A SEMINAR PAPER
ON
ROHINGYA MIGRATION AND LAND USE LAND COVER CHANGE IN BANGLADESH

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A SEMINAR PAPER ON

ROHINGYA MIGRATION AND LAND USE LAND COVER CHANGE IN BANGLADESH[1]

BY

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Abstract

The violence created by Myanmar military, local militias and police resulted in more than a million and a half Rohingya people migration to neighboring country Bangladesh since August 2017, joining thousands of others living in overcrowded settlement camps in Teknaf region. Refugees left their habitats in search of their life security, protection, food, and shelter. However, they found insufficient support from international organizations including UNHCR and other organizations. For building up new refugee camps, hills are leveled and huge numbers of trees are cut off to use as firewood for cooking and constructing materials. That causes significant deforestation and land cover changes. To arrange accommodation for this mass influx of refugees, forestland is destroyed to construct spontaneous settlements results in an immense threat to wildlife sanctuaries, biodiversity, and entire ecosystems in the region. Using GIS, remote sensing imagery and a random forest (RF) machine learning algorithm along with ground observation data, the territorial expansion of refugee settlements can be quantified. Among all the camps, three largest crowds are in: Kutupalong–Balukhali, Nayapara–Leda, and Unchiprang which developed between pre and post-August of 2017. Among the three refugee camps, there is an increase of 175 to 1530 hectares between 2016 and 2017, and a net growth rate of 774%. The greatest camp expansion is observed in the Kutupalong–Balukhali site, increase of 146 ha to 1365 ha with a net spread of 1219 ha in the same time period. While the expansion of refugee camps is occurring at a rapid speed, this increase mostly occurred by replacing the forested land, degrading the forest cover surrounding the three camps by 2283 ha. Such degradation of these critical ecological resources might trigger multiplicative impacts on the environment, biodiversity, wildlife habitat and overall socio-economic health of the entire region.

Keywords – forests, Rohingya refugees, ecology, vegetation, remote sensing

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Chapter I

Introduction

1.1 History

From the history of mankind, it is evident that the refugee crisis has occurred from time immemorial. The world is facing the most severe refugee crisis in history with an average of 28,300 people per day and every 20 min forced to flee their homes due to war, violence, or persecution for their race, religion, ethnicity or political opinion, and the number is growing every day (UNHCR, 2018).

The history tells us around 12 million Africans slaves were shipped across the Atlantic from the 15th to 19th century (Segal, R. 1997). Because of the Waterloo war and the great Irish famine, there was a mass emigration from Ireland can be traced to the mid-18th century, when some 250,000 people left Ireland over a period of 50 years to settle in the New World (Papademetriou et al., 2010). The north was heavily favored by the new Italian constitution (1861). High taxes and other economic measures compelled many Southern Italian farmers to seek their fortune elsewhere. About 5.5 million Italians immigrated to the United States from 1820 to 2004 (Cavaioli, F. J. 2008). Following the partition of British India into Pakistan and India, one of the greatest international migration in history began, some 15 millions of people migrated from their motherland to a new shelter (Hill et al., 2004). At the end of World War II, the map of Europe was changed that many people found themselves living in hostile territory and Germans were expelled, evacuated or fled from Central and Eastern Europe to the new Germany (Prauser, S. & Rees, E. A. 2004). Many nations in Africa have suffered civil wars and ethnic strife since the mid of last century. That resulted in immigrating a massive number of refugees of many different nationalities and ethnic groups. The total number of refugees in Africa increased from 860,000 in 1968 to 6,775,000 by 1992. The number had dropped to 2,748,400 refugees by the end of 2004, according to the United Nations High Commission for Refugees. Angola, Uganda, Darfur, Nigeria, Central African Republic, Sudan, South Sudan, Somalia, Libya have been suffered from this cursed refugee crisis (Craver, K. W. 2014). Millions of people fled from Vietnam when it was taken over by the communists in their war with the USA in 1975 (Rummel, R. J. 1998). When the Soviet Union invaded Afghanistan in 1979, the country was thrown into instability. A

total of 6 million Afghan refugees were hosted in Pakistan and Iran, making Afghanistan the largest refugee-producing country in the world, a title held for 32 years (Wickramasekara et al., 2006). In 2003, some 33,000 Chechens applied for asylum in the European Union (EU), according to the United Nations High Commissioner for Refugees, making them the largest group of new refugees arriving in developed nations. According to an estimate from March 2009, there were some 130,000 Chechen refugees in Europe (Molodikova, I., & Watt, A. 2014). In April 2007, there was an estimate of over 4 million Iraqi refugees around the world (UNHCR 2017). Around five million Libyans have taken refuge due to NATO intervention in Libya. Syrian refugee crisis is an ongoing crisis and an example of a war as a driver of mass migration. The UN Refugee Agency counted 5,165,502 registered refugees, as of August 2017 (Fisseha, M. 2017).

The Rohingya refugees of Myanmar are the latest addition to this list. The Rohingya people are one of the most stateless and widely persecuted minorities in the world, facing an ethnic cleansing by the Buddhist majority in Myanmar forcing them to flee in search of relative safety in the neighboring country of Bangladesh (BBC, 2018). The Rohingya have experienced the significant military action as well as intensive propaganda campaigns throughout their history; in the last 100 years, the most notable attacks occurred in the 1970s, 1991-2, 2012, 2015, and 2016-present. In 1982, the government of Myanmar amended their nationality laws, removing citizenship and basic rights from the Rohingya (Lindblom et al., 2015). Since August 2017, a renewed wave of the Rohingya influx began, with thousands arriving at southern Bangladeshi camps every day (Safi, 2017). Impact of the refugee crisis on the environment and the natural resource of the host community has become an emerging issue in refugee research. Temporary shelters are often built near environmentally sensitive areas like national parks, reserve forests reserves, or agriculturally marginal areas. Refugees often stay in their host countries for long periods of time, having a prolonged impact on the environment (Shepherd, 1995). The majority of this population settled in makeshift camps, replacing forested hills surrounding the two existing refugee camps located in Kutupalong and Nayapara in Teknaf (REUTERS, 2018). It provides an important environment for a vast array of plants, including a number of medicinal plants that are used by the local communities (Karim M.N., 2009), as well as being a source of substantial carbon storage (Pan et al., 2011). Additionally, this environment contains a sanctuary for wild Asian elephants, nesting sites for many shorebirds, and provides food and shelter for

monkeys, snakes, bats, and other wild animals (Alam et al., 2012). In recent time, the refugees became active users of the forest resource in many developing countries which generated extra pressure on the forest and have created the scarcity of forest resources (Khan et al., 2009). The protected forest, with its wildlife habitat and other natural capital in the study area, is being destroyed and degraded at an alarming rate mainly due to clear-cutting for agriculture, ranching and development, and logging for timber. However, degradation due to rapid conversion for refugee camps and makeshift settlements is the greatest catalyst of environmental destruction occurring at a large that causes serious land use land cover changes scale in recent times (Rahman, M. Z. 2018). Land use and land cover change (LULCC) is considered an important tool to assess global change in different spatiotemporal scales (Lambin, 1997). As land use change is a locally extending and globally significant ecological trend, these changes have important indications for future changes in Earth's environment and have for subsequent land use change (Agarwal et al., 2001).

1.2 Objectives:

The specific objectives of this review paper are:

i. To review the present situation of Rohingya people in different refugee camps in Bangladesh
ii. To review the vegetative and land cover change in corresponding area

Chapter II

Methodology

This Seminar paper is exclusively a review paper, so all of the information has been collected from the secondary sources. I went through various relevant books, journals, proceedings, reports, publications etc during this paper preparation. It has been prepared by browsing internet, studying comprehensively various articles published in different journals, books, proceedings, dissertation available in the libraries of BSMRAU and personal communication. I have also searched related internet web sites to collect information. I got valuable suggestion and information from my major professor and course instructors. All the information collected from the secondary sources have been compiled systematically and chronologically to enrich this seminar paper.

CHAPTER III

Review of Major Findings and Discussion

3.1 Current Situation

3.1.1 Way of Living

Violence in Rakhine State which began on 25 August 2017 has driven an estimated 436,000 Rohingya people across the border into Cox's Bazar, Bangladesh. The current estimation of the number of people who have settled in the varios camps and other refugee camps are estimated below:

Table 1. New arrivals with location and numbers according to make makeshift and settlement

Location	Population before Aug Inflow	Total Inflow (individual)	Total Population (combined)
Makeshift Settlement / Refugee Camps			
Balukhali MS	20,016	25,454	45,470
Kutupalong MS	79,479	98,758	178,237
Kutupalong RC	13,901	20,000	33,901
Leda MS	14,240	11,053	25,293
Nayapara RC	19,230	15,000	34,230
Shamlapur	8,433	24,834	33,267
Grand Total	155,299	195,099	350,398

Location	Total Inflow (individual)	Total Population (combined)
New Spontaneous Settlements		
Hakimpara	51,437	51,437
Mainnerghona	70,764	70,764
Burma para / Tasnimarkhola	27,557	27,557
Unchiprang	27,998	27,998
Rubber garden	25,248	25,248
Jamtoli / Thangkhali	17,095	17,095
Grand Total	220,099	220,099

[Source: ISCG, 1 Oct, 2017]]

Rohingya people came to Bangladesh with a very few possessions. Most of their savings have been used in transportation and constructing a shelter. Now, they are dependent on humanitarian assistance for food, and other life-saving needs. In some of the sites, there are minimum facilities, in fact; there is no access to water and sanitation facilities, raising the risks of an outbreak of disease. The Rohingya population in Cox's Bazar is highly vulnerable, and living in extremely difficult conditions. They have fled conflict and experienced severe trauma. Highest population movement occurred in Cox's Bazar, with a maximum gathering in Ukhia. Bangladesh government has allocated 2,000 acres for a new camp there. Moreover, access is confined to the site and no way through this site; this is preventing the development of infrastructure including water and sanitation facilities.

Table 2. New arrivals with location and numbers according to host community

Location	Population prior to Aug Inrush	Total Inrush (individual)	Total Population (combined)
Host Community			
Cox's Bazar Sadar	12,485	2,805	15,290
Ramu	1,600	1,395	2,995
Teknaf	33,687	37,920	71,607
Ukhia	8,452	31,107	39,559
Naikhongchhari (Bandarbhan)		18,700	18,700
	56,224	91,927	148,151
Grand Total	211,523	507,125	718,648

[Source: Inter-Sector Coordination Group, 2017]

3.1.2 Rohingya Influx

In this below graph, the total number of refugees from 1991 to 2017 is delineated. The population graph was almost constant for almost 24 years but a sudden rise of the curve can be seen in 2017 which is due to cleansing operation by Burmese army started on August 25. Extreme violation of human rights led to a haphazard situation at Rakhaine state and forced their

Rohingya inhabitants to flee from their own country. Prior to the influx, this number was around 250 thousand which jumped to the number of around 850 thousand after the influx.

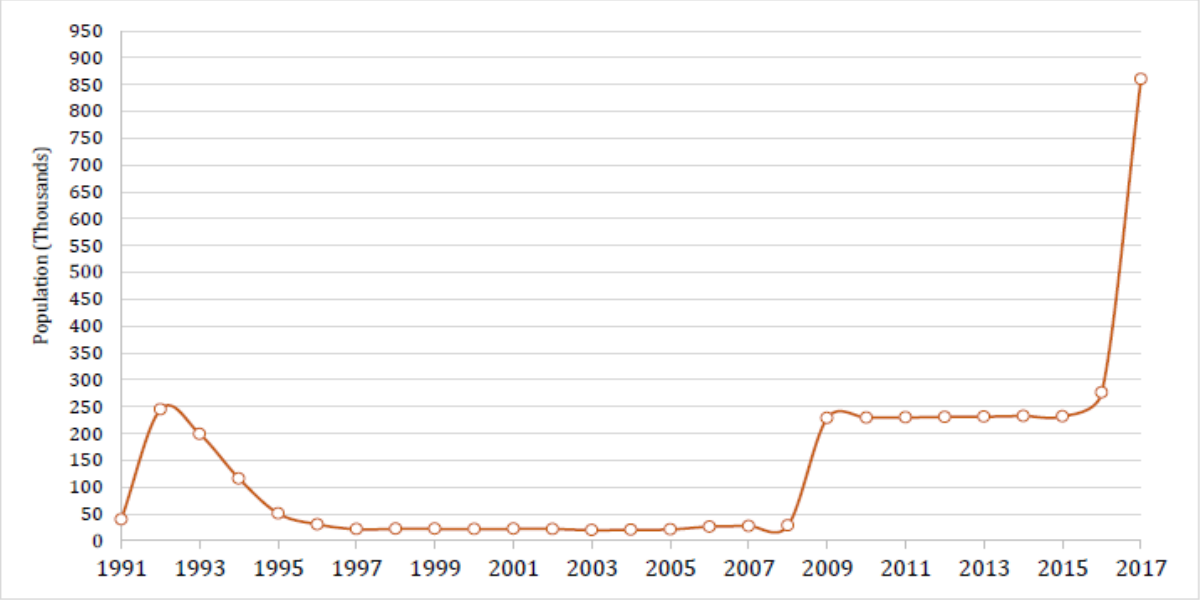

Figure 1: Number of Rohingya refugee influxes in Bangladesh from 1991 to 2017.

[Source: UNHCR (1991-2016) & ISCG (2017)]

3.1.3 Location of Rohingya Camps

Most of the Rohingya camps are situated in Cox's Bazar district and one in Bandarban district. Among them Teknaf upozilla are occupied with the highest numbers of camps. In below figure 2, there shows location and elevation of the study area, including the geographical setting of each refugee camp with the total refugee population as of 25 March 2018. The inset map (top right corner) shows Bangladesh with three sides; west, north and east, bordered by India and only a small border with Myanmar in the southeast where the study area, Teknaf, is located.

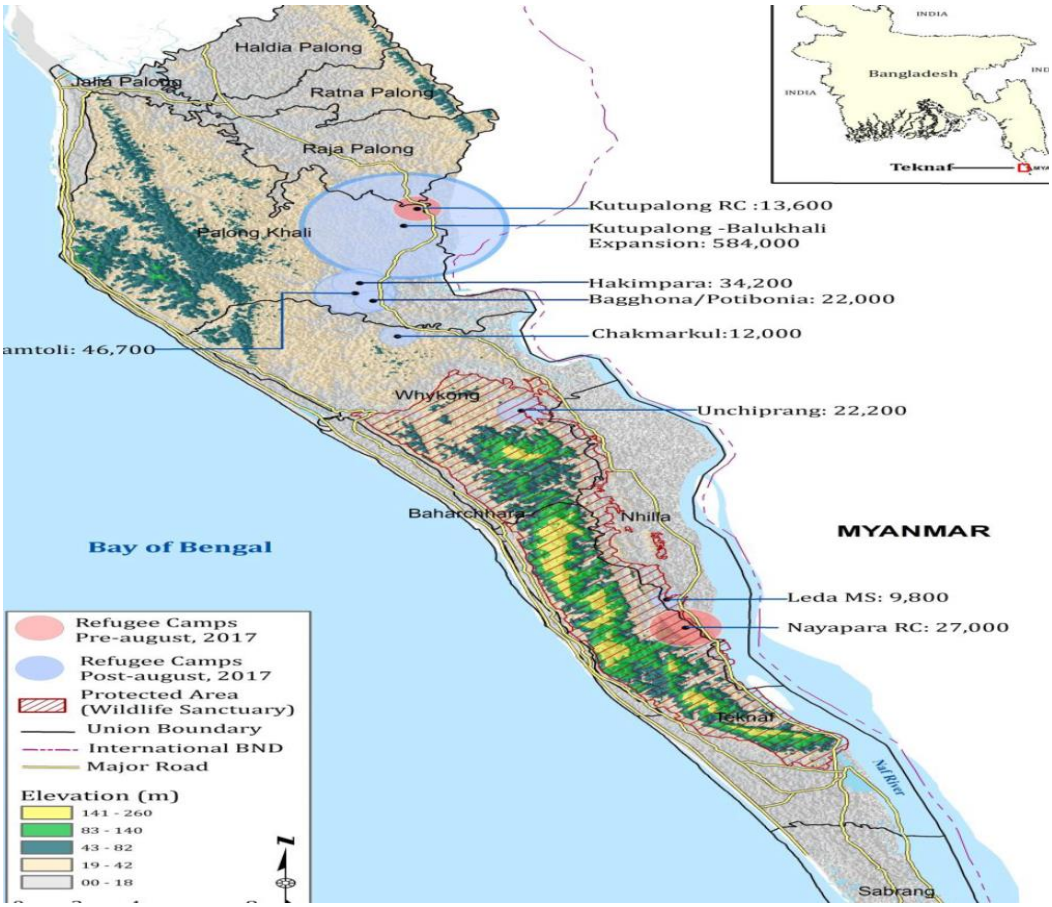

Figure 2. Location and elevation of the Rohinya camps.

[Source: Inter Sector Coordination Group (ISCG), 2018]

3.1.4 Demographic Status

Rohingya people came from Myanmar live in different camps of a different area of Teknaf upozilla. Rohingya family holds comparatively a large numbers of member ranging from three to fourteen people because most of the families are combined (brothers, sisters and their families living in one household). Maximum families are rated in the group (>6-7) and average household size is 6.2 people per households.

Table 3. Demographic characteristics of Rohingya refugee in Teknaf

Variable name	Frequency	Percent	Cumulative percent
1. Family size			
<5	3	7.5	7.5
>5-6	9	22.5	30
>6-7	16	40	70
>7-8	7	17.5	87.5
>8	5	12.5	100

[Source: Khan et al. 2012]

It is stated that 100% of the Rohingya refugees were landless. Among them, refugees who are involved in farming, the average household has only 0.09 ha own encroached land (refugees arriving between 1960 and 1970 was able to encroach land), and 0.06 ha encroached land that were rented from local people.

Table 4. Land holding pattern of Rohinya people in Teknaf

Variable name	Frequency	Percent	Cumulative percent
Land holding pattern (ha/respondents)			
Encroached			
<0.09	10	25	25
>0.09	7	17.5	42.5
Rent			
<0.06	15	37.5	80
>0.06	8	20	100

[Source: Khan et al. 2012]

3.2 Vegetation Cover and Rohingya Impact

3.2.1 Vegetation Cover in Teknaf

Tables 5 and 6 represent the characteristics of vegetation cover change in Teknaf sub-district and Teknaf Wildlife Sanctuary, respectively. The changes of vegetation cover in each year is shown in the rightmost column of the tables.

Table 5. Total vegetation cover of Teknaf sub-district

Year	Area (ha)	Area change (ha)
2014	26105.04	-
2015	25984.08	-120.96
2016	26298.54	-314.46
2017	25014.06	-1284.48

[Source: Imtiaz, 2018]

Table 6. Total vegetation cover of Teknaf wildlife sanctuary

Year	Area (ha)	Area change (ha)
2014	11448.00	-
2015	11491.56	43.56
2016	11467.53	-24.03
2017	11364.66	-102.87

[Source: Imtiaz, 2018]

This table shows a drastic change in vegetation cover in the year 2017 in both of Teknaf subdistrict and Teknaf Wild Life Sanctuary. Total vegetation cover decreased by 1284.48 hectares and 102.87 hectares in Teknaf sub-district and Teknaf Wildlife Sanctuary, respectively. In both cases, total vegetation cover is less than any other year since 2014. These changes are

significant because this impact assessment is done just after 3.5 months of massive Rohingya influx. This massive Rohingya influx started in Bangladesh on 25 August 2017.

3.2.2 Dependency Rate on Forest

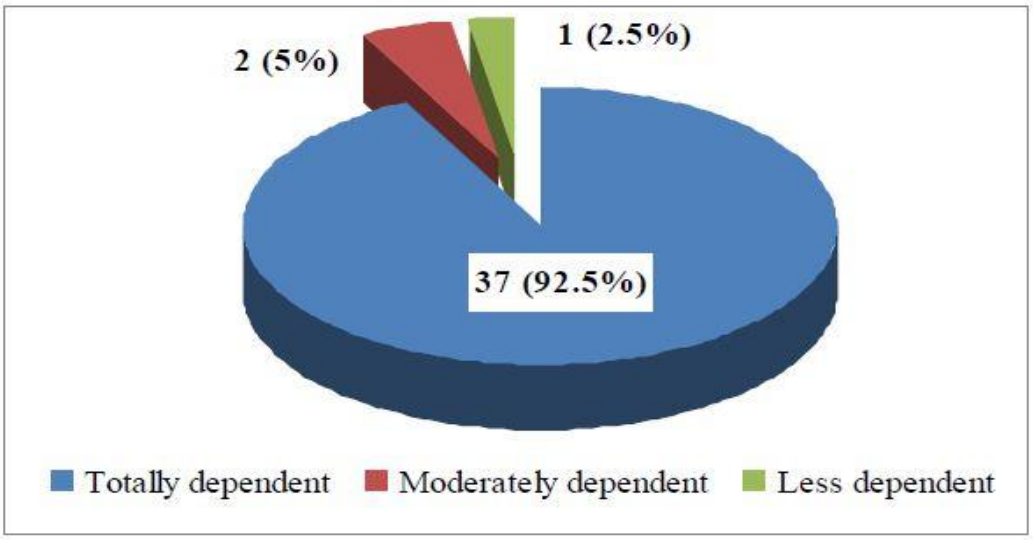

Figure 3: Dependency rate of Rohingya people on the forest.

[Source: Ullah et al. 2011]

3.2.3 Causes of Dependency on Forest

There are 12 main causes which included over exploitation of fuel-wood, make fire for better sun-grass regeneration, illicit felling, bamboo and cane extraction, brickfield within the forest, grazing, betel leaf cultivation within the forest, invasion of forest land, medicinal plant and vegetables collection, green and dry leaves collection, sand and stone collection and hunting. Among these twelve causes, Rohingya people have been actively involved with eight activities. However, they were engaged as day labor in the brickfield, sand and stone collection and betel leaf cultivation. Since they have no cattle, no land covers are used for grazing. Among all causes overexploitation of fuel-wood ranked as one of the main reasons for forest destruction.

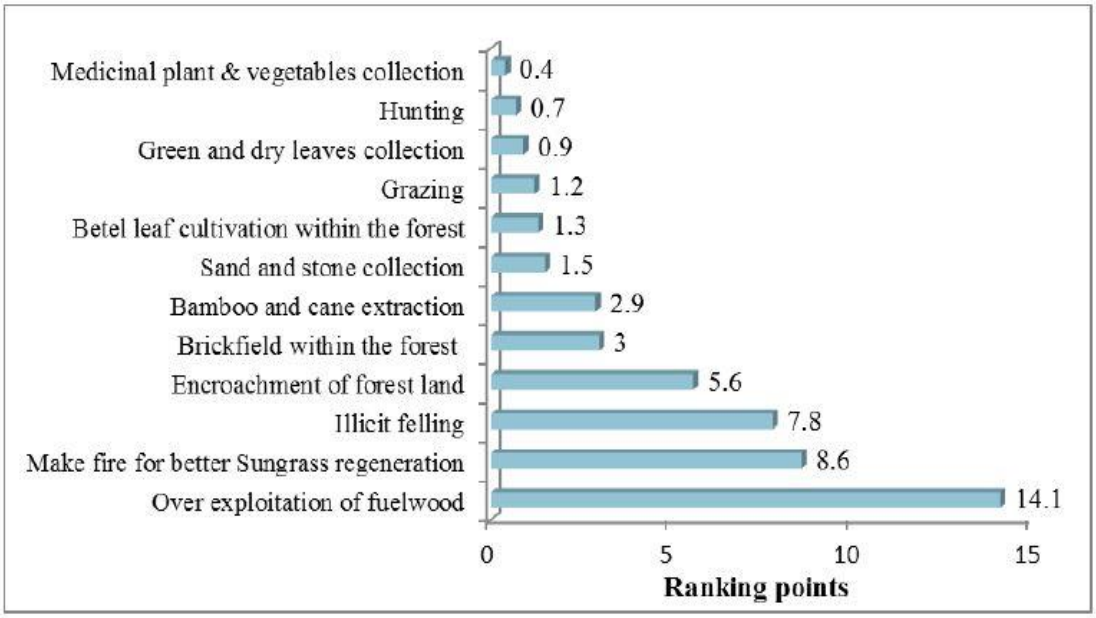

Figure 4: Main causes of forest destruction by Rohingya refugees.

[Source: Haque et al. 2012]

3.3 Land Use Land Cover Change

3.3.1 Change of Land Cover

Land cover maps are classified into three major land cover classes- including forest (green), refugee camp (fuchsia), and non-forest (gray), at two time-steps representing pre-influx: (A) December 2016 and post-influx: (B) December 2017. The pre-influx map (A) shows two refugee settlement camps; however, in the post-influx land cover map (B), many additional, spontaneous camps are visible with forested land replaced by continuous expansion of refugee settlements in the following map.

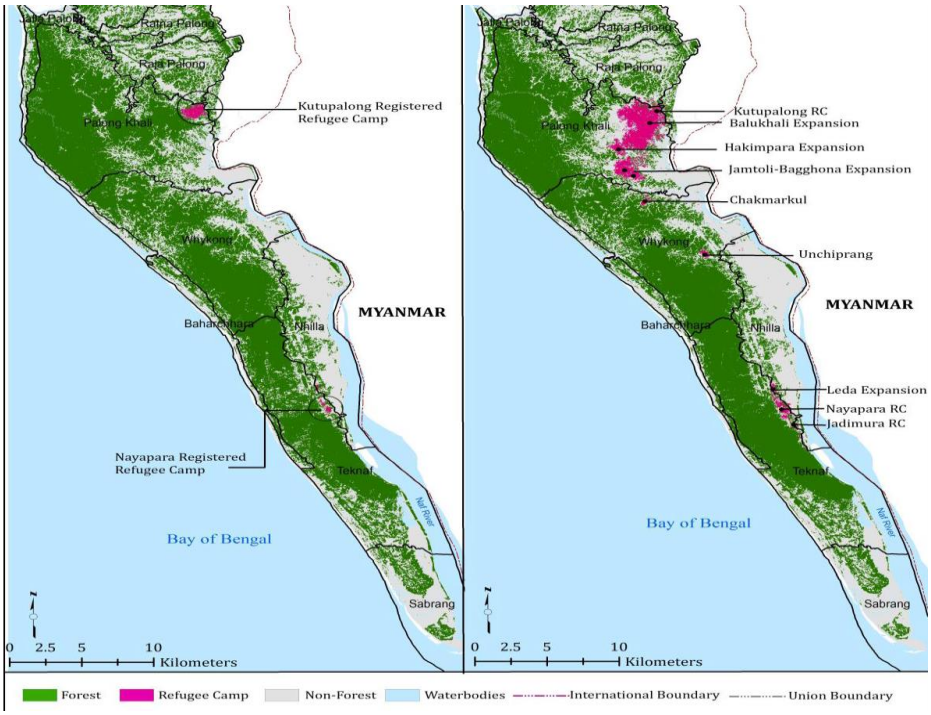

Figure 5: Land cover maps of refugee camp area.

[Source: Remote Sens. 2018]

3.3.2 Change Detection through Imagery

False color composite images of the three camp sites between pre- and post-August of 2017 were illustrated. The columns represent the three different camps (i.e., camps A, B and C) while the rows represent the two-time steps. The first row of images was taken in December 2017, presenting the post-August refugee influx: (A1) Kutupalong–Balukhali camps; (B1) Unchiprang camp; and (C1) Nayapara–Leda camp area. The second row of images (A2, B2 and C2) are from December 2016 showing the same camps and surrounding areas as the A1, B1 and C1 images, respectively, prior to the mass influx of Rohingya refugees in August of 2017. The yellow polygons drawn on the images highlight gray spectral reflectance representing the three refugee camp sites, and show a large-scale physical expansion in the first row of images (December 2017) compared to the second row of images (December 2016). In these false color composite images, red depicts forestland; dark blue indicates water, and brown represents soil/non-forest.

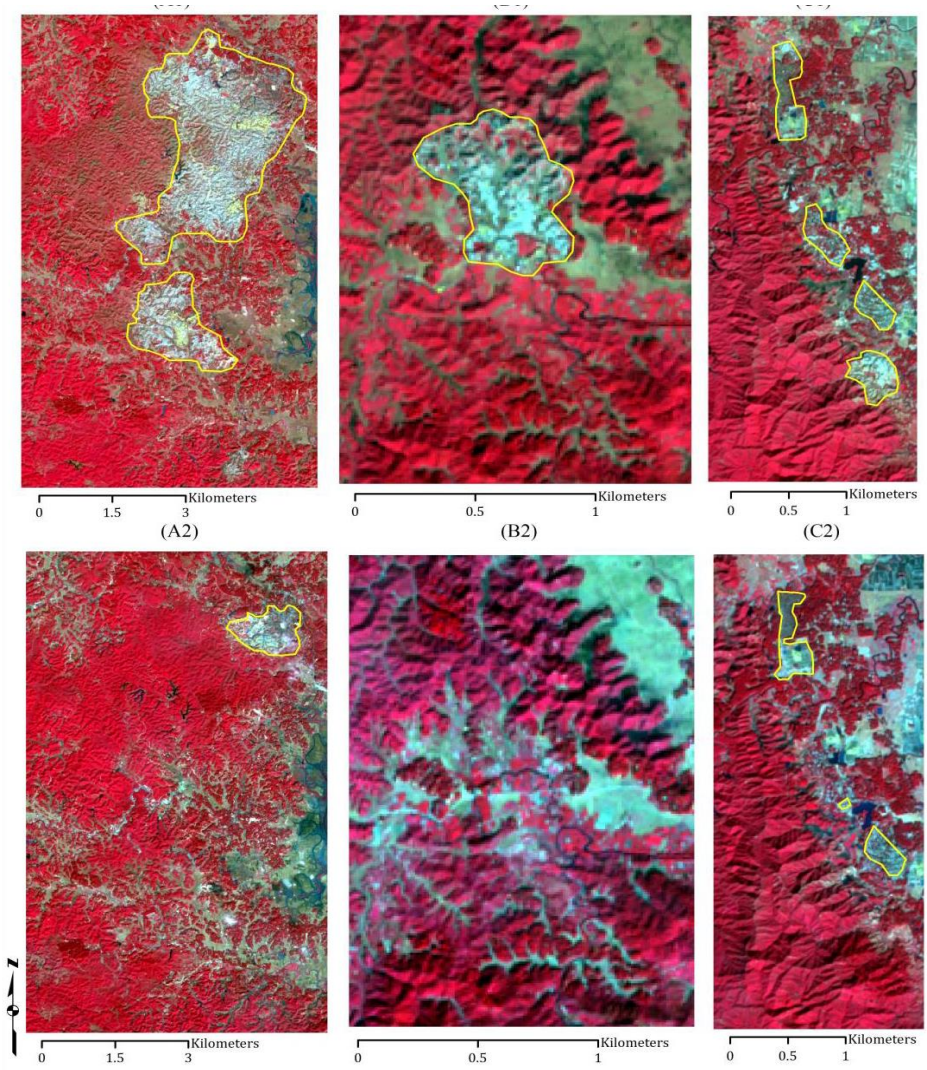

Figure 6: False color composite images of the three major camp area.

[Source: Hasan et al., 2018]

3.3.3 Forest Cover Change

The time series land cover maps generated in this study suggest that there were approximately 146 hectares of land occupied by refugee camps in December 2016. Pre-existing sites. As a result, land occupied by settlements expanded very rapidly across the Kutupalong refugee camps, increasing from 146 hectares to 1365 hectares between December 2016 and December 2017, with a total growth rate of 835 percent. The forest cover within the 10 km buffer created around the center of the preexisting refugee camps in Kutupalong shows a downward trend, from 11,800

hectares to 9740 hectares (total forest loss 2060 hectares) with a net decline rate of 18%. The forest loss during this short time period is driven mainly by the ever-increasing spatial expansion of the refugee camps and associated anthropogenic activities, such as cutting down forest for timber, fuel wood and other subsistence needs. As a result, non-forest related activities have shown an increase with a net gain of 842 hectares around the Kutupalong camps.

Table 7. Area (in ha) and spatial changes in land cover classes and overall net gain and losses between 2016 and 2017 in three study sites: Kutupalong–Balukhali, Unchiprang, and Nayapara–Leda

Kutupalong-Balukhali	2016 (ha)	2017 (ha)	Net Change by Class (ha)	Growth/Decline Rates (%)	Net Change in Three Camp Areas between 2016–2017
Camp	146	1365	1219	835	Camp Area: +1356 ha Forest: -2283 ha Non-forest: +928 ha
Forest	11,800	9740	-2060	-18	
Non forest	7550	8392	842	11	
Unchiprang					
Camp	0	32	32	32	
Forest	1499	1452	-47	-3	
Non Forest	949	964	15	1.5	
Nayapara–Leda					
Camp	29	133	105	359	
Forest	2860	2684	-176	-6	
Non forest	925	996	71	8	

[Source: Khan et al., 2012]

3.3.4 Quantification Using NDVI

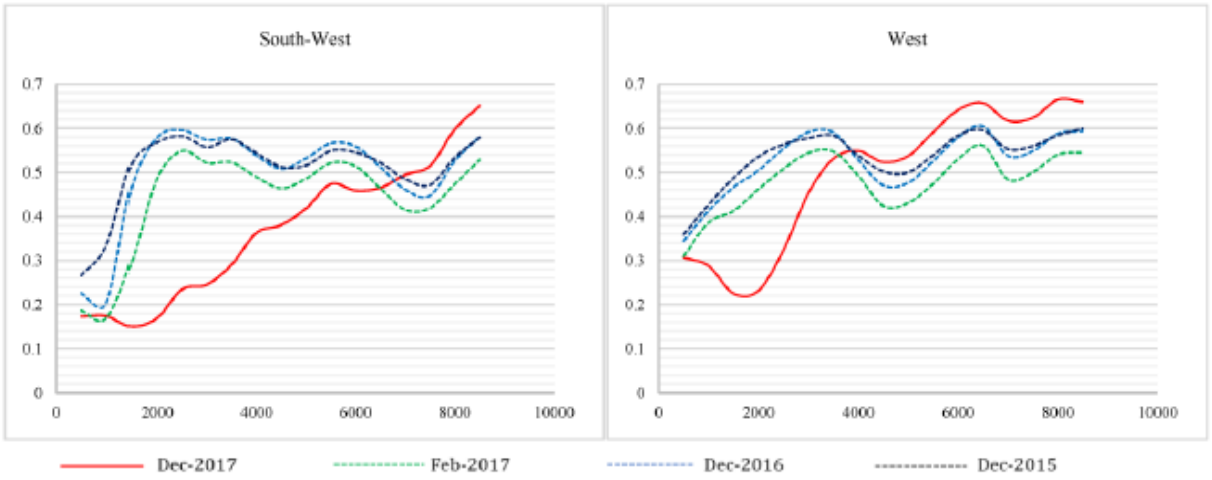

Figure 7: NDVI of two most affected directions i.e. Southwest and West.

[Source: Hasan et al., 2018]

It shows the vegetative condition of Southwest and West region ranging in the 10 km buffer around Kutupalong and surrounding refugee camp area from 2015 to 2017. The Y-axis represents NDVI ranging between +1 and -1. The X-axis represents the distance of each buffer. Higher NDVI values indicate healthy, green vegetation while lower values correspond with stressed, depleted vegetation or barren land. The above graph indicates that vegetation greenness/health was persistent in the pre-influx period (i.e., pre-august 2017); however, vegetation health and biomass declined significantly in the post-influx period in the two most affected directions of Southwest and West of the Kutupalong–Balukhali camps.

3.3.5 Refugee Camp Expansion and Forest Cover Change

This vast camp expansion associated with large scale forest cover decline took place mainly in the south, west and southwest directions extending from the preexisting refugee camps in Kutupalong. For example, in the southerly direction from Kutupalong, refugee camp expansion totaled 324 hectares, and in the west and southwest camps expanded 184 and 605 hectares, respectively. Meanwhile, forest cover in this three-direction radius declined by 202, 364, and 940 hectares respectively. Additionally, forest to camp and non-forest to camp conversion rate was

763 and 536 hectares, respectively. The highest forest conversion again took place in a southwest direction from the camps; the forest to camp and forest to non-forest conversion rates were 471 and 629 hectares respectively. Hence, major camp expansion and loss of forest resources surrounding the Kutupalong camp occurred mainly in a southwesterly direction, accounting for 605 hectares of refugee camps with 940 hectares forest degradation between December 2016 and December 2017. This results in 8 km toward the south-southwest from the preexisting refugee camps in Kutupalong, reaching Thangkhali and further south-southwest to Hakimpara, Jamtoli, and Bagghona camps.

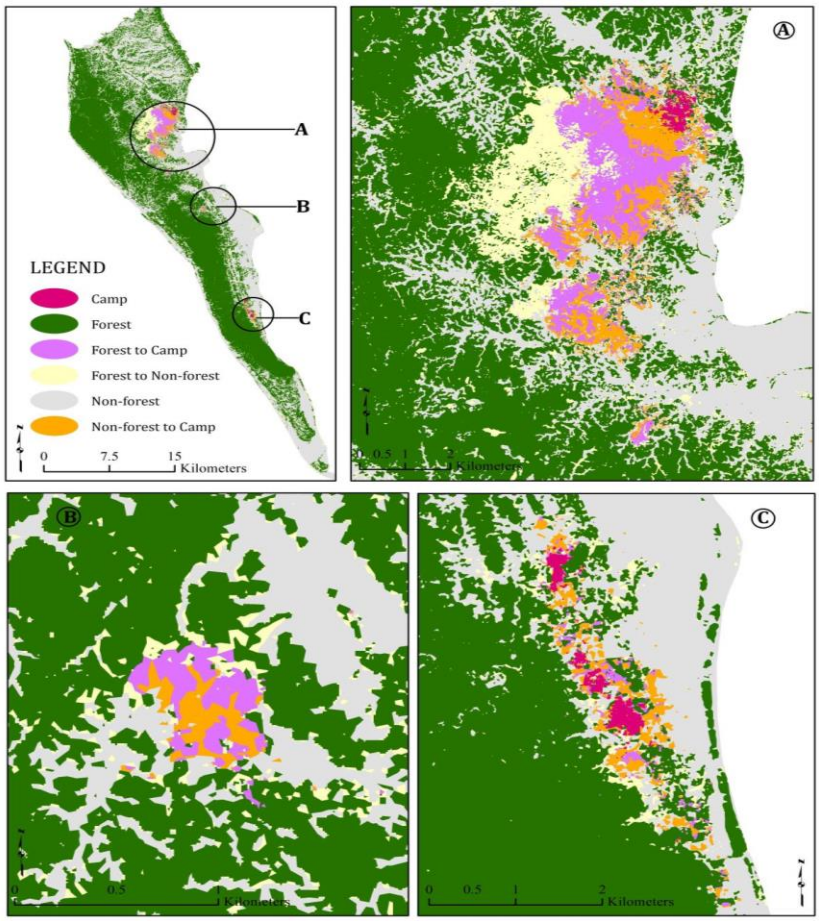

Figure 8: Land cover class conversion map showing depicting land cover conversion and non-conversion at three refugee camp sites: (**A**) Kutupalong–Balukhali, (**B**) Unchiprang, and (**C**) Nayapara–Leda expansion sites.

[Source: Hasan et al., 2018]

3.3.6 Overall Impacts on Forest Resources

The way of livelihoods of Rohingya refugees on forest have several impacts on Teknaf wild sanctuaries. The Teknaf region had almost 100% forest cover in 1980 while, by 1990 it had dropped to 55%. Current data states that only 8% natural forest remaining in the reserve. Formerly, this area supported the highest biodiversity in the country including 290 plant species, 55 species of mammals, 286 species of birds, 56 species of reptiles, 13 species of amphibians, and 8 primates among 10 living in the country (NSP,2006). But now, their number is seriously decreasing.

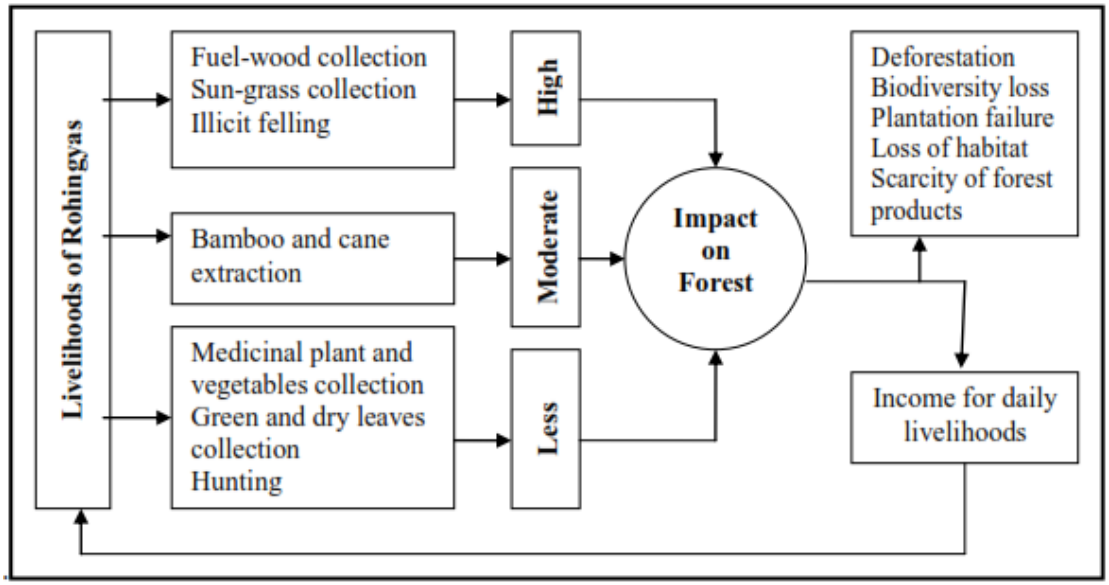

Figure 9: Schematic diagram of Rohingyas' livelihood activities and impacts on forest.

[Source: Khan et al., 2012]

3.4 Future of Rohingya Return

A study on randomly selected 21,800 Rohinya people in two camps of Teknaf shows that as high as 38% expressed intention to return though they knew that the conditions of the Rakhaine state had not improved (Tran, 2017). A UNHCR survey figured that less than 30% of the Rohingya desired to repatriate. However, the Bangladesh government has corresponded by insisting that all the Rohingya refugee should return (Lambrecht, 2018).

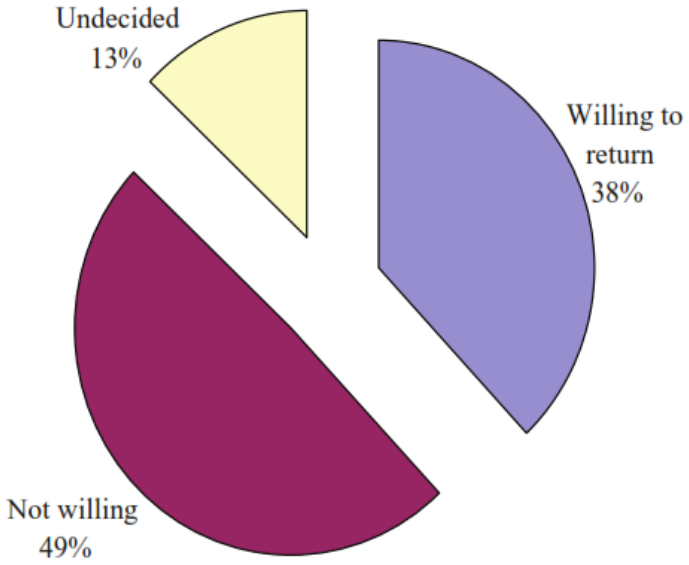

Figure 10: Percent of the Rohimgya refugees who want to go back.

[Source: UNHCR Survey Data 2018]

Chapter IV

Conclusion

An unexpected influx of Rohingya refugees into southeastern Bangladesh is throwing the ecologically fragile region on the edge of an environmental disaster. The continuously increasing population also impacts the local resources and the ecosystem. Forest resources are linked to many other issues, such as biodiversity conservation, climate change adaptation and mitigation, as well as coastal resilience. As many as seven reserve forests, totaling about 5650 acres, have been damaged from the erection of makeshift shelters, burning of firewood, and anthropogenic activities relating to subsistence needs of the refugees. As a result, lands that were formerly vegetated and forested are now converted to refugee camps as populations urgently seek shelter and safety in an area unequipped and unprepared to deal with the crisis.

Based on remote sensing data and a nonparametric land cover classification technique such as Random Forest, land cover change and forest cover degradation resulting from Rohingya refugee settlement expansion between pre-august and post-august influxes of August 2017 are estimated. Such degradation of these critical ecological resources might trigger multiplicative impacts on the environment, biodiversity, wildlife habitat and overall socio economic health of the entire region. If no measures are taken now or in the near future to protect the vegetation cover, forests, and overall local environment, there will be long-term and irreparable damage that may cause larger problems for the country as well.

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