In general it is found that an increasing tendency of salinity is observed since last 5 years. The crop production rate decreases in the study area of Fultola, Batiaghata and Dakop due to the rising of salinity. In Batiaghata, the crop production rate is comparatively high due to presence of low salinity. This research gives a primary idea about the salinity condition and effect of salinity on crop production at the study area.

## 6. References

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