

# Survivality and Growth Performance of Jarul (*Lagerstroemia Speciosa L.*) in the Raised Land of Less Saline Water Zone in the Sundarbans

Dr. Asm Helal Siddqui <sup>1\*</sup> and Md. Akramul Islam <sup>2</sup>

<sup>1</sup> Divisional Officer and <sup>2</sup> Research Officer.

\*Corresponding author email id: helalrobfri@yahoo.com

**Abstract** – Survivality and growth performance of jarul (*Lagerstroemia speciosa L.*) in the raised land of less saline water zone or oligohaline (salinity ranges from 0-5 ppt) in the Sundarbans was conducted by the Mangrove Silviculture Division of the Bangladesh Forest Research Institute. Total 0.19 ha experimental plantations were raised in Randomized Complete Block Design (RCBD) at 1.0m × 1.0m, 1.5m × 1.5m, 2.0m × 2.0m spacing in three replications with nine plots at Bogi Forest Research Station in the Sundarbans in 1993. The mean survival (%) was found 87%, 77% and 73% respectively for each replication and total survival percentage (%) was found 79% which indicates that this area is suitable for the plantation of that species. The total height (m) were found 15.19 ± 0.44, 14.62 ± 0.42, 15.37 ± 0.19 and DBH (cm) were found 16.40 ± 1.01, 16.22 ± 1.84, 17.49 ± 0.88 as well as the MAI were found for height (m) 0.58, 0.56, 0.59 and DBH (cm) 0.63, 0.62, 0.67 respectively in the different spacing. On the other hand CV at different spacing was 5.07, 4.99, 2.09 for height and 10.71, 19.69, 8.69 for DBH. From the analysis of ANOVA (The calculated values  $F_{.05}(2) = 1.14$  for height and  $F_{.05}(2) = 0.28$  for DBH), showed that there is insignificant differences in the total height (m) and DBH (cm) of species in different replication. So it can be concluded that Jarul (*Lagerstroemia speciosa L.*) species can be planted at less saline zone considering medicinal values, aesthetic values, biodiversity point of view, climate resilient coastal afforestation, to enhance vegetation coverage and after all to accelerate sustainable livelihood pattern adjacent to the local communities in the Sundarbans.

**Keywords** – Growth Performance, Oligohaline, Sundarbans, Survivability, Jarul.

## I. INTRODUCTION

Mangrove forests are among the world's most productive ecosystems, as well as unique wetland ecosystems in intertidal coastal regions of the tropics and subtropics [14, 15]. The Sundarbans are a deltaic swamp forest, situated at 21°27'30" and 22°30'30" N and 88°02'00" and 89°00'00" E in the southwestern part [1]. It occupies 4.2% of the total area of Bangladesh and constitutes 44% of the forest cover in the country [5]. The mangrove forests of Bangladesh provide important ecosystem goods and services to the environment and densely populated coastal population including shoreline stabilization, storm protection, water quality maintenance, micro-climate stabilization, groundwater recharge and discharge, flood and flow control, sediment and nutrient retention, habitat protection and biodiversity, biomass, productivity and resilience, recreation, tourism and culture, hunting and fishing, forestry products, and water transport [4]. Despite the many ecosystem services mangrove provide, deforestation and land conversion pressures on these coastal ecosystems are high because approximately 44 % of global population resides within 150 km of the coastline [6].

Human threats to the mangroves include the overexploitation of forest resources by local communities, conversion into large scale development such as agriculture, forestry, salt extraction, urban development and infrastructure and diversion of freshwater for irrigation [3].

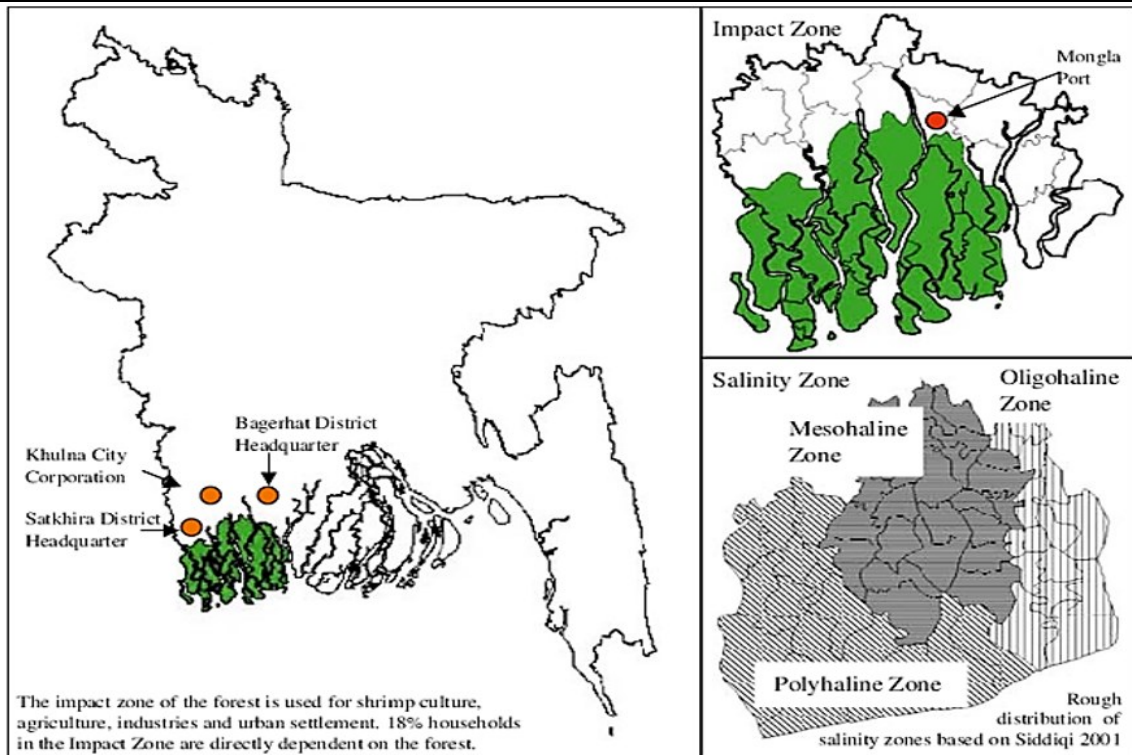


Fig. 1. Map of the Sundarbans showing different zones.

The coastal ecosystem is highly dynamic ecosystem. The climate is humid, maritime and tropical. The soil of the forest is of recent deltaic origin. Based on soil salinity distribution, three distinct salinity zones - oligohaline (salinity  $< 2 \text{ dsm}^{-1}$ ), mesohaline (salinity  $2-4 \text{ dsm}^{-1}$ ) and polyhaline ( $4 \text{ dsm}^{-1}$ ) zones could be recognized [7]. At the eastern part of the soil (having good supply of fresh sediments), the top 15 cm soil layer is soft and fertile [26]. The pH in depressions with high organic matter ranges from 5.3 to 6.4 [26].

Different causes such as conversion to agriculture, shrimp farms, development, and human settlement, over-harvesting, fishing, pollution, decline in freshwater availability, flooding, reduction of silt deposition, coastal erosion, disturbances from tropical cyclones etc. are responsible for the degradation of mangrove coverage in the Sundarbans (16). Relative sea-level rise could be the greatest threat to mangroves. Predictions suggest that 100% of the mangrove forests could be lost in the next 100 years if the present rate of loss continues [17]. *Lagerstroemia speciosa* L. is commonly known as Jarul is a deciduous tropical flowering tree from family Lythraceae that grows in Bangladesh and it has been traditionally used for the treatment of various disorders as diabetes, obesity and kidney malfunction [19]. It is a small to medium-sized tree growing to 20 metres (66 ft) tall, flaky bark with an acute apex. Pharmacological properties of the species include antioxidant, antibacterial, antiviral, anti-inflammatory, antinociceptive, antidiarrhoeal, cytotoxic, xanthine oxidase inhibition, anti-obesity and anti-fibrotic activities [18]. Besides it provides a wide range of ecological services, enhance aesthetic values and also a massive source of medicine as mentioned above to the local community [18].

Four detailed vegetation inventories [8, 9, 10, 11] have been performed. Short-term ecological studies suggest that the structure and composition of the forest have changed for various reasons and that the forest is declining in terms of growing stock and ecosystem vigor [12, 7]. A large part of the forest is unproductive and these are non-commercial areas. About 16% of the total mangrove plant species are at elevated risk of extinction and 10% are near threatened [25]. Seven percent of the area was devoid of forest cover [23]. Another report [23], however

states this figure to be 2%. N.C.C. areas are composed of raised land or depressions which have become unsuitable for natural regeneration with mangrove species. Consequently, there are potentialities for improvement of the land area by raising plantations [24]. So, the feasibility of nonmangrove species in the raised but vacant lands was highly desirable. There were some interim reports on non-mangrove species trial which showed the initial success of the trial plantations [7, 13]. Due to this consideration the Mangrove Silviculture Division of the Bangladesh Forest Research Institute Started raising plantations on experimental basis with mainland species since 1980. From then nonmangrove species in the raised land were managed. Consequently, a pilot plantation of jarul (*Lagerstroemia speciosa* L. Pers.) were executed in less saline water zone adjacent to Bogi Forest Research Station of Mangrove Silviculture Division in 1993.

Sundarbans plays a pivotal role to the coastal communities. In provides cultural services (tourism), Non Timber Forest Products (NTFPs), serves as coastal defense, climate resilient ecosystem and green ecofriendly environment with its aesthetic values and so on. At the same time Sundarbans is a blessing to local people with its infinite resources and services. The present paper deals with survival percentage and growth performance of jarul (*Lagerstroemia speciosa* L. Pers.) from a pilot plantation in coastal raised lands for the continuous establishment of forest cover in the coastal belt. Simultaneously this may be pioneer species to the local people considering its medicinal and aesthetic values, promising biodiversity retaining capacity, natural shelterbelt to cope with natural hazards as well as adverse effect of climate change on a sustainable basis in coastal region of Sundarbans.

## **II. MATERIALS AND METHODS**

### *Site Selection:*

The Sundarbans is the largest single tract naturally diverse mangrove ecosystem. Sundarbans is slightly saline, silty clay loam and sub-soil consists of alternate layers of clay and sand, and it is uniform throughout the forests. Karim (1988) classifies salinity boundaries based on pre-monsoon and post-monsoon levels of the river water. These are oligohaline (0-5 ppt), mesohaline (5-18 ppt) and polyhaline (> 18 ppt). The site selected was a relatively raised land in the slightly (oligohaline) saline zone of the Sundarbans. In the rainy season it remained inundated during high tides but in the dry season, it remained above the high tide level. The site was located beside the Baleswar river. The soil was silty-clay-loam in the surface,  $p^H$  varying between 7 and 8 (21). Maximum salinity during the dry season was 2m mhos/cm (22). Before plantation the site was cleared and demarcated by proper fencing.

### *Raising and Maintenance of Nursery:*

Required total 2000 number of seedlings was raised in polybags at Bogi Research Station by establishing a mangrove nursery in 1992. The young, mature, vigorous and disease resistant seeds of Jarul were collected from healthy mother trees or plus trees of Kustia and Jessore. The nursery was prepared and loamy soil was mixed with dry cow dung in 4"×6" polybag. During April-May seeds were given into the polybag and after ten to twelve days later germination was observed. The nursery was fenced with barbed wire to prevent entrance of deer, wild boar and also from tourist as well. Subsequently the shade was removed to allow the seedlings for hardening. At the same time appropriate water and sunlight was provided at the nursery. The seedlings in the nursery were maintained for about 10-12 months. Regular weeding in the nursery was done.

### *Experimental Design and Planting:*

Experiments with Jarul plants were laid out in less salinity zones of the Sundarbans (Compartment No. 01). The experimental plantations of Jarul were raised by planting nursery raised seedlings in polybags in Randomized Complete Block Design (RCBD) at 1.0m×1.0m, 1.5m×1.5m, 2.0m×2.0m spacing in three replications with nine plots (spacing varies according to purpose of research, species variation and site condition) (Figure- 2. d). A total of 0.19 ha experimental plantations were maintained properly in the Sundarbans. Planting was carried out in June, 1993 with the onset of monsoon. Each trees are numbered by red color enamel paint (Figure-2.a). Experimental plantations were initially protected by fencing against browsing up to the period it reached beyond the browsing height. Three weeding were done in the first year and two weddings in the subsequent years.



a) Numbering of species in the replication



b) Researchers are collecting data in plantation site.



c) Forest Guard are measuring DBH (1.3m) in plantation site



d) An overview of experimental plantation site

Fig. 2. Experimental plantation site of jarul (*L. Speciosa*) at Bogi Forest Research Station in the Sundarbans (Picture: 10 April, 2019).

### *Data collection and Analysis:*

The trees were marked at DBH level (1.3 m) by red band with figure enamel paint. Fresh numbering and repainting were done once in a year. Data on survival and growth (Average height and DBH) were collected twice in a year (Figure-2.b.c). At the same time, a total of 0.19 ha experimental plantations were maintained properly by weeding, pruning, climber cutting, repairing of fence etc. Microsoft word and Microsoft excel programs were used to process all collected data.

### III. RESULTS AND DISCUSSIONS

The experiment was carried out in the less saline water zone in the poorly regenerated areas of the Sundarbans. The experimental plantation in the poorly regenerated areas of the Sundarbans was hampered due to natural disaster, deer browsing, and illegal poaching and so on. Despite this non-mangrove plantation in the raised land was nursed and managed properly in each year.

Table 1. Survival percentage (%) of Jarul (*Lagerstroemia speciosa L.*) in less saline water zone.

Less Saline Zone	Replication-1 (1m x 1m)			Replication-2 (1.5m x 1.5m)			Replication-3 (2m x 2m)		
	Plot-1	Plot-2	Plot-3	Plot-1	Plot-2	Plot-3	Plot-1	Plot-2	Plot-3
Jarul									
Total survival percentage (%) of plot	90	90	80	80	90	60	70	80	70
Total survival percentage (%) of replication	87			77			73		
Total survival percentage (%)	79								

In the experimental plantation of Jarul in less saline water zone, the average survivability was observed 90%, 90% and 90% respectively of each plot in replication-1 (Spacing-1m x 1m). Whereas it was observed 80%, 90%, 60% and 70%, 80%, 70% in case of replication 2 and replication-3 successively (Table-1). The mean survival (%) was found 87%, 77% and 73% respectively for each replication. Therefore, total survival percentage (%) was observed 79% which indicates that this area is suitable for the plantation of jarul (Table-1). Rest 21% species were may be damaged huge stagnant water logging, deer browsing, natural disaster or by various anthropogenic causes.

Table 2. Growth performance of Jarul (*Lagerstroemia speciosa L.*) species planted in less saline water zone at different spacing in the Sundarbans.

Indicators	Less saline water zone					
	Spacings					
	1m x 1m		1.5m x 1.5m		2m x 2m	
	Height (m)	DBH (cm)	Height (m)	DBH (cm)	Height (m)	DBH (cm)
Mean ± se	15.19 ± 0.44	16.40 ± 1.01	14.62 ± 0.42	16.22 ± 1.84	15.37 ± 0.19	17.49 ± 0.88
Mean annual increment (MAI)	0.58	0.63	0.56	0.62	0.59	0.67
Coefficient of variation (CV)	5.07	10.71	4.99	19.69	2.09	8.69
F <sub>.05</sub> (2) =	1.14 for height and 0.28 for DBH					

The growth performance of 26 years old Jarul (*Lagerstroemia speciosa L.*) species were analyzed and mean values for different statistical indicatory are given in table-1. The total height in the Diameter of Breast Height (DBH), Mean Annual Increment (MAI), and Co-efficient of Variance (CV) differ insignificantly among the spacing 1m x 1m, 1.5m x 1.5m and 2m x 2m in less saline zone. The total height (m) were found 15.19 ± 0.44, 14.62 ± 0.42, 15.37 ± 0.19 and DBH (cm) were found 16.40 ± 1.01, 16.22 ± 1.84, 17.49 ± 0.88 as well as the MAI were found for height (m) 0.58, 0.56, 0.59 and DBH (cm) 0.63, 0.62, 0.67 respectively in the different spacing (Table-2). On the other hand CV at different spacing was 5.07, 4.99, 2.09 for height and 10.71, 19.69, 8.69 for DBH. Considering height and DBH data analysis of variance (ANOVA) have been done. (Table-2) The calculated

values were  $F_{.05}(2) = 1.14$  for height and  $F_{.05}(2) = 0.28$  for DBH (Table-2), there were insignificant differences in the total height (m) and DBH (cm) of Jarul (*Lagerstroemia speciosa L*) species planted at less saline zone in the Sundarbans.

#### IV. CONCLUSION

From the experimental plantations of Jarul (*Lagerstroemia speciosa L*) was observed that it showed satisfactory survival percentage. Although jarul was planted in raised area with high elevation but the main problems for raising mainland species in N.C.C area of the Sundarbans are water logging and animal attack. Experimental plantations of Jarul species showed insignificant differences in the total height (m) and DBH (cm) planted at less saline water zone in each replication with different spacings in the Sundarbans. Thus indicates that this species is suitable in less saline water zone with almost similar growth performance. Considering different services such as medicinal values, aesthetic values, biodiversity point of view, climate resilient coastal afforestation and after all to accelerate sustainable livelihood pattern adjacent to the people of Sundarbans. At the same time this species can enhance vegetation coverage in Sundarbans and this will be automatically revival of the Forest coverage and reduce the disaster and other natural calamities from the coastal regions of Bangladesh. Thus massive plantation of Jarul (*Lagerstroemia speciosa L*) can be raised in the Sundarbans. It is, therefore, imperative to carry out research for finding out more viable non-mangrove species which are susceptible to natural disasters, considerably immune to animal attacks, can withstand excessive water logging and more suitable to the communities of Sundarbans considering their livelihood status on a sustainable basis.

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## AUTHOR'S PROFILE



### Dr. Asm Helal Siddiqui

Dr. A.S.M. Helal Siddiqui was born in Kaliganj, Jhenaidah, Bangladesh in the year 1964 in a respectable Muslim Family. After obtaining B. Sc. (Hons.) and M.Sc. Degree in Botany Department from Rajshahi University in 1986 and 1987 respectively he took up an appoint as a Social Service Officer in Social Well fare Department of Bangladesh Government at Shariatpur on the July 1992. He worked there one and half a year and resigned the post on 14 November, 1993. He was appointed as a Research Officer at Mangrove Silviculture Division under the Bangladesh Forest Research Institute on the 16<sup>th</sup> November, 1993 and working till date. Dr. Helal Siddiqui is brilliant academic career all through his life. He did his

Doctoral degree (Ph.D.) in plant Pathology In 1914. He also presented many papers in the National Seminars during his present job. He is a member of many national and international organizations like Bangladesh Association for the Advancement of Science, Senior Forest Research Officer's Association, Bangladesh Botanical Society, University Students Association Member of Bangladesh Biggani Somity, Graduate Somity, Kaliganj, Jhenaidah. He has so far number of publication (80+) at his credit in the field of forestry on wildlife and silvicultural aspect published in the National and International journals. His some books are already renowned such as Sundarbans at a glance, Sundarbaner Kobita, Sundarbans and Visit to the Sundarbans, Palm species of Bangladesh, Cultivation and Uses, Arannyo Bilash, etc. Besides, his editorial comments and features are highlighted so far in different aspects in the daily newspaper. He is experienced as a researcher and the administrator. At present he is working as a Divisional Officer (DO) in Mangrove Silviculturte Division of Bangladesh Forest Research Institute of the People's Republic of Bangladesh. email id: helalrobfri@yahoo.com



### Md. Akramul Islam

Md. Akramul Islam was born in Tala, Satkhira, Bangladesh in the year of 1990 in a well-known renowned family. After completing S.S.C. & H.S.C. with dignity he was admitted in Khulna University, Khulna, Bangladesh for B.Sc. (Hons.) in Forestry and Wood Technology Discipline. After obtaining B.Sc. (Hons.) he completed M.Sc. in Forestry from Khulna University, Khulna, Bangladesh. During his study period he studied different subjects related to Forestry especially in Mangrove related subjects such as Introduction to Forestry & Forest Environment, Research Methodology, Mangrove Ecology & Coastal Afforestation, Statistics, Forest Ecology, Forest Tree Physiology, Dendrology & Species Silviculture,

Forest Management, Project Thesis, Forest Surveying, Practice of Silviculture, Forest Mensuration & Inventory, Forest Harvesting & Transportation Engineering, Forest Development planning, Sustainable Forest Management, Forestry for Community Development, Forest Tree Improvement, Project Design & Management etc. At the same time he completed his Master Degree in Development Studies from Islamic University in Bangladesh. He was appointed as a Research Officer (RO) at Mangrove Silviculture Division under the Bangladesh Forest Research Institute on the 27<sup>th</sup> December, 2018 by the recommendation Bangladesh Public Service Commission (BPSC) of the People's Republic of Bangladesh and working till date. He also got some training on Financial Management Information System, Forestry Research Management, and different Innovation Training on Research, Global Environment Facility (GEF) and Green Climate Fund (GCF) Project Formulation and so on. He is a good resource person of various training program. He used to teach different training program in the stake holders adjacent to the Sundarbans region. He is a member of many national organizations like Bangladesh Association for the Advancement of Science, Bangladesh Forester. Besides he is sincere, modest and honest in his field as a researcher. email id: akramkukhulna@gmail.com