CHAPTER 1
INTRODUCTION

1.1 Background

Mangroves forests consist of tropical trees and woody shrub like plants growing at intertidal zone and highly productive ecosystem. Mangroves plants prefer to settle in river deltas, estuarine and lagoons, they rarely settle in stagnant water. Mangrove trees often found in combination with coral reefs and seagrass beds (Kathiresan and Bingham, 2001).The mangrove forest are much essential for both ecological as well as economical perspective,in addition it deals in protective and productive roles, productive for growth of economy and protective for biodiversity such as, free living, crawling, borrowing, sessile, climbing and other organisms (Rehman *et al.* 2018).

Due to their halophytic nature, mature mangrove species are salt resistant and well-adapted to harsh environmental circumstances, such as fluctuating salinity and pH (Parida and Jha 2010; Krauss and Ball 2013). The word "mangrove" refers to a wide variety of tropical plants that have evolved to thrive in tidal habitats (Sternberg et al., 2007). According to Komiyama et al. (2008), true mangroves are facultative woody halophytes that are evergreen. According to Kathiresan and Bingham (2001), the mangroves are home to 40 to 70 species that are divided among 16 groups of dicotyledons and monocotyledons.

The "Sundar-bans," the biggest adjacent mangrove forest in the world, is located on the border between Bangladesh and India. According to Polidoro et al. (2010), there are 12–13 different species of mangrove in Bangladesh, 30–35 in India, 4–8 in Pakistan, and 18–20 in Sri Lanka.

Mangroves, as wooded wetland habitat, provide a variety of ecosystem services, including protection of beaches and coasts from storms, waves, and floods, decrease of beach and soil erosion, and carbon sequestration (Millennium Ecosystem Assessment 2005; Barbier 2007).

Protection of mangrove habitats from direct human impacts (felling, destructive fishing methods and resource use, livestock) and indirect human impacts (changes in hydrology through dykes, dams, etc.) often results in natural

regeneration, whereas planting, especially if the wrong species is planted in unsuitable locations, often results in limited success (Samson and Rollon 2008; Pham et al. 2009). Mangroves are increasingly being identifiedas specialised coastal ecosystems rather than atypical land wooded vegetation. Physical and bioticfeatures, such as their location along tidal creeks, mud flats, and coastal waterways,aswell as the physicochemical and biological processes that occur at the ecosystem level, mustbe considered in their management (Macintosh et al. 2011).In most circumstances, an ecosystem-based strategy will result in more effective conservation, rehabilitation, restoration, and sustainable management (Shepherd 2008).

In Pakistan this forest once covered 250,000 hectares andranked as fifth largest mangrove ecosystem in the world according to (Dawn report.,2017) the mangroves of Indus delta decrease 98,014 hectares and is ranked as lower than 15th atthe global level. Mangroves are plants that make up the tropical intertidal forest ecosystem. They include woody trees and shrubs that thrive in the zone between land and water along the world's tropical coastlines. Mangrove development and physiological mechanisms differ in nature due to their complexity of structure, variances in flooding regime, tidal inundation, and quick intake of additional nutrients, as well as soil type (Alongi, 2009).

Avicennia marina dominates the current mangrove forest, with just a few populations of Aegiceras corniculatum, Ceriops tagal, and Rhizophora mucronata (Saifullah et al., 1994). The level of salinity required for optimal growth varies greatly, ranging from 10% to 50% seawater (Downton, 1982; Clough, 1984; Naidoo, 1987; Lin and Sternberg, 1992; 1995;Ball et al. 1995; Smith et al. 1995), with an increase in salinity causing a decline in overall growth. For most plants, highly saline conditions result in reduced stomatal conductance, lower water potential, and inorganic ion buildup (Ball et al. 1984; Naidoo, 1987). Mangrove forests have played an important part in the economic development of tropical and subtropical peoples during the last few decades, as well as providing a large habitat for land and aquatic plants and animals. According to (Dawn report., 2017), the mangroves of the Indus delta formerly encompassed 250,000 hectares and were classified as the fifth biggest mangrove ecosystem in the world. However, the

mangroves of the Indus delta have decreased to 98,014 hectares and are listed as lower than 15th at the worldwide level.

Biodiversity of Mangroves

Mangrove forests dominate the vegetation along the Sindh coast. Eight species have beendocumented (ADB & IUCN 2002).

Table I List of Species and Distribution of Mangroves in Pakistan
Source: (Nasir & Ali, 1972)

Species	Distribution
RHIZOPHORACEAE	
Bruguiera gymnorhiza (L)	Indus delta (Hassan) and Indus Estuary (Murray); no specimens atKew, Edinburgh,or Pakistan.
Ceriops tagal (Perr.) C.B.	Karachi and Sindh Coast (stocks), IndusMouth, and "Salt Water Creek" (Murray)
Ceriops decandra (G.) Ding Hou	Sindh tidal zone; occurrenceconsidered doubtful
Rhizophora apiculataBlume	Tidal marshes at Indus mouth:MianiHor, Las Bella (T & S)
Rhizophora mucronataLamk.	Muddy coastlines and tide streams at the Indus River's mouth (Henslow; LasBella and MakranCoast (Burkill))
MYRSINACEAE	
Aegiceras corniculatum (L.) Blco.	Mangrove wetlands at the Indus River's mouth(Stocks, Ritchie) Jafri: MianiHorKarachi
AVICENNIACEAE	
Avicennia marina (Forsk.) Vierh.	Tidal mangrove swamps, China Creek, etc.(Jafri), KalmatHor, Sand Spit(stern), etc.
SONNERATIACEAE	
Sonneratia caseolaris (L.) Engler	Indus delta has no specimens visible; Indusmouth and Tidal Zone (common,authentic Murray).

The mangrove forest comprises 20,000 hectares and is densely forested. This mangrove environment provides a safe haven for both terrestrial and marine

fauna. Tropical dolphins, porpoises, and toothed whales are among the forest mammals of the Indus Delta. There is little information on reptiles, however three species oflizards, one species of toxic snake, and two species of marine snakes have been documented. The most common and Dominent species is *Avicennia marina*.

Other species have suffered significant declines, if not extinction. *Rhizophora mucronata* is widespread in Miani Hor, Balochistan. *Ceriops tagal* may be found in patches in Miani Hor, Daboo, and Khai creeks. Except for a few tiny plants in Daboo creeks and Pakar creek near Shah Bunder, *Aegiceras corniculatum* is nearly extinct on the Sindh Coast. The mangrove swamps of the Sindh Coast are monospecific in the sense that Avicennia marina accounts for about 99.9% of the entire forest area (Qureshi, 1991, 1995).

Mangrove Distribution Restrictions

Climate: Because they are tropical species, mangroves cannot withstand cold temperatures. Depending on air and sea temperatures, their latitudinal limitationsvary throughout the planet (Tomlinson 1986; Waisel 1972; Sherrod et al. 1986; Sherrod & McMillan 1985).

Salinity: Since most mangroves may flourish in freshwater, salt is often not necessary for development (Tomlinson 1986; Ball 1988).

Tidal fluctuation: Additionally, tidal influence is not necessary but yet has a significant indirect effect:

Most other vascular plants are mostly driven out by saltwater inundation, which also lessens competition. Tides extend the growth of mangroves inland and carry saltwater up estuariesagainst the outflow of freshwater. Tides export organic carbon and reduced Sulphur compounds while bringingsediment, nutrients, and clean water into the mangrove ecosystem. Where evaporation is high, tides help flush soils and decrease salinity.

Sediment and wave energy: According to Tomlinson (1986), mangroves thrive ina depositional environment with little wave energy.

Major Threats to Mangrove Forests

Mangrove degradation and deforestation are two global issues that are prevalent. Mangrove forests have decreased in Pakistan during the past 50 years

(Memon, 2005). Mangroves are currently in a precarious situation as a result of various factors that have either directly or indirectly affected the mangrove forest. Evidence of this can be found in the published literature, which shows a steady decline over time—from 380,000 hectares in 1950 to 86,767 hectares in 2005— and the removal of mangroves from the edges of the coast at Port Qasim. Sadly, a number of anthropogenic pressures, including pollution (waste water dumping), sealevel rise, urbanization, siltation and coastal erosion, overexploitation of mangrove resources, etc., are causing the mangroves of Pakistan to deteriorate. The Indus delta's cover has been drastically diminished, despite having being considered the fifth-largest mangrove forest in the world with a 400,000-ha area covered. According to reports, harvesting caused a massive loss of 67% of the thick mangrove forest between 1953 and 2001 (Qamar, 2009).

Rising Sea Level and Salinity

Global warming is one of the many factors that threaten the mangroves ecosystem in all over the world. Currently Global warming is the primary cause of the phenomena knownas sea level rise, and Pakistan ranks 10th on the list of countries most vulnerable to its effects. One of the world's biggest dry mangrove ecosystems, the Indus delta mangroves covered over 250,000–283,000 hectares until the early 1980s, but they shrank by 160,000 hectares in 1990. According to (WWF-Pakistan, 2006), the Indus delta's mangroves span around 73,000 hectares. However, another research (Qureshi, 1993) calculates that the Indus delta has lost approximately 1,700 km2 due to marine invasion. Rising sea levels may cause the problem of coastal erosion because of higher wave actions, strong tides and possibility of greater flow, all of these may lead the depletion of mangroves forest and damaged physical structures. These critical hazards reduced silts deposition and may contribute the destruction of mangrove ecosystem.

In order to protect the land and environment from natural catastrophes such powerful waveactions, stormy winds, cyclones, and tsunamis, mangrove forests assist to cover the shoreline margins (Cornforth et al., 2013; Giri et al., 2007a; Porwal et al., 2012; Satyanarayana et al., 2011). However, the hurried removal of these trees by neigh bourhood residents may cause soil erosion, which is a

significant source of silt in the vicinity of mangroves. Additionally, the Indus delta was covered with barrages and dams, which during the flood season were filled with fresh water and used for human and animal sustenance. However, following the flood season, these many dams and barrages are permanently flooded with seawater.

Urbanization and Water Pollution

The rapid growth of coastal communities and sudden economic expansion after 1990 the phase of industrialization may result in increase the consumption level of forest resources, it is estimated that an average coastal population has been growing 6-8% annually overlast 10 years. This annual growth in coastal population occurs due to migrants from different countries especially Bangladesh and Burma that have been settled along the Indus delta. Because to pollution, overexploitation, and fluvial discharge into the Indus River, human and industrial activities have been alarming mangrove land coverage over the past ten years (Ansari 1987; IUCN1988; Qureshi 1993). Mangrove tree decrease has been attributed to sudden urbanisation, followed by poor urban planning, which led to untreated industrial and domestic wastewater being discharged directly or indirectly into the Indus delta(Amjade et al., 2007).

1.2 Research Problems

Mangroves have grown poorly in our coastal regions as a result of the rise in salinity brought on by the use of Indus River water for farming. Additionally, overgrazing and chemical pollution have caused the localised extinction of several mangrove species (Kogo et al., 1986). The effectiveness of the restoration effort in the area depends on the availability of knowledge on the salt tolerance of Indus delta mangroves, which is lacking. The goal of the current study is to compare the salt tolerance of two Pakistani mangrove species, Aegiceras corniculatum andCeriopst agal. Mangroves can endure a wide variety of salinities in their natural environment (Suarez et al. 1998) can live in intertidal zones with high salinity water(Shan et al. 2008). According to the Millennium Ecosystem Assessment 2005 and Barbier 2007, mangroves, which are a kind of wooded wetland habitat, offer a variety of ecosystem services, such as protecting beaches and coasts from storms,

waves, and floods, reducing beach and soil erosion, and carbon sequestration.Along with increasing fisheries revenue, they also serve as spawning grounds, food sources, havens, and habitat for a variety of aquatic species (Barbier 2007; Nagelkerken et al. 2008; Walters et al. 2008; Alongi 2009, 2014; Lee et al. 2014; Duke and Schmitt 2015).Mangroves have been extensively damaged and changed to various types of land use worldwide, despite their significance (Alongi 2002; Duke et al. 2007; Duarte et al. 2009; Giri et al. 2011).

1.3 Research questions

Based on these problems, it can be concluded several formulations. The Problems that will bediscussed further are:

- How to investigate the physiological responses of Aegiceras corniculatum and Ceriops tagal to varying salinity levels, including measurements of growth, photosynthetic activity, leaf area?
- How can the distribution of Aegiceras corniculatum and Ceriops tagal alongthe Karachi coastline be analysed in connection to salt gradients?
- How can the effects of salt be assessed on the ability of Aegiceras corniculatum and Ceriops tagal to reproduce and the establishment of their seedlings?

1.4. Aim and Objectives of the Research

This study's main goal is to evaluate people's attitude towards mangroves and their understanding of the issues surrounding mangrove loss and its effects. The following goals are specifically the focus of this research:

1. To look at how salinity interacts with growth and survival in *Aegiceras corniculatum* and *Ceriops tagal.*
2. To explore the potential use of Aegiceras corniculatum and Ceriops tagal as indicators of salinity levels in coastal ecosystems, considering their responses and adaptations to different salinity regimes.
3. To propose management strategies and conservation measures for Aegiceras corniculatum and Ceriops tagal in the coastal area of Karachi, Pakistan, based on their salinity tolerance and ecological importance.

4. To recommend Local Communities about awareness of Mangrove Forests.

1.1 Significance of the Research

- Through altering people's behaviors and attitudes towards the destruction of mangroves, the research can help increase awareness among the public and be used as a tool to encourage prevention and reduction of mangrove damage at higher education institutions.
- The study offers some valuable insights through recommendations for improving current laws and rules pertaining to managing mangrove damage, particularly in areas with mangroves, in order to prevent and minimize problems with mangrove destruction at higher education institutions.
- By providing information based on this area of concern, the study opens up opportunities for more research, assuring those who are interested in studying mangrove forests in particular.
- This study makes it possible for readers who are not researchers to access material that may be published in a variety of venues, including blogs, magazines, online news sources, and other media that aim to educate thepublic.