Contribution of Bamboo Cultivation for Disaster Risk Reduction & Livelihood in Coastal Areas of Bangladesh

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ABSTRACT

Bangladesh is the world's biggest delta, which is immensely vulnerable to climate change. It has a long historical experience of disasters. Although people's resilience made this copying with various disasters successful but recent climate change has changed all the equation. The resilience mechanism which was effective for the disasters is not befitted with the problems owing to climate change. From the ancient period, coastal zones were the worse victim of disasters and the problem sustains for climate change as well. 32 percent of the country's total land is coastal zone and the geo-physical characteristics of these areas are significantly different than other region. Apart from the geo-physical characteristics, the socio-political context makes the region worse. Along with climate change, cyclone, tidal surge, flood, erosion, rise in sea level, increased water salinity, inundation are provoking the extinction of biodiversity. Owing to climate change 35 million people from 47,211 square kilometers are facing the threat of life and living. Cultivation is very uncertain here because of salinity and rise of sea level in consequence of climate change which also destroyed forests and increased the level of erosion high. Hundreds of villages have become defunct because of this erosion and that is why the coastal people are forced to migrate to the cities. Livelihood and erosion- these two ambivalent issues can be potentially solved by cultivating bamboo. It has the significant bendability to reduce the intensity of cyclone also it's dense and wide-spreading root system holds more soil and prevent the erosion effectively. Besides, bamboo shoots are very healthy and expensive food and in Bangladesh predominantly bamboo made products are very valuable. Thus the coastal erosion can be lower with the bamboo cultivation which could be also a sustainable way to manage livelihood there.

So this present study will focus on the feasibility of reducing natural antagonism and manage sustainable livelihood of the coastal region of Bangladesh through bamboo cultivation as an indigenous technique.

Keywords: Climate Change, Resilience, Disaster Management, Coastal Areas, Bamboo Cultivation, Livelihood.

Introduction

Although Bangladesh has insignificant responsible for climate change and global warming but with its flat topography, low laying land and other geographic characteristics make this country highly prone to disasters[1]. Besides, highly dense population, developing social-economic condition provokes the situation worst. Since 1980, till now

[1] Khan, N.I., Elahi, F., & Rana, A.R. (2015). A Study on the Effects of Global Warming in Bangladesh. *The International Asian Research Journal,* 03(02), pp.18-24.

Bangladesh has faced more than 200 natural disasters[2]. The cyclone of 1991 and the flood of 1998 fetched radical changes in the country's disaster management system[3]. Earlier the concept of disaster management in Bangladesh was bound into the post disaster management i.e. search and rescue, relief, rehabilitation, medical campaign, reconstruction but with this tangible alteration the country started the journey towards sustainable solution. Currently the preparedness and prevention phases are highly prioritized in disaster management circuit of Bangladesh. Most frequent calamities in Bangladesh include cyclones, floods, tidal surge, droughts and earthquakes. On an average a baneful cyclone strikes in Bangladesh in every 3 years which traumatize more than 70 percent of total population. Besides 25 percent of the country's land is being flooded every year and a terrible flood strikes in every 4-5 years which imperil 70 percent land[4]. Since 1980 there have been nearly 200,000 people lost their life in these disasters and an economic loss of 17 billion US dollars has made and the coastal regions of Bangladesh are in the center of this loss[5]. Being the transitional surface between the land and sea, coastal regions are the first and most vulnerable to the natural disasters and the unusual climate change multiplied the prevalence of disaster vulnerability in more fatal magnitude. Albeit previously the coastal regions were only suffered during any course of disaster but currently they are suffering from excessive salinity, sea level rise, erosion round the year. The people of these regions became shelter less destitute to force migration to the cities. So the activities of government-private and development partner organizations are so visible in order to prevent the 711-km wide coastal regions of southern Bangladesh from natural disaster and climate change. Any change in climate lead to destabilization of environment and social conditions around the globe and it affects the migration of people within and between countries around the[6]. That is way it's been treated as the top priority amongst the disaster management system.

Grounding the socio-economic circumstances diversified disaster management measures have been taken in the coastal regions. For instance we can mention the recent built sea wall of Japan. To protect the coastal regions from natural disasters i.e. tidal surges, tsunami, cyclone the Japan already built some 395 km concrete seawall. This 12.5 meter seawall replaced the previously built 4 meter breakwater at a cost of $12.74 Billion[7]. It should be noted here that, Japan's economy can implement such an ambitious project but for a developing countries life Bangladesh it would be luxurious and irrational. We believe any naturalistic project to protect the coastal regions from disasters would be economically congruous and permissible for the national economy of Bangladesh. By analyzing the overall economic and geographic characteristics of Bangladesh, we can say that the agrarian project can play an effective role in disaster

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[2] Give2Asia. (2014).DISASTER PREPAREDNESS AND RESILIENCY: BANGLADESH. Retrieved from https://give2asia.squarespace.com/disaster-preparedness-and-resilience-bangladesh

[3] Bangladesh Ministry of Food and Disaster Management. (2008). *National Plan for Disaster Management 2008-2015.* Dhaka: Government of the People's Republic of Bangladesh

[4] Hossain, A.N.H.A. (2003). Bangladesh: Flood Management. Retrieved from https://www.floodmanagement.info/publications/casestudies/cs_bangladesh_full. Pdf

[5] Asian Disaster Reduction Center. (2015). *Information on Disaster Risk Reduction of the Member Countries*. Retrieved fromhttps://www.adrc.asia/nationinformation.php?NationCode=50&Lang=en&Mode=country

[6] United States Environmental Protection Agency. (2017). International Climate Impacts. Retrieved from https://19january2017snapshot.epa.gov/climate-impacts/international-_climate-impacts_.html

[7] Lim, M. (2018). Seven years after tsunami, Japanese live uneasily with seawalls. Reuters. Retrieved from https://www.reuters.com/article/us-japan-disaster-_seawalls/seven-years-after-tsunami-japanese-live-uneasily-with-seawalls-idUSKCN1GL0DK

management in these regions. As of now many countries in Asia especially in South Asia emphasizing on cultivating bamboo as an effective measure of disaster management and. Since these coastal regions are marked as hostile for crop-cultivation so this bamboo project could be also effective for sustainable livelihood for the destitute people of coastal regions.

Objective of the Study

This present study focused on the role of bamboo cultivation in Bangladesh to ensued effective disaster management in the coastal regions as well as ensuring sustainable livelihood for the destitute people. Furthermore, it has also emphasized on the replication of this model elsewhere in the world.

Methodology

The core of this present research paper has structured by qualitative research and findings from the current information for the secondary sources i.e. newspapers, journals and relevant articles.

Coastal Regions of Bangladesh

Southern parts of Bangladesh, where land and Bay of Bengal meets is the coastal regions. Also Bangladesh has a rich riverine network connects land and sea[8]. The coastal region is 710 kilometers long covering 19 districts and 147 upazilas. The total population of these regions is about 36 million[9]. The detailed information will be presented in the Table:1:

Table: 1. Districts of the Coastal Zone of Bangladesh

SL	District	Area (Km2)		
		Total	Exposed	Interior
1	Bagerhat	3959	2679	1280
2	Barguna	1831	1663	168
3	Barisal	2785		2785
4	Bhola	3403	3403	
5	Chandpur	1704		1704
6	Chittagong	5283	2413	2870
7	Cox's Bazar	2492	2492	
8	Feni	928	235	693
9	Gopalganj	1490		1490
10	Jessore	2567		2567
11	Jhalokati	749		749
12	Khulna	4394	2767	1627
13	Lakshmiur	1456	571	885
14	Narail	990		990
15	Noakhali	3601	2885	716
16	Patuakhali	3221	2103	1118
17	Pirojpur	1308	353	955
18	Sathkhira	3858	2371	1487
19	Shariatpur	1182		1182

[8] Tinker, H.R., & Husain, S.S. (2015). Bangladesh. Encyclopedia Britannica. Retrieved from URL https://www.britannica.com/place/Bangladesh

[9] Ahsan, M.E. (2013). *Coastal Zone of Bangladesh: Fisheries Resources and its Potentials* (1st ed., pp.05-06). Saarbrücken, Germany: LAP LAMBERT Academic Publishing.

Total	47201	23935	23266

Source: PDO-ICZMP, 2003

Natural Disasters of Bangladesh

Bangladesh is suffering from multifarious natural disaster due to its geographic and geologic setting[10]. Bangladesh's geo-physical location makes it prone to various hazards e.g. Flood, cyclone, drought, earthquake, salinity, sea level rise, erosion, landslide etc. However, natural disasters which are indistinguishable in coastal regions of this country are cyclone and erosion due to heavy rain and flood. In the table 2 the devastating cyclone of Bangladesh will be mentioned:

Table: 2. Major Cyclones in Bangladesh

Date	Name (if available)	Maximum Wing Speed (Km/hr.)	Storm Surge Height (meter)	Death Toll
May 25, 1985	Unknown	154	3.0-4.6	11,069
April 29, 1991		225	6.0-7.6	1,38,882
May 19, 1997		232	3.1-4.6	155
November 15, 2007	Sird	223	Unknown	3363
May 25, 2009	Aila	92		190
17 May 2013	Mahasen	85		17
29 July 2015	Kemon	75		132
21 May 2016	Roanu	100		26
31 May 2017	Mora	110		18
4 May 2019	Feni	80		14

Source: Wikipedia, Bangladesh Meteorological Department & The Daily Star

Table: 3. Major Floods in Bangladesh

Year	Flooded area (km2)	Percentage of total area	Number of deaths

[10] Carter, W. N. (1991). Disaster Management - A Disaster Management Hand Book, Manila: ADB.

1984	28314	19	513
1987	57491	38	1657
1988	77700	52	2379
1998	100000	68	1050
2004	88542	60	600
2012	74 Sub Districts		163
2017	183 Sub Districts		121

Source: Wikipedia, Reliefweb, Flood World

As the cyclone and flood related aftermath cause most decay-damaged than any other natural disasters in Bangladesh so we emphasize on the bamboo cultivation as a natural way of sustainable disaster resilience in the coast.

What is Bamboo

Bamboo is a perrenial evergreen that is part of the grass family[11]. It is also considered to be the fastest growing plant in the world. The internodal regions of the bamboo stem are usually hollow and the vascular bundles in the cross-section are scattered throughout the stem instead of in a cylindrical arrangement[12]. Bamboos include some of the fastest-growing plants in the world, due to a unique rhizome-dependent system. Certain species of bamboo can grow 91 cm within a 24-hour period, at a rate of almost 4 cm an hour[13]. Bamboos are of eminent financial and social criticalness in South Asia, Southeast Asia and East Asia, being utilized for structure materials, as a sustenance source, and as an adaptable crude item. Bamboo has a higher explicit compressive quality than wood, block or concrete, and a particular rigidity that rivals steel[14]. There are a wide range of views on the number of the types of bamboo. A few specialists state there are around 1000 types of bamboo, while others state there are in excess of 1600 species on the planet developing normally. Obviously, every one of these types of bamboo are both enlivening and helpful when they are utilized in the homes and organizations in nations around the globe[15]. Most common natural species of bamboo are Bambusa, burmanica, Polymorpha, Nutans, Tulda, Dendrocalamus hamitonil, Longispathus, Melocanna baccifera, Schizostachyum dullooa and for the cultivation Bambusa Balcooa, Cacharensis, Comillensis, Jaintian vulgaris, Thyrsostachys oliveri are very common.

In Bangladesh 26 species and one variety of bamboo under 7 genera occur both in wild and cultivated states. Bamboo species growing in forest areas are Bambusa burmanica, polymorpha, nutans, tulda, Dendrocalamus, hamiltonii, longispathus, Melocanna baccifera and Schizostachyum dullooa, baccifera grows in pure brakes, while the others grow sporadically in small patches. Natural bamboos occur in eastern hill forests of the country. Common village bamboos are Bambusa balcooa, cacharensis, comillensis, jaintiana, nutans, salarkhanii, tulda, vulgaris, and Thyrsostachys oliveri[16]. Muli bamboo is

[11] Bamboobotanicals (2011). Bamboo Anatomy And Growth Habits. Retrieved from http://www.bamboobotanicals.ca/html/about-bamboo/bamboo-growth-habits.html

[12] Wikipedia contributors. (2019, May 21). Bamboo. In Wikipedia, The Free Encyclopedia. Retrieved 21:50, May 22, 2019, from https://en.wikipedia.org/w/index.php?title=Bamboo&oldid=898059508

[13] Bamboo Land. (2017). About bamboo. Retrieved from http://www.bambooland.com.au/useful-info/about-bamboo

[14] Roach, M. (1996, June 1). The Bamboo Solution: Tough as steel, sturdier than concrete, full-size in a year. *Discover Magazine*. Retrieved from http://discovermagazine.com/1996/jun/thebamboosolutio784

[15] Bamboo Grove. (2007). Species of Bamboo. Retrieved from https://www.bamboogrove.com/bamboo-species.html

[16] Banglapedia.(2015). Bamboo. Retrieved from http://en.banglapedia.org/index.php?title=Bamboo

the family member of Gramineae Melocanna baccifera which is the most common in Bangladesh and grows everywhere.

Bamboo Propagation & Project Duration

The bamboo propagation spreads in two ways; the seeds and roots method. Bamboo flower contains seed which can be the natural way of propagation of bamboo. Besides the seed, plating the root is another way of propagation. Bamboo takes 3 years to be matured. The bamboo species of Bangladesh are 10-20 meters long and are between 1.7 to 7.5 centimeters in diameter[17].

Bamboo Propagation in Saline Water

Since the level of salinity is increasing at alarming rate in the coastal region of Bangladesh so it'll be very challenging to propagate bamboo in this esteemed regions. Not all the bamboos which are easy to find in Bangladesh are tolerable to the salinity so the disaster resilience concept with bamboo was in challenge earlier. But three species of bamboo named Dendrocalamus strictus , Dendrocalamus longispathus and Bambusa bambos were investigated for their tolerance to the saline water in hydroponic culture system in 2015. Where all the physical growth aspects were monitored for 14 days in the laboratory experiment. All the vegetative aspects of these 3 species i.e. shoot height, number of leaves, root growth, weight were normal with no significant difference as comparison to the non-saline water. Among these three species Bambusa bambos is common in Bangladesh.

Disaster Resilience with Bamboo

Limiting Soil Loose

Bamboo has very wide- spreading and dense root system[18]. This can potentially limit the coastal region's erosion holding earth firmly. To prevent erosion, bamboo anchors the coast and soil with its wide-spreading and deep root system Bamboo root is very thin and fibrous so most often its root goes up to 3 feet very easily[19]. A single matured plant's root system is capable of expending by 25% to hold 6 cubic meters of soil. Every year during rainy season, coastal life and living of Bangladesh remain under extinction threat due to the erosion. Thousands of villages are getting disappeared into the water body because of strong current in the coast and lack in the dam infrastructure. One of the major reasons if climate change migration is due to this vicious scenario. So for the countries like Bangladesh, bamboo could be the best possible sustainable and natural solution for this problem. Some south Asian countries e.g. Philippines are trying to implement this kind of natural projects[20]. The most vulnerable districts to erosion of

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[17] Banglapedia.(2015). Bamboo. Retrieved from http://en.banglapedia.org/index.php?title=Bamboo

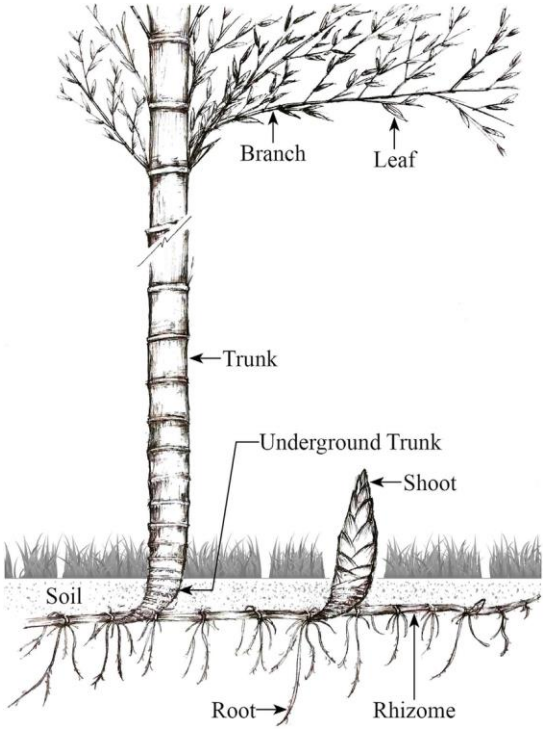
[18] Bamboo Land. (2017). About bamboo. Retrieved from http://www.bambooland.com.au/useful-info/about-bamboo

[19] Bamboo Garden. (2011). Frequently Asked Questions about bamboo. Retrieved from http://www.bamboogarden.com/FAQ%20general.htm

[20] Relief Web. (2012). Feature: DENR promotes bamboos for natural disaster prevention. Retrieved from https://reliefweb.int/report/philippines/feature-denr-promotes- bamboos-natural-disaster-prevention

Bangladesh can be stabilized with this project. Besides this benefit, bamboo ensures the protection of water sources through the reforestation of watersheds[21].

Figure:1. Bamboo Root System



Source: Song, Peng, Zhou & Zhang (2016)

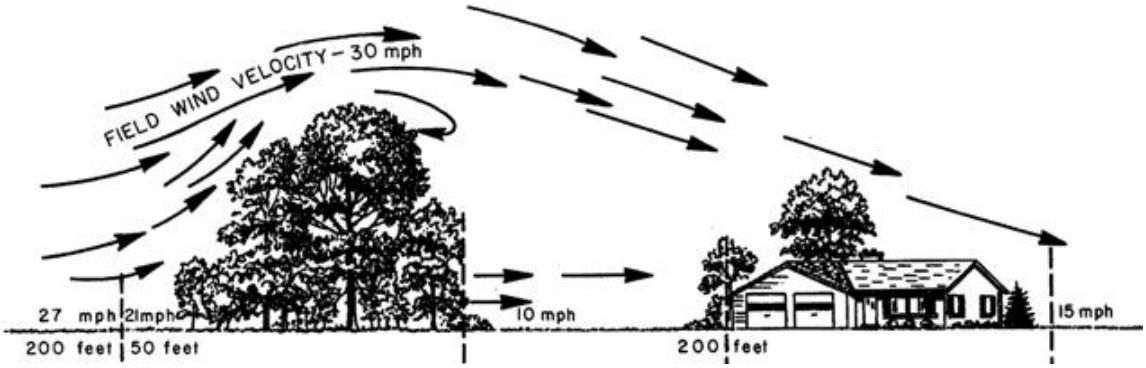
Wind Break

The main purpose of wind break is to weaken or stop the undesirable wind force to protect the establishment behind it. Sometimes it's been considered as the natural wall to protect the civilization from natural disasters. Wind breaks made with some special types of plant. Wind break made with bamboo are more suitable because of its flexibility and dense root system. Making wind break with bamboo than other tree is more preferable because it helps to reduce the wind force rather than attempt to fully stop[22]. Besides, its dense deep root system prevent it from uprooting. Even if it uprooted then it cause little or no damage in the circumstances comparison to the other plant. In most of the cased in Bangladesh, more damage occur because of the tree uprooting as most of the houses in the country side are made of mud, wood and other non-brick materials.

Figure: 2. Wind Break Mechanism

[21] The Nature Conservancy. (2017). A Natural Solution to Water Security. Retrieved from https://www.nature.org/en-us/what-we-do/our-insights/perspectives/a-natural-solution-to-water-security/

[22] Bamboo Inspiration. (2008). Bamboo Windbreak. Retrieved from https://www.bamboo-inspiration.com/bamboo-windbreak.html



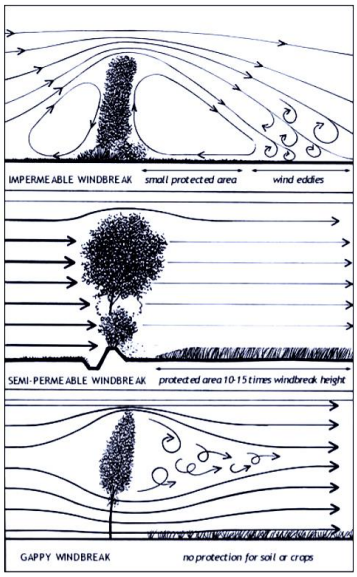
Source: Lincoln Conservation District (2013)

Figure: 3. Bamboo Wind Break Pattern

Figure 1

Figure 2

Figure 3



Bamboo is the combination of exaple 1 & 2

Source: UF/IFAS Citrus Research and Education Center. (2004).

Contribution of Bamboo to Livelihood

Bamboo has significant impact on the society especially for the agro-based economy. For Bangladesh it is the most significant non-timber forest[23]. The main positive concerns of bamboo based business are household production, female engagement and very low skill requirement. The most traded species of bamboo of Bangladesh are *Bambusa balcooa, Melocanna baccifera, Bambusa tulda,* and *Bambusa vulgaris* where *Bambusa balcooa* covered 39% of the total market in the year of 2007[24]. Bamboo is regarded as the poor man's timber so it'll increase the income in the coast and create working opportunities for the destitute people[25]. It's been estimated that more than two billion

[23] INBAR. (2015). Bangladesh: The Bamboo Pioneers Transforming The Country's Furniture Sector. Retrieved from https://www.inbar.int/bangladesh-the-bamboo-pioneers-transforming-the-countrys-furniture-sector/

[24] Bangladesh to export bamboo soon (2009, March 19), *The Daily Star.* Retrieved from https://www.thedailystar.net/news-detail-80318

[25] Khan SA, Khan NA. (1994). Non-wood forest products of Bangladesh: an overview. Bangladesh J Forest Sci. 23(1): 45–50.

people around the world but mostly in Asia use bamboo on daily basis[26]. Bangladesh has both forest and village sources for bamboo and there are more than 4500 small and cottage industries based on bamboo as well[27]. Since bamboo is very easy to cultivate in the coastal regions than other trees or crops so we'll focus on the livelihood earning through bamboo based products.

Useful Bamboos Species in the Existing Market

These three species *Bambusa balcooa, Melocanna baccifera, Bambusa tulda,* and *Bambusa vulgaris* are most common for producing products in the small and cottage industries based on bamboo.

Table: 4. Bamboo Species and Their Source

Botanical Name	Local Name (s)	Source (s)
Bambusa balcooa Roxb.	Borak, Barua, Bhaluka bans	Both village and forest
Bambusa tulda Roxb.	Mitinga, Mita, Nitai bans	Both village and forest
Bambusa vulgaris Schrd. ex. Wendl	Baijja bans	Village
Melocanna baccifera (Roxb.) Kurz	Muli, Nali bans	Forest bamboo

Source: Mukul & Rana, 2013

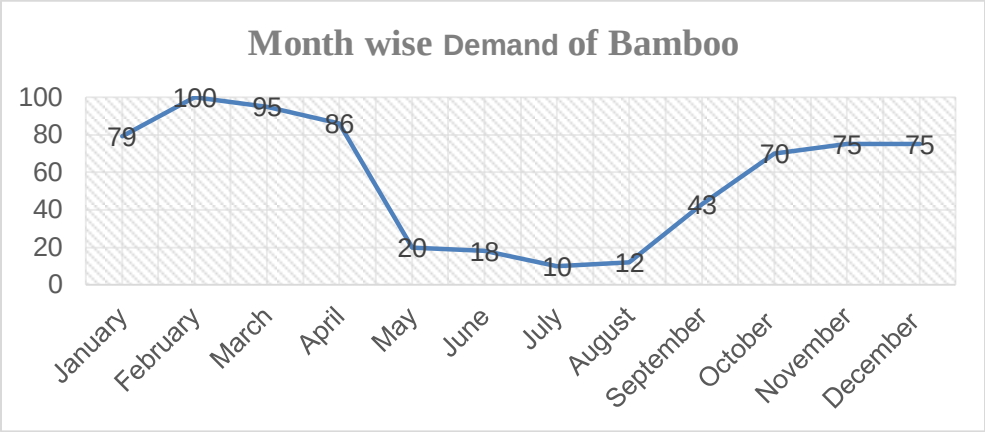
Bamboo-Based Products

We have mentioned (Table 4) four species of bamboo are common for the bamboo-based trading in local markets. They are being traded as pole or natural structural form or making secondary goods. Bambusa balcooa, Bambusa baccifera are traded as unprocessed form mainly used to make the structure for roof casting. Bambusa tulda, and Bambusa vulgaris are used to make fences, mats, and domestic baskets and utensils. With the initiation of the construction work between the month of October and April, the demand of bamboo remains very high and the rest of the time belongs mostly to the rainy season is the off-peak time for bamboo trading.

[26] INBAR (1999). Socioeconomic issues and constraints in the bamboo and rattan sectors: INBAR's assessment. INBAR Working Paper No. 23. International Network for Bamboo and Rattan, Beijing.

[27] Banik RL. (1998). Bamboo resources, management and utilization in Bangladesh. In: Rao AN, Rao VR, editors. Bamboo conservation, diversity, ecogeography, germplasm, resource utilization and taxonomy. Proceedings of training course cum workshop, 1998 May 10–17, Kunming and Xishuangbanna, Yunnan (China); p. 137–150.

Figure:4. Month wise Demand of Bamboo



Source: Mukul & Rana, 2013

Bamboo- Based Business and Profit Assessment

Since the destitute 36 million huge population of the coast of Bangladesh are vulnerable with earning livelihood so profit assessment of esteemed bamboo-based business is very important to assure its sustainability. Bamboo industry broadens the way of earning livelihood throughout the year and also it is likely employ the surplus labor force with low cost[28]. Agricultural employment is seasonal in nature and in the slack seasons, alternative income opportunities needed to fulfill the basic needs of the rural wage class and surplus family labor[29]. Bamboo based industry creates more income opportunity for the surplus and especially in house female work force.

Table: 5. Bamboo-based Secondary Products and Direct Selling Price

Product and Use	Production Cost ($)	Production Time (hr.)	Selling Price ($)			
			Factory	Intermediaries	Wholesaler	Retailer
Fence, in rural/temporary housing (36 × 120 inch)	1.25	4	1.50	1.80	2.10	2.35-2.85
Bookshelf, domestic Use	2.0	5	2.35	2.58	2.80	3.01−3.16
Screener, domestic Utensils	.85	2.5	1.01	1.15	1.42	1.82-2.20
Mat, for construction	.74	2	1.0	1.18	1.26	1.85

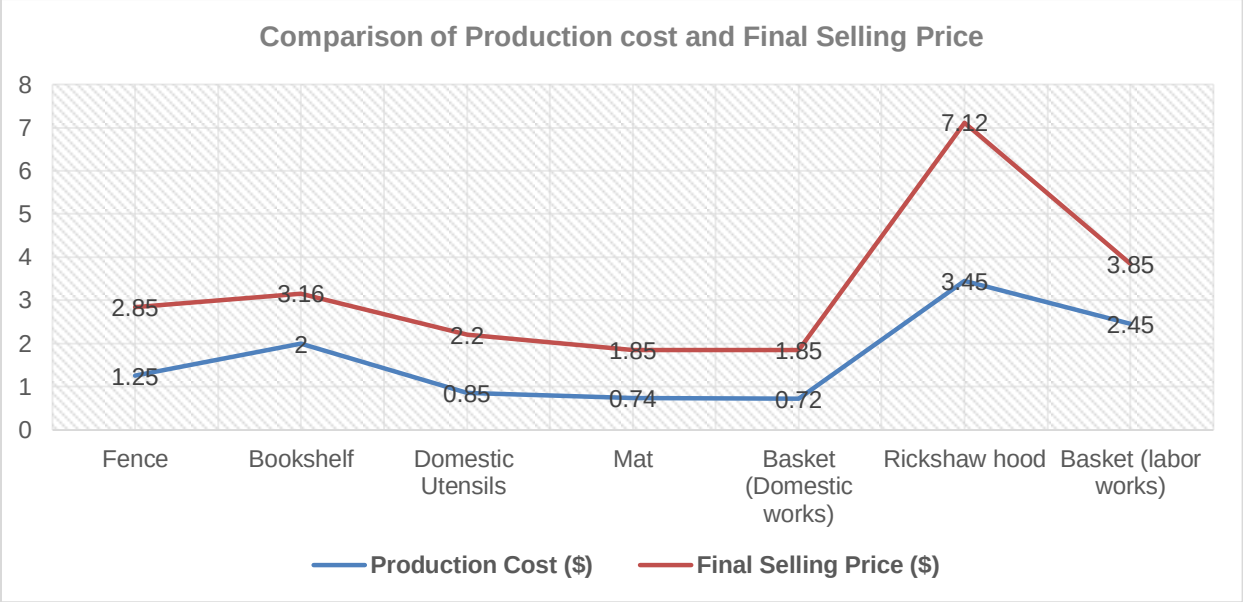
[28] Mottaleb, K.A. (2008). Rural Craftsmanship, Employment Creation and Poverty Alleviation: The Case of the Bamboo Craftsmanship in Bangladesh. *Civil Service College, Dhaka*

[29] Haque, M. Shamsul & Hussain, Zahid (1984). Cottage Industries of Bangladesh: Potential for Development. *Dhaka: Institute of Business Administration, University of Dhaka.*

(48 × 60 inch)						
Basket, domestic Utensils	.72	3	.98	1.16	1.36	1.85
Rickshaw hood, parts of Rickshaw	3.45	6	4.15	4.85	5.15	7.12
Basket, in labor works	2.45	4	2.95	2.15	3.10	3.85

Source: Market survey during June 2018

Figure:5. Comparison of Production cost and Final Selling Price



Discussion and Conclusion

Bamboo plays a vital role in improving rural poor people's livelihood since its availability[30]. More than 300,000 people are involved with the bamboo-based small and cottage industries and most them are poor including women and children[31]. South-eastern hilly districts are the major sources of the bamboo in Bangladesh[32]. So the engagement of this particular region is more likely higher than other region. Since the

[30] Nath TK, Uddin MB, Ahmed R. 2000. Role of bamboo based cottage industry in economic upliftment of rural poor: case study from rural Bangladesh. Malaysian Forester. 63(3):98–105.

[31] Banik RL. (1998). Bamboo resources, management and utilization in Bangladesh. In: Rao AN, Rao VR, editors. Bamboo conservation, diversity, ecogeography, germplasm, resource utilization and taxonomy. Proceedings of training course cum workshop, 1998 May 10–17, Kunming and Xishuangbanna, Yunnan (China); p. 137–150.

[32] Banik, R.L. (1994). Distribution and ecological status of bamboo forests of Bangladesh. Bangladesh J Forest Sci. 23(2):12–19.

main concern of this study is to popularize the bamboo-based industry in the coastal regions to highlighting the sustainable business issues around the year is significant here. Although unprocessed and bamboo-based products have great local market demand but when sustainability is the concern then foreign trade is the important aspects of this probable sustainable solution.
Bangladesh has a large scale market for the furniture. Most of the raw materials come from the imported wood. But with the green furniture concept, bamboo is becoming the main raw materials for the furniture industry of Bangladesh[33]. Earlier most of the bamboo was used in the paper mills in Chandraghona, Chhatak, Paksey and Khulna. These raw materials for paper mills used to supply from Sundarbans[34]. Between 1981 and 2000 over 700 million bamboo culms are removed annually that us almost 1 million tones. Two sources, state forests provided 200 million culms and another 500 million culms were supplied from the village forests[35].

Bangladesh Forest Research Institute (BFRI) has taken the initiative to export bamboo shoot. To implement this visionary step BFRI has started motivating the root level farmers with insurance of new scientific cultivation techniques. Since international market has a massive demand of the bamboo shoot so the institute emphasize on the production which ultimately fetch a huge amount of foreign currency. BFRI has already sourced more than 200 acres of land in the Chittagong hill tracks for producing export oriented bamboo and the land engagement will be increased in near future. For popularizing the bamboo cultivation with the modern technology, International Center for Bamboo Cultivation and Rattan (ICBR) has provided fund and technology[36]. With BFRI another Bangladeshi stakeholder from the private sector BRAC initiate the project inside their tea estate[37]. Since every year the demand of bamboo based products are increasing 20% globally so BRAC will procure the local bamboo products and standardized it for the international market. The project has a huge prospect so the BFRI has initiated the training program for the officials and entrepreneurs.

So we believe cultivating bamboo will ensure the sustainable livelihood round the year for the coastal people of Bangladesh.

Limitation of the Study

The study has following limitations:

A. Any controlled laboratory experiment was now conducted to check bamboo's bendability with the powerful wind.
B. All species of Bangladeshi bamboo may not have same bendability, flexibility.

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[33] INBAR. (2015). Bangladesh: The Bamboo Pioneers Transforming The Country's Furniture Sector. Retrieved from https://www.inbar.int/bangladesh-the-bamboo-pioneers-transforming-the-countrys-furniture-sector/

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[35] FAO. (2007, October 15). *Bamboo products and trade.* Retrieved from http://www.fao.org/3/a1243e/a1243e04.pdf

[36] INBAR. (2017). Transfer of Technology Bamboo Shoot Production, Processing and Marketing from China to Bangladesh and Sri Lanka. Retrieved from https://www.inbar.int/project/transfer-of-technology-bamboo-shoot-production-processing-and-marketing-from-china-to-bangladesh-and-sri-lanka/

[37] Bangladesh to export bamboo soon (2009, March 19), *The Daily Star.* Retrieved from https://www.thedailystar.net/news-detail-80318

C. How much density of the bamboo forest is required for effective wind break was not examined.
D. Salinity tolerance of all species is yet to investigate.
E. Comparison of root mass amongst the species is required to investigate.
F. While the cultivation period if disaster did strike then the protection plan for the bamboo is yet to investigate.
G. How the government land in the coastal regions will be distributed among the root level farmers is yet to finalize.
H. When the local stakeholder i.e. root level farmer will be allowed to collect the bamboo from this social forest is yet to decide.
I. The profit sharing management among all the stakeholders of this esteemed project is yet to decide.

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