The Critical Links between Socio-Demographic Dynamics of Sundarbans Impact Zone and Forest Resource Depletion, Bangladesh: A Review

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Abstract: The question often asked is, does population dynamics in Sundarbans Impact Zone (SIZ) matters to degradation of Sundarbans Reserve Forest in Bangladesh? This study aims to examine the link whether population factors contribute to degradation of Sundarbans or not. Population size of SIZ increased by around 56% in 2011 compared with 1974 (from 1377763 in 1974 to 2155889 in 2011). Annual population growth rate in SIZ districts decreased dramatically, but sheer number of population increased significantly which had contributed to increase the overall population size. During 2001 and 2011, population growth rate of SIZ area was negative, yet the forest land decreased which could be explained by the impact of climate change. Hence, not only population factors but also other mediating factors are interplaying to the depletion of resources from Sundarbans. Rigorous study on demographic determinants of SIZ is required while formulation policies and programs at micro and macro level.

Keywords: Sundarbans Impact Zone (SIZ), Population Dynamics, Resource Depletion, Mangrove Forest, Bangladesh

1. Introduction

With 11% forest area (World Bank), Bangladesh is the 8th most populous country (Population Reference Bureau) of the world. According to 2011 Census, the total population of Bangladesh was 14, 97, 72, 364 with a density of 1015 person per square kilometer. And the density of population in 2011 almost doubled compared to 1974. Conversely, forest cover decreased between 1983 and 1995 at an average annual rate of 0.12%, and average stand density of the forest reduced by 87% between 1933 and 1995 (Sen, 2010). The heavy population pressure is placing growing demand on natural resources, especially forest sector. Over one million people directly or indirectly depend on the forest for their livelihood and the forest contributes great amount of Gross Domestic Product (GDP) in Bangladesh (Giri et al., 2008). About 2% of the labor force of the country was engaged in the forestry sector, contributed about 2% of total GDP of Bangladesh (BBS, 2014). The per capita forest land in Bangladesh has been decreasing at an alarming rate. At approximately 0.02 ha per person of forest, Bangladesh currently has one of the lowest per capita forest ratio in the world (Zaman, 2011). Most of the forest cover has distributed sparsely over the country.

Bangladesh has shared the world's largest mangrove forest with India. Since 1947 the Sundarbans mangroves are divided between India and Bangladesh (erstwhile East Pakistan), as Sundarbans in Bangladesh (also known as Sundarbans Reserve Forest, SRF) and as Sundarbans National Park in India (Rahman, 2007). The Sundarbans Mangrove Forest (SMF) extends over the South-west part of Bangladesh (Bagerhat, Satkhira and Khulna district of Bangladesh) and the Southeastern part of the State of West Bengal in India. The SRF is located at the southern edge of the Gangetic delta bordering the Bay of Bengal and is bounded by the *Baleswar* River on the east and *Harinbanga* River (international boundary with India) on the West. The SRF covers an area of 6,017 square kilometer which accounts for 4.07% of total area of Bangladesh and 40% of total area managed by the Forest Department (BBS, 2014). Sundarbans is the single largest source of forest resources in the country. Around 2 million people of the Sundarbans Impact Zone (SIZ) directly and indirectly depend on Sundarbans and its resources. Among them several thousands of frontier populations are directly engaged in Sundarbans resource extracting for their livelihoods. These people enter into the forest to catch fish fry, collect honey, wood resources and other economic purposes. Consequently, demographic variables are very important for population- environment study. The forest is very important for its protective and productive functions. The role of Sundarbans in environmental process is noteworthy. It plays as a buffer in protecting the densely populated areas from the aggression of frequent cyclones, storm surges and tidal waves. It is the most economically valuable and the richest natural forests of Bangladesh. Over 0.1 million people work as primary collectors of forest products in Sundarbans (Choudhury & Hossain, 2011). Sundarbans contributes about 41% of the total forest revenue (Shah, 2010). The Sundarbans is free from any encroachment and permanent human habitation except few hundreds of Forest Department personnel on official duty.

2. Aims and Methodology

This research work intended to examine the link, whether population factors contribute to degradation of Sundarbans or not. To arrest the critical link this study examined the socio-demographic dynamics of SIZ from 1974 to 2011 (census years) and role of population dynamics to the depletion of Sundarbans resources.

This study combined socio-demographic dynamics of SIZ and depletion of resources from Sundarbans reserved forest. Data were collected from published census reports of Bangladesh Bureau of Statistics (BBS) and other secondary literatures. These included researches and data sets from Bangladesh Bureau of Statistics (BBS), United Nations, World Bank, Integrated Protected Area Co-Management (IPAC), NGO publications, newspapers, etc. and researches carried out by scholars (books, journals, etc.). Population data were collected from BBS population censuses reports for 1974, 1981, 1991, 2001 and 2011. The same data were analyzed to establish changes in population size, age structure and sex composition through time. Changes in population in terms of size, age structure and sex composition for 1974, 1981, 1991, 2001 and 2011 were analyzed to determine trends and changes in population characteristics to compare such changes with changes in forest cover. Statistical tables and graphs were generated using Microsoft Office Excel package.

3. Study Area

The periphery of the SRF includes the legally declared "Ecologically Critical Area" assumed to be

within a 20 km band surrounding the SRF. This is what can be called the Sundarbans Impact Zone (Islam, 2010). The SIZ comprises 5 districts (Bagerhat, Khulna, Satkhira, Pirojpur and Barguna), 10 upazilas (Sadar, Mongla, Morrelganj, Sarankhola; Dacope, Koyra, Paikgacha; Shymnagar; Mathbaria; and Patharghata), 151 unions/wards and 1,302 villages (Islam, 2010). This study considered population dynamics of SIZ at upazila (sub-district) and district level.

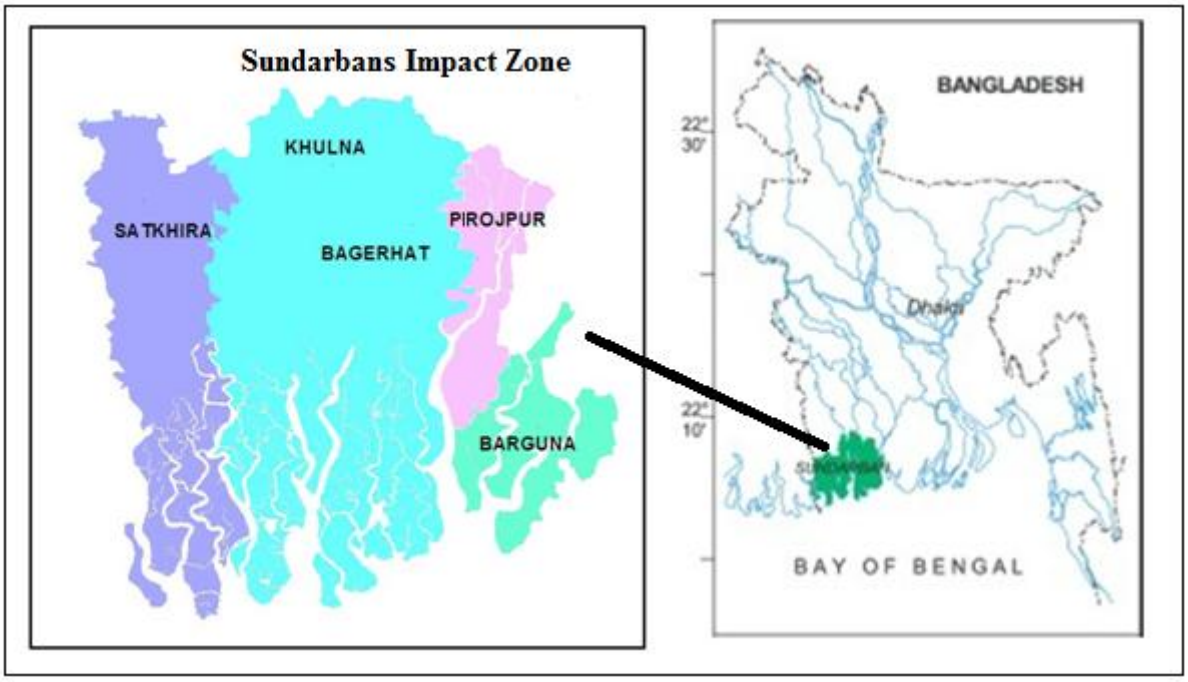

Figure 1: Map of study area

4. Results

4.1. Socio-Demographic Dynamics of SIZ

4.1.1. Population Size and Distribution

SIZ districts had a population of 7.8 million which constituted about 5.4% of country's population (BBS, 2011). Among the SIZ districts, the highest percentage of population was settled in Bagerhat SIZ (53.3%), followed by Khulna (25.6%), Pirojpur (23.6%), Barguna (18.36%) and the lowest in Satkhira SIZ (16.0%). Around 2.2 million people inhabited in the SIZ upazila which was around 1.5% of the country's total population and around 32% of the SIZ districts (BBS, 2011).

The demographic trends for Bangladesh revealed that the population became almost doubled between 1974 and 2011 (from 76 million in 1974 to 144 million in 2011). This data also demonstrated that at national level, population increased by about 60% during 1981 to 2011 (from 90 million in 1981 to 144 million in 2011), while at the same period population increased by 28% in Bagerhat (from 208143 to 266389) and Sarankhola (from 92734 to 119084), 40% in Mongla (from 97399 to 136588), 8% in Morrelganj (from 272112 to 294576), 36% in Shyamnagar (from 234164 to 318254), 55% in Koyra (from 125090 to 193931), 31% in Dacope (from 116455 to 152316) and 41% in Paikgachha (from 175715 to 247983). This analysis suggested that population

growth (in percentage) of SIZ upazilas did not crossed the national growth.

Although the absolute number of population during 1974 to 2011 increased, the percentage of population shared by SIZ upazila to the country's total population decreased during the same period. Moreover, the actual size of population decreased in 2011 compared to 2001 census.

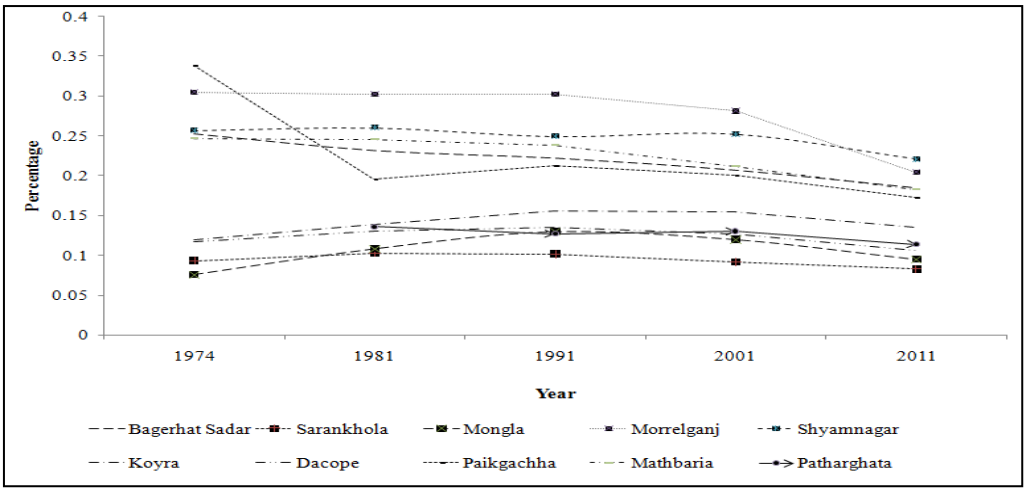

Figure 2: Percentage of population shared by each upazila

4.1.2. Annual Population Growth Rate

At national level, the annual population growth rate was positive in 2001 and 2011, but negative growth was observed in Mongla, Dacope, Paikgachha and Mathbaria upazila suggesting absolute decrease in population size. While other SIZ upazilas observed positive growth with colossal fluctuations.

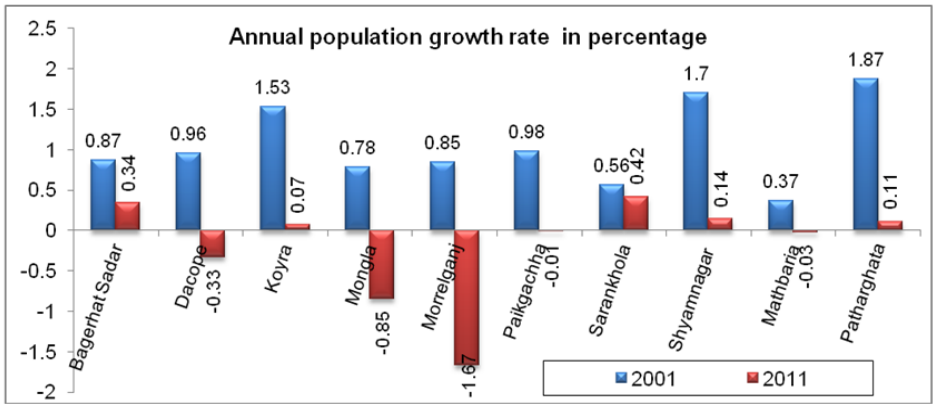

Figure 3: Annual population growth rate of SIZ upazila

SIZ districts experienced a dramatic decline in growth rate. The highest growth rate was found in Khulna (5.12%) district in 1974, while this district observed negative growth rate (-0.25%) in 2011. In 1974, almost similar growth rate observed for Bangladesh (2.48%) as a whole and Bagerhat (2.62%), but after four decades (in 2011) Bagerhat (-0.47%) showed negative growth rate. The

similar declining tendency found for Satkhira, Pirojpur and Barguna district. Differences in growth rate were mainly caused by variations in the rates of internal migration. Probably these factors also influenced by climatic abnormalities in coastal zones.

Table 1: SIZ district wise population growth rate from 1974- 2011

SIZ district	1974	1981	1991	2001	2011
Bagerhat district	2.62	1.6	1.75	0.79	-0.47
Satkhira District	3.45	1.7	1.66	1.56	0.62
Khulna district	5.12	2.48	1.28	1.7	-0.25
Pirojpur district total	2.35	1.41	1.16	0.44	0.02
Barguna district total	2.53	1.89	1.36	0.9	0.5
Bangladesh	2.48	2.35	2.01	1.58	1.47

Source: Compile from different censuses of BBS (1974, 1981, 1991, 2001 and 2011)

4.1.3. Household and Household Size

For forested areas, households are an important demographic variable in determining the dependency on forest resources. In the frontier forest area, most of the households have a profession which is related to forest. The extent of forest resource dependency depends on household size, the number of households and the materials used to build homes.

During 1974 to 2011, the number of households increased in all SIZ upazilas. The number of households in Sarankhola (from 12680 to 64022), Mongla (from 11058 to 32383), Shyamnagar (from 33209 to 72279), Koyra (from 19524 in 1981 to 45750 in 2011) and Dacope (from 16846 to 36597) upazila crossed doubled figures during that time. In 2011, number of people per household in SIZ upazilas was within 3.8- 4.24 that was dismounted from around 6 in 1981. The average household size of SIZ upazila was below the national average (4.44 in 2011) size.

4.1.4. Population Density

Population density in SIZ districts (556 persons/ km^2) and SIZ upazilas (425.5 persons/ km^2) were below national average (976 persons/ km^2) in 2011. While the population density at national level increased by about 84% in 2011 from 1974, some SIZ districts like Bagerhat (44%) recorded the lowest increase in population densities followed by Khulna (68%) and Satkhira (76%). It is worthy to mention that population densities decreased remarkably in some SIZ upazilas like Mongla (8.8% from 102 to 93 persons/ km^2), Morrelganj (15.7%, from 758 to 639 persons/ km^2) and Dacope (3.1%, from 159 to 154 persons/ km^2) during 2001 to 2011 period. Such decreased in population densities also observed for Bagerhat (4.6%, from 391 to 373 persons/ km^2) and Khulna (2.4%, from 541 to 528 persons/ km^2) districts. Probably, this decrease in population densities was due to landfall of two devastating cyclones namely Sidr (in 2007) and Ayla (in 2009) that endangered the

lives and livelihoods of thousands of population.

4.1.5. Urbanization

Bangladesh has been experiencing a rapid expansion of urban areas since 1974. The proportion of urban population increased gradually from 7% in 1974 to 28% (adjusted, including Statistical Metropolitan Area) in 2011. SIZ upazilas showed a meager progress in urban growth. Most of the upazilas hardly crossed double digit of urbanization rate in 2011. Cyclone Sidr and Ayla affected upazilas recorded negative urban growth in 2011 compared to 2001. These upazilas were Shyamnagar (5.42%), Koyra (5.89%) and Dacope (9.31%).

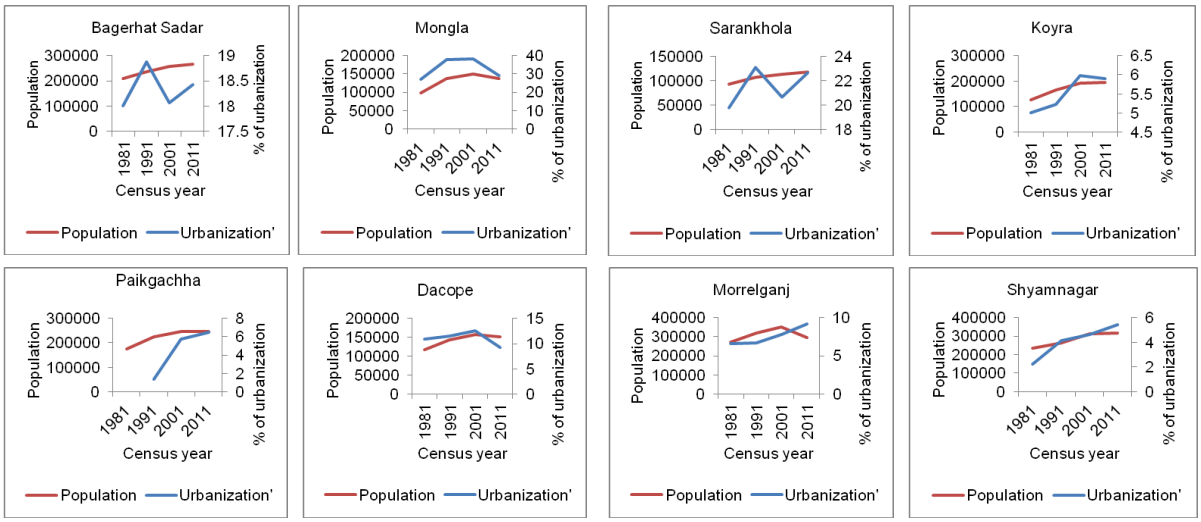

Figure 4: Population and urbanization rate of selected SIZ upazilas

4.1.6. Age Sex Distribution

Age-sex composition has environmental implications because different population subgroups behave differently. According to 2011 census, the total male population in the SIZ upazilas was 1.07 million and female 1.09 million. The sex ratio of female overtops compared to male which was 99.9 for SIZ upazila in 2011. The greater number of female population may be a reflection of male out migration. Within SIZ upazila, female population was larger (sex ration below 100) in Morrelganj (95), Shyamnagar (93), Koyra (97), Mathbaria (96) and Patharghata (97) upazila in 2011.

The age structure of SIZ upazila is quite interesting. The proportion of 65 years and above population was almost doubled in SIZ area compared to national age structure. However, economically active population was always below the national proportions. This indicates that the dependency ratio (0-14 years and 65+ years) is higher in SIZ area. The proportion of the population aged 15-49 accounts for 50.1% of the total population. This group of people is engaged in harvesting resources from the SRF. Hence, the changes in age structure are closely associated with

resource extractions.

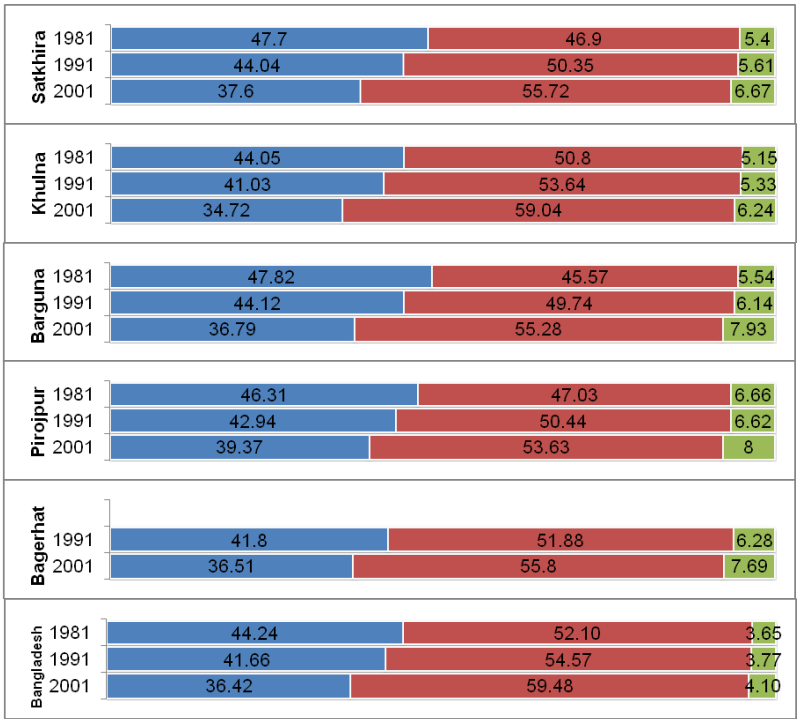

Figure 5: Broad age group wise population in SIZ districts and Bangladesh

4.1.7. Income and Poverty Situation

SIZ is relatively income poor and people are suffering from marginalization and inequality in income. Among the SIZ upazilas, Head Count Ratio (HCR) for SIZ Satkhira (0.65) was higher compared with 0.45 for non-SIZ upazilas of Satkhira, followed by SIZ Bagerhat (0.43) and non-SIZ Bagerhat (0.24) and SIZ Khulna (0.41) and non-SIZ Khulna (0.32). These three districts are lies in SRF area. The exceptions were found for Pirojpur and Barguna. Among the SIZ upazilas, the guesstimated HCRs were higher for Shyamnagar (0.65), Dacope (0.60) Morrelganj (0.50), Sarankhola (0.49), Mongla (0.42), Koyra (0.35) and Paikgachha (0.34).

Moreover, the proportion of people living below the extreme poverty and upper poverty line was higher in SIZ upazila. Although, the percentage of people living below the extreme poverty line decreased significantly, the percentage of people living below the upper poverty line increased radically from 2005 to 2010 in Koyra, Paikgachha and Mathbaria. Among the SIZ districts and upazilas, Sarankhola had the highest percentage of extreme poor people (28.2%) which was also characterized by 48% of people living below the upper poverty line. Shyamnagar was the highest poverty stricken area in 2010 (50.2% people were living below upper poverty line).

Table 2: Percentage of poor and extreme poor people in SIZ

District/ country	Upazila	2005		2010	
		% Extreme poor (lower poverty line)	% Poor (Upper poverty line)	% Extreme poor (lower poverty line)	% Poor (Upper poverty line)
Bagerhat	Sadar	42.7	31.6	18.6	35.9
	Sarankhola	62.8	48.7	28.2	48.0
	Mongla	56.4	41.5	22.7	41.9
	Morrelganj	64.0	50.3	27.0	46.5
Satkhira	Shyamnagar	75.7	65.2	33.8	50.2
Khulna	Koyra	50.0	34.8	29.1	49.1
	Dacope	73.3	60.4	24.9	44.5
	Paikgachha	49.6	34.4	23.3	42.4
Pirojpur	Mathbaria	38.1	17.9	25.6	38.0
Barguna	Patharghata	56.3	36.1	6.10	12.9
Bangladesh		25.1	40.0	17.6	31.5

Source: Poverty maps of Bangladesh, 2005 and 2010

4.2. Depletion of Sundarbans Forest Cover

Sundarbans have been losing its coverage, density, composition, and overall productivity. Forest cover has decreased between 1983 and 1995 at an average annual rate of 0.12%, and average stand density of the forest has been reduced by 87% between 1933 and 1995 (Sen, 2010).

A study conducted by Ministry of Environment and Forest on 'Assessment of Sundarbans Reserved Forest in 1960, 1985, 1995 and 2013'. This research described the occupancy of different mangrove species in different years. The study found that the areas covered by different forest types had been decreasing at an alarming rate. The area occupied with Sundari tree was decreased by 24% in 2013 (742.64 km^2) compared with 1960 (985.51 km^2). The rate destruction was higher in 1970s to 1990s. Most of the degradation (around 16% loss) held between 1960 (985.51 km^2) and 1985 (828.45 km^2). Although, around 1% of Sundari forest cover was lost during 1995 to 2013, population size of SIZ increased by 8.31% during 1991 to 2011. During 1985 to 2013, around 14% Sundari - Gewa forest cover was lost (1232.47 km^2 in 1985 to 1022.74 km^2 in 2013). The occupancy of Sundari - Passur tree decreased 93% between 1960 and 1985 (297.52 km^2 in 1960 to 22.14 km^2).

5. Discussions and Conclusions

The natural forest of Bangladesh has been depleted at an alarming rate. The annual loss of forest in Bangladesh is estimated around 0.015 Mha (Choudhury and Hossain, 2011). The Sundarbans mangrove ecosystems have remarkable value for south-west coastal communities and for the country as a whole. But the forest resources are being destroyed at alarming rates. In general, the

more people in the frontier forest, the greater is the impact on forest and environment even when a population and its growth are relatively small.

In reality, the size of population of SIZ locality in 2011 was declined from 2001. During this period, the size of households, density of population and urbanization decreased significantly. The annual population growth rate of SIZ districts also decreased dramatically. The urbanization rate in SIZ upazila's was much lower than the other areas of the country. Population and poverty processes were also intimately linked to forest cover change. Poverty is also a dominant phenomenon in SIZ locality. The percentage of extreme poor (lower poverty line) people in SIZ is higher than the national average. These extreme poor people are generally engaged themselves in extracting natural resources either from Sundarbans or from common property.

During 2001 and 2011, the population growth rate of SIZ upazila was negative, yet the vegetated land decreased. This could be explained by the climate change. The coastal zone was affected by two major consecutive cyclones (Cyclone Sidr in 2007 and Cyclone Aila in 2009). These cyclones endangered the lives and livelihoods of coastal communities. After cyclone Aila, more than 20,000 families have been displaced on the embankments and others near roads and collective centers from Koyra and Dacope (IOM Displacement Tracking Matrix, February 2010). Many people seasonally migrated from the SIZ for their livelihoods.

The population dynamics of SIZ locality provide a unique setting for examining population-environment linkages. The population-environment linkages must be considered in the context of the people and available natural resources. There is no doubt population growth is one of the factors for depletion of forest resources from the SRF and theoretically, it is proved high population density contributes to intense use of forests, fisheries, and water resources. But population factor is not alone responsible factor for decreasing tree cover from the SRF. This study found that population size was increased by 8.31% between 1991 and 2011, whereas almost at the same time (from 1995 to 2013) Sundari tree cover decreased by 1%. Therefore, frontier population factor is not alone responsible for depletion of tree cover from the SRF, there are some other factors like upstream withdraw of water, illegal logging, expansion of shrimp and crab farming, frontier agriculture, pollution, climate change included natural disasters e.g. tropical cyclones, coastal erosion, storms surges, floods, hydrological changes, sea level rise, and above all lack of awareness are interplaying in depletion of tree cover from the SRF. All of those mentioned factors need to be synergistically considered while formulating any conservation efforts for Sundarbans. Otherwise we will mistakenly put our blame to the frontier population only.

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