Journal of Wildlife and Biodiversity 3(3): 10-21 (2019)

(http://jwb.araku.ac.ir/)

DOI: 10.22120/jwb.2019.104762.1057

Research Article

Rohingya refugee crisis and human vs. elephant (*Elephas maximus*) conflicts in Cox's Bazar district of Bangladesh

Md. Habibur Rahman

Laboratory of Tropical Forest Resources and Environments, Division of Forest and Biomaterials Science, Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan

email: habibmdr@gmail.com

Received: 5 March 2019 / Revised: 11 April 2019 / Accepted: 23 April 2019 / Published online: 14 May 2019. Ministry of Sciences, Research and Technology, Arak University, Iran.

Abstract

About 930,000 Rohingya people were migrated in the Cox's Bazar district of Bangladesh following the ethnic cleansing violence in the Rakhine State of Myanmar. They built their camps by clearing the natural forests and social forestry plantations which was one of the important natural habitat and corridor of critically endangered wild Asian elephant (*Elephas maximus*) in Bangladesh. The Rohingya people extensively collected timber and fuelwood for construction and cooking from the forests and destroyed nearly 2,000 hectares of forest land. As a result, in search of food and route for natural movement, *E. maximus* entered into the camps, destroyed the settlements and a severe human-elephant conflicts arose resulted in 13 refugees were killed and nearly 50 people were injured. Studies revealed that there are 48 *E. maximus* is roaming around the camps, and all most all the incidents occurred during the dawn time where male and children were the main victims. Government, aid agencies and NGOs are operating in the field to take on the state of affairs. They commenced to enhance consciousness, setting up 56 watchtowers and 30 volunteer elephant response teams to warn residents when elephants enter the camp. Reduction in demand of fuelwood through supplementing the alternative fuel, reforestation with native and fruit-bearing tree species, agroforestry practices, plantation of elephant preferred fodder species, ensure safe trans-boundary corridors, and non-forestry income-generating activities can reduce and mitigate the Rohingya and. *E. maximus* conflicts.

Keywords: *Elephas maximus*, habitat loss, human-elephant conflicts, Rohingya refugee.

Introduction

Globally, there are about 35,000-40,000 wild Asian Elephants (*Elephas maximus*, family Elephantidae) and about 20% of the world's human population lives in or close to the home range of the species. Bangladesh has about 268 (ranges from 210 to 330) resident wild elephants, 93 (range from 79 to 107) migratory and 96 captive elephants (IUCN 2016). Motaleb *et al.* (2016) provided a details distribution of wild Asian elephants in Bangladesh and found *E. maximus* are limited to the forests of southeast, central-north and northeast regions. Resident wild elephants are roaming in the evergreen forests of Chattogram, Chittagong Hill Tracts and Cox's Bazar areas of southeast Bangladesh. Transboundary elephants inhabiting in the international borders with India (northeast and central-northern) and Myanmar (southeast). Locally critically endangered' and globally endangered *E. maximus* is a flagship species of these tropical forests (Khan 2015). The country has 12 elephant corridors and 57 trans-boundary elephant crossing points with India and Myanmar among which 39 are natural, 11 abandoned and seven sites are vagrant crossing points through which elephants pass regularly (IUCN 2016).

Choudhury (2007) reported that more than 500 elephants were in the forests of Bangladesh

even during the middle of the last century, however reducing at an alarming pace due to the scarcity of food, habitat destruction and degradation through deforestation and forest degradation, poaching for meat and tusks, elephant route and corridor fragmentation, land use change due to increasing human population, cultivation (agriculture and slash and burn shifting cultivation) and unplanned development activities, monoculture exotic species plantation, and human vs. elephant conflicts due to people's dependency on forest ecosystem services (Islam *et al.* 2011, Motaleb *et al.* 2016).

As elephants always follow their fixed routes and corridors during movement, Motaleb *et al.* (2016) identified that human settlements, roads and highways, crops, construction of infrastructures within or near the elephant movement routes and corridors can largely affected their mobility. Here, a severe human vs. elephant conflicts arise when people protect their assets, resulted in elephant injuries and deaths, human injuries and casualties, damages to assets. Between 2003 to 2016, a total of 227 people and 63 elephants was killed in the conflicts; while 24 people and four elephants were killed in 2016 alone (IUCN Bangladesh 2016).To reduce the number of human vs. elephant conflict occurrences in the central-north and south-east conflict-prone areas of Bangladesh, Bangladesh Forest Department (BFD) and IUCN (International Union for Conservation of Nature) has been engaged the local communities in the protection and conservation of wild *E. maximus*. They have formalised 'Elephant Response Team (ERT)' and introduced a range of conflict management techniques including cultivation of non-preferred crops of farmers, salt lick establishment, bio-fencing by rattan plant, plantation of elephant fodder and shade tree species, solar electric fencing, chilli rope, watchtower, and setting up trip alarms as early warning system, etc. at the grass roots level (Wahed *et al.* 2016). These measures have demonstrated improvement in human-elephant conflict mitigation in the selected regions of Bangladesh.

Since the 1990s, the Rohingya (a Muslim minority ethnic groups in Myanmar) have continued to flee from the Rakhine State across the border, largely to the Ukhia and Teknaf sub-districts of Cox's Bazar district in Bangladesh. At the latest, since 25 August 2017, Bangladesh hosts about 930,000 forcibly displaced Rohingya people following the ethnic cleansing violence in the Rakhine State, has resulted in a critical humanitarian emergency. These consist of nearly 700,000 new arrivals in addition to more than 240,000 Rohingya refugees already living in the area from early 1970s and 1990s (Inter Sector Coordination Group 2018a,b). They have been staying in very congested condition at 33 camps and host communities (Fig. 1) (Human Rights Watch 2018).

Furthermore, the hilly forested 'Kutupalong-Balukhali Expansion Camp' is now concerned to as the world's largest refugee camp living more than 630,000 refugees (Fig. 1). It is well known for the important habitat corridor of *E. maximus*. It is also used as a migration route of *E. maximus* between Myanmar and in search of food and shelter. The Rohingya people encroached the land and cleared forest trees for settlements which resulted in negative effects (e.g., deforestation, landslides, scarcity of fodder trees) on the critical natural habitat and natural movement of *E. maximus* and other wildlife too (Joint Response Plan (JRP) 2018, Human Rights Watch 2018). As the concept of "human vs. wildlife conflict" is the central to conservation work, therefore, the present study assessed the causes, consequences and mitigation measures of human vs. *E. Maximus* conflicts in the Rohingya refugee camps of Cox's Bazar district of southeastern Bangladesh

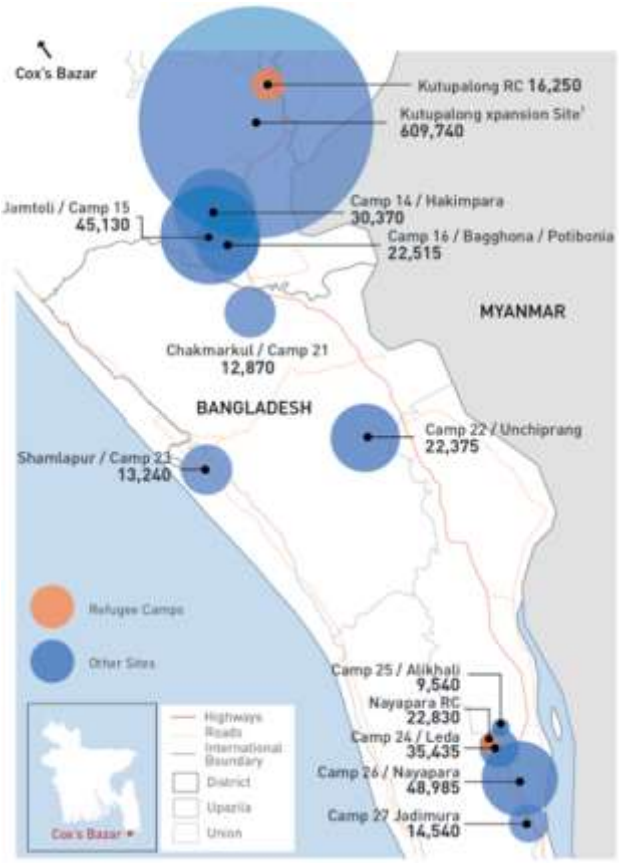

Figure 1. Location of Rohingya refugee camps with the number of refugees in Cox's Bazar district (Inter Sector Coordination Group 2018b)

Material and methods

Cox's Bazar district is placed in the ecologically critical area and fragile ecosystem of Bangladesh, situated alongside the beach of the Bay of Bengal, having world largest unbroken 120 km golden sand beach. The region is rich in biodiversity with numerous environmental assets, scenic beauty and various tourist attractions. The main land uses of the region were small-scale agricultural crop production, betel nut/leaf cultivation, homestead agroforestry, aquaculture and salt farming, shrimp hatcheries, fishing and dry fish processing. Deforestation and forest degradation have taken place concurrently as forest resource extraction has become a secondary occupation (UNDP Bangladesh and UN WOMEN Bangladesh 2018).

This perspective study is based on secondary information gathered from the desk review of available published information regarding Rohingya refugee crisis and human vs. *E. Maximus* conflicts. Rohingya influx maps, scientific articles, reports of government and non-governmental organizations (NGOs), and reports published in the national and international dailies about the social, humanitarian and environmental impact of the Rohingya refugee influx in Bangladesh were collected, summarised and analysed for the study. BFD staffs, on-going project staffs, researchers, journalists, and aid agencies staffs were also interviewed over phone to collect data. As the study focus only the impact of Rohingya refugee crisis on forest resources and human vs. *E. maximus* conflicts so the other important issues like fresh water, soil and terrain, solid waste management, marine and fresh water resources, safety and security, and gender and health issues were not covered under the study. In addition, open access image of the present situation of the Rohingya's life and livelihoods were collected from internet searching.

Results

Historically, Rohingya camps are located adjacent to the three forest protected areas, including the Teknaf Wildlife Sanctuary, Himchari National Park, Inani National Park as well as three ecologically critical areas namely Teknaf Peninsula, St Martin's Island, and Sonadia Island. Rohingya influx pressure has led to deforestation and forest degradation by large-scale conversion of natural forest to settlements and agricultural land which has a significant impact on landscape diversity, vegetation abundance and species diversity. An estimation of the USAID's CREL (Climate Resilient Ecosystem and Livelihoods) project assessed that the refugee camps have already encroached over 800 ha of forest protected areas and another 2,500 ha of forest land are being planned to accommodate the influx of Rohingya in additional camps (personal communication).

Imtiaz (2018) has carried out a remote sensing analysis of vegetation cover change in the Rohingya refugee camp areas and found a drastic change in vegetation cover only after

four months. Total vegetation cover decreased by 1,284.48 ha and 102.87 ha respectively. Similarly, Hassan *et al.* (2018) showed a significant expansion of refugee settlements from 175 to 1,530 ha between 2016 and 2017, and the net growth rate was 774% for that time. Individually Kutupalong-Balukhali Expansion Camp was grown from 146 ha to 1,365 ha with a growth rate of 835% in the same time period. In case of deforestation, a total of 2,283 ha of forest land has been replaced by settlements. Furthermore, BFD has submitted an account of over BDT 1.5 billion (BDT means Bangladeshi Taka, the currency. USD 1= BDT 84.44, as of 10 April, 2019) loss due to deforestation and forest degradation done by the Rohingya refugees (Hussain 2017). But the overall environmental damage would be longer and bigger than expected.

UNDP Bangladesh and UN WOMEN Bangladesh (2018) assessed that a total of 1,740 ha of hills and forests were cleared to make shelters and other facilities also for fuelwood collection. About 1,502 ha of forest lands have been taken over by the Rohingya makeshift settlements, among 793 ha of natural forest land and 709 ha of plantation land. Moreover, around 1,200-1,600 ha of hilly land in the Teknaf-Ukhia-Himchari watershed area have been cleared. In case of impact of the forest, only Ukhia forest range has been affected by 1,427 ha forest land, and in the Teknaf forest range the influx has impacted on the plantations in the buffer zone and core zone of the Teknaf Wildlife Sanctuary. The Table 1 shows that approximately 50% of forest land lies in the 5 km buffer and 95% of forest land is in the 10 km buffer of Rohingya refugee camps. That means all forest land remaining in the area of interest will be cleared if the impact covers all of the 10 km buffer.

Rohingya refugee impacts on forests

Rohingya's illegally collected and uses fuelwood, bamboo and timber for cooking and building their shelters. This has resulted in indiscriminate deforestation, forest degradation and serious wildlife habitat destruction. Forest resource collection have already been a significant impact on natural forests and social forestry plantations. More than 1,500 local social forestry participants have lost their sharing trees due to cut trees from the social forestry plantations. It was estimated that nearly 68,00,000 kg of fuelwood was collected each month and each of the Rohingya families used on an average 60 culms of bamboo to made their shelters (UNDP Bangladesh and UN WOMEN Bangladesh 2018).

Aid agencies reported that the current local market supply of fuelwood has not met the increased demand of Rohingya. About 65% of refugees collected fuelwood from nearby forests, 33% purchasing from local markets, and only 2% received fuelwood as aid (International Organization for Migration 2017b; World Food Programme 2018). The Table 2 presents the estimated size of the three forest protected areas potentially impacted by the fuelwood collection by the Rohingya refugees.

Local BFD staffs reported that the following tree species have been declining day-by-day due to massive deforestation and forest degradation occurred in the camp sites: *Acacia auriculiformis, Acanthus ilicifolius, Albizia* spp., *Alstonia scholaris, Ammora wallici, Anisoptera glabra, Arthocarpus chaplasha, Dipterocarpus* spp., *Eugenia* spp., *Gmelina arborea, Hopea odorata, Lagerstroemia speciose, Mangifera sylvatica, Phyllanthus emblica, Tetrameles midiflora, Terminalia bellirica, Terminalia chebula,* and others.

Table 1. Impacts on forest land in the area of interest of Rohingya refugee camps

Forest land cover	Baseline area (ha)	Impacted part (%) of baseline area		
		Camps' footprint	Footprint of 5 km buffer	Footprint of 10 km buffer
Plantation	1,469.00	7	54	93
Shrub dominated area	548.00	1	52	94
Shrub dominated forest	21,438.00	3	58	97
Hill forest	4,662.00	0	35	94

Note: Buffer of 10 km includes buffer of 5 km. Both buffers exclude camps' footprint;
Source: UNDP Bangladesh and UN WOMEN Bangladesh (2018)

Table 2. Available fuelwood demand in the area of interest of Rohingya refugee camps

Name of protected area	Baseline area (ha)	Projected 5 km (ha)	% to baseline area	Projected 10 km (ha)	% to baseline area
Teknaf Wildlife Sanctuary	11,615	6375	55	11615	100
Himchari National Park	1,729	0	0	0	0
Inani National Park	7,770	1862	24	7264	93

Source: UNDP Bangladesh and UN WOMEN Bangladesh (2018)

Removal of dry litter has no immediate effect upon the forest, but in the long run it lowers the quality of the site and ultimately leads to a decrease in tree growth and makes the site quality poor in nutrients. Besides, deforestation and forest degradation exacerbate the risk of landslides and flooding which was already happening during the monsoon season. Moreover, a new access road to the Rohingya camps to Teknaf highway is under construction and this will facilitate access to the forest and their resources (UNDP Bangladesh and UN WOMEN Bangladesh 2018).

Rohingya refugee camps and impacts on the species habitat

IUCN and UNHCR (United Nations High Commissioner for Refugees) conducted a survey in 2018 on the presence of elephants around Kutupalong-Balukhali Expansion Camp in Cox's Bazar, based on elephant signs e.g., footprints and dung piles. See details IUCN Bangladesh (2018) for tracks/travelling routes of the elephant survey around Kutupalong-Balukhali Expansion Camp in Cox's Bazar. The study demonstrates that the refugee camp lies within an active corridor for *E. maximus*. The survey recorded 160 elephant dung piles and 630 elephant foot-print points of different ages around the camp area and was mapped. By using dung piles method, the estimated mean elephant number was found 38 (range 31 to 45) and suggested 56 spots to install watchtowers and formation of 25 ERTs to guard the camp (IUCN Bangladesh 2018). The Table 3 shows the number of *E. maximus* in 2015 and 2018 four Forest Ranges surrounding the Kutupalong-Balukhali Expansion Camp area of Cox's Bazar district. The table shows a higher number of *E. maximus* in 2015 to 2018 might be due to an increase in elephant population by birth or due to entrapment of elephants on the western side of Kutupalong-Balukhali Expansion Camp because of the camp's expansion since August 2017 on the elephant corridor (IUCN Bangladesh 2016, 2018).

Table 3. Status of *E. maximus* in four Forest Ranges of Cox's Bazar South Forest Division

Forest Range	Area (sq km)	Elephant number in 2015		Elephant number in 2018		Change of mean
		Range	Mean	Range	Mean	
Inani	65.80	10-14	12	16-21	18	+6
Teknaf Sadar	47.50	6-8	7	8-12	10	+3
Shilkhali	29.42	5-7	6	5-8	7	+1
Whykhong	50.97	2-5	3	2-4	3	0
Total	266.45	-	28	-	38	+10

Source: IUCN Bangladesh (2016, 2018)

Threats of Rohingya Refugee Crisis in Cox's Bazar District

Rohingya refugee camps and human vs. Elephas maximus conflicts

The three pre-existing Rohingya settlements and the new camps were all on forest land in the Cox's Bazar South Forest Division. The camps and settlements were encroached on E. maximus territory, which posed a risk for people and for the elephants. Rohingya's already cut trees from more than 600 ha of social forestry land, which has long been a major source of tension between BFD, host communities and the refugees (Joint Response Plan (JRP) 2018).

Wild E. Maximus is currently existing under the perpetual threat of habitat destruction, loss of corridors and routes, and are pressured to live in the smaller habitats compare to their old home range. Deforestation also caused a shortage of elephant's daily and seasonal food (tree parts, grasses, herbs and shrubs) which put negative impact on their round the year and on their migration diet. Except E. maximus, the makeshift camps have a significant impact on other wildlife's (such as deer, wild boar, monkeys, birds, squirrels, red jungle fowl and different types of snakes) food shortages, shrinking habitats, and disruptions in breeding grounds.

Aid agencies reported that fuelwood collection was unsafe for refugees particularly for the girl and female in terms of physical attack by the wild E. Maximus while collecting fuelwood from the forest (International Organization for Migration 2017b; World Food Programme 2018). Therefore, restrictions on elephants' free movement, the scarcity of their food and new settlements in their habitats by refugees fuelled the human-elephant conflicts in the camp area, leading to deaths on both sides. The Fig. 2 shows a distinct image of deforestation and forest degradation done by the Rohingya refugees.

There are five elephant corridors are located in Cox's Bazar North Forest Division and three in Cox's Bazar South Forest Division that elephants have used for centuries. There are around 48 elephants during monsoon and 78 during the dry season in the area and they move between Bangladesh and Myanmar in search of food (IUCN Bangladesh 2018) however, elephant feeding areas are crowded with makeshift settlements. New settlements destroy the wild elephant's habitat which not merely posing a big threat to the wild elephant's survival but also to human security. Since September 2017, human-elephant conflicts have happened on the edge of the refugee camps in the elephant corridors of Ukhia, causing 13 human deaths, another 50 people have been injured and lost the little property they had. Table 4 shows the synopsis of Rohingya refugees killed and injured by wild elephants. All most all the incidents occurred during the dawn time between 3 to 5 am when refugees were in sleep and male and children were the utmost victims. Sukumar (2006) also found that an elephant usually comes to the settlements between dusk and dawn. Due to frequent elephant attacked, many kids have become scared of elephants and other animals and no longer seek out places of education or therapy. Fears of being trampled by an elephant can become intolerable for the children.

Figure 2. Clockwise: (i) Rohingya refugees taken initial shelter in a forest, (ii) temporary settlement in a forest, (iii) man and women cut trees for new settlement, (iv) permanent settlement by destroying forest, (v) refugees collect tree logs from forest, (vi) stack of fuelwood collected from forest for sale within the camps

Table 4. A synopsis of Rohingya refugees killed and injured by wild elephants

Date (2017-2018)	Number of killed refugee				Number of injured refugee
	Time	Male	Female	Child	
September 18	5 am	1 (55)	-	1 (2)	-
October 14	1 am	-	1 (30)	3 (0.6, 6, 9)	6
January 9	3 am	1 (45)	-	-	-
January 19	4 am	1 (45)	-	-	5
January 21	-	-	-	1 (10)	2
February 22	5-6 am	1 (28, 30)	-	1 (0.7)	30
May 9	-	-	-	1 (12)	1
Total		5	1	7	44

Long term threats

E. maximus in the refugee camps have already made some extensive damage to the camps and property, while killed and injured people in encounters. As a result, refugees were unable to lead normal lives because of the elephants around them, which can be called "hidden dimensions of conflict" (Thekaekara 2017). Agencies reported that in the near future, some camps (e.g. camps 3, 17 and 19) area would be extended, which will increase the more probability of human vs. *E. maximus* conflict in the new camps. So, it is now highly recommended to study the current *E. maximus* movement patterns and necessary care and mitigation measures before taking a final decision to expand the mentioned camp sites.

Sukumar (2006) suggested that an elephant usually comes to the settlements are strongly seasonal, corresponding with crop harvesting periods. Paddy harvest season and monsoon will be brought *E. maximus* from the forest closer to Rohingya settlements in search of food. Under this circumstance, when refugees will started small-scale agriculture surrounding their camp area, can lose their entire crops overnight from an elephant's raid.

Refugees collected extensive forest resources from forest protected areas, which are the most important *E. maximus* habitat of the country and flagship species of these forests. Thus, if resource destruction level and human-elephant conflicts remain constant for the long-term the whole forest ecosystem will be collapsed. Due to highly diverse food habit, *E. maximus* are acting as a seed dispersal agent in the forest ecosystem, can disperse a large variety of plant species at a given site, which ultimately shape the structure, composition, and function of forest ecosystems (Campos-Arceiz and Blake 2011). Moreover, the large amounts of dung generated help nutrient cycling in the forest ecosystem and also facilitate the dispersal of seeds (Sukumar 2006). Therefore, reducing the number and the loss of *E. maximus* will have long-term negative consequences of the distribution of plant species and whole forest ecosystem in Cox's Bazar.

Joint Response Plan (JRP) (2018) assessed that the collection of fuelwood from the natural forest within a five km perimeter around the camps will sustain supply for four months, but the 14,000 ha of forest land will be degraded. If fuelwood will be collected from plantations, the supply may last for an additional 11 months. Furthermore, collection of fuelwood within the 10 km boundary will sustain supply for a year, but the remaining 26,000 ha of forest would be degraded. If fuelwood will be collected from plantations, the supply may last for an additional 31 months.

Management implications

In responding to the crisis of the Rohingya refugee fleeing into Cox's Bazar, 127 international, national and local NGOs (13 local, 45 national and 69 international) are working in partnerships to supporting the government. A total of 12 United Nations agencies and the International Red Cross and Red Crescent Movement are also supporting response activities. Civil societies, including faith-based organisations and various government-to-government supported programmes also working there to tackle the situation (Joint Response Plan (JRP) 2018).

UNHCR and IUCN were implemented a new plan to foster 'safe co-existence' between animals and sprawling refugee settlements. The plan includes trainers who can teach the refugees how to respond when an elephant approaches, including by deterring it from entering the camp. The curriculum began to enhance consciousness, putting up 56 watchtowers and 30 volunteer ERTs to warn residents when elephants go into the camp. As part of the initiative, people were made aware of what they should act if they come across an elephant (McVeigh and Peri 2018). Part of awareness raising, part pantomime, the scenario uses life-size puppets of elephants made from bamboo and old clothing and expertly propelled by volunteers (Aidan and Redwan 2018) (Fig. 3).

Figure 3. Rohingya refugees at the Kutupalong-Balukhali Expansion Camp are trained in how to deal with an elephant encounter (top); Elephant Response Team members are attending lecture session of training (down-right); an elephant watchtower beside the camp (down-left) (sources: open access images from internet searching)

McVeigh and Peri (2018) suggested that elephants respond to emotions like if victim stressed, they get strained and people can respond with firecrackers or throwing stones. The ERTs tried to forge a human shield and peacefully lead the elephants back to the forest but when there is a population of about one million, it is a big task. However, concerned stakeholders have recommended that Bangladesh and Myanmar both countries needed to create safe passages and sanctuaries for wild *E. maximus*.

Conflict mitigation measures

To mitigate the human vs. *E. maximus* conflict in the Rohingya refugee camp areas, first and foremost job is to be reduction in demand of fuelwood for cooking and supplementing the alternative fuel. Some NGOs already took a programme called "Clean Cooking Programme" and supplied fuel-efficient stove and charcoal only to the 100,000 families, biogas and LPG (Liquefied Petroleum Gas) to another 10,000 families. This programme estimated that it will save over 1,200 ha of forest land per year, and reduce CO_2 emissions by more than 500,000 tonnes in a year.

BFD and NGOs can reforest the deforested camp areas with fuelwood and fruit-bearing tree species to meet the demand of fuelwood also for the seasonal fruits for both human and *E. maximus.* The following tree species can be chosen for reforestation: *Albizia* spp., *Erythrina indica, Bambusa* spp., *Bombax ceiba, Areca catechu, Cocos nucifera, Artocarpus heterophyllus, A. chaplasha, Mangifera indica, Musa* spp., *Ficus* spp., *Psidium guajava, Syzygium* spp., *Streblus asper, Aegle marmelos, Dillenia indica, Elaeocarpus floribundus, Zizyphus mauratiana,* etc. Moreover,

agroforestry practice could be work here better. Rohingya people can cultivate seasonal short-rotational crops like *Musa* spp., *Carica papaya*, *Zingiber officinale, Curcuma longa, Capsicum annuum* and other seasonal vegetables, *Citrus grandis* and *C. limon* throughout the year. Multiple crops serve as insurance to the refugees as when one crop gets damaged, another provides crops and income. This kind of practice gives a good turnover in terms of yield, reduces the soil erosion, loss of soil nutrients and fertility (Rahman and Alam 2016).

Second important work is to be the reforestation and restoration of degraded natural forests with *E. maximus* preferred fodder species like *Bambusa* spp., *Ficus* spp., *A. heterophyllus, A. chaplasha*; *Dipterocarpus turbinatus*, *Syzygium* spp., *B. ceiba, M. indica, Tectona grandis, C. nucifera, Musa* spp., *Cyperus difformis*, *Imperata cylindrica*, *Cynodon dactylon*, *Thysanolaena maxima*, *C. grandis*, *C. limon*, *Bauhinia vahlii*, *Spatholobus parviflorus*, *Embelica officinalis*, *D. indica, A. catechu, Dalbergia sissoo, Mallotus philippinensis, Lagerstroemia speciosa, Adina cordiafolia, Butea monosperma*. BFD can create more watershed in the forests that *E. maximus* can drink water as when they required.

Bangladesh has 57 trans-boundary elephant crossing points with India and Myanmar; hence Bangladesh-India-Myanmar can sign a formal agreement on trans-boundary for *E. maximus* conservation and management to ensure safe and free movement of wild *E. maximus* across the international borders. Positively, Bangladesh-India already agreed for ensuring the development of wild *E. maximus* habitat and to ensure safe passage for the wild *E. maximus* through a MoU (Memorandum of Understanding).

Enukwa (2017) listed 19 different human-elephant conflict mitigation methods from different country studies. The study concluded that beehive fencing, electrical fencing, habitat manipulation and improvement could be considered the most effective and sustainable measures to mitigate human-elephant conflict, however, many of these methods provide only temporal solutions, and therefore become ineffective and unsustainable. In Cox's Bazar, aid agencies and NGOs can create advanced non-forestry income-generating activities for the refugees with an objective to increase access to sustainable livelihoods and nutrition sensitive life-skills, and enhance agricultural production capacity. Both men and women should be implied in these activities with appropriate training, cash grants and tools that they both can contribute equally in their families. Community-based agroforestry, handicrafts, seasonal vegetables, and livestock rearing with market linkages could be a solution to engage most poor and vulnerable families in these activities.

Finally, the Cox's Bazar district is the topmost priority place for tourism with the world's longest sandy unbroken sea beach (120 km), a beautiful coral 'St. Martin's Island', and the world's longest marine drive (80 km). Both government and private sectors invested a lot of further large-scale development in tourism and infrastructure of this district. Rohingya crisis has already put negative impact on tourism in this area so the government, private sectors and aid agencies can prepare a new long-term framework and tourism development plan engaging Rohingya refugees. Besides local people, Rohingya's can trained on handicrafts and as a tour guide that they can earn sufficient income from tourism. In this way they can be a resource person rather than a burden to the host country Bangladesh.

Conclusion

The present study revealed that the Rohingya refugee crisis and Rohingya vs. *E. maximus* conflicts put significant negative impact on the local environment, life, livelihoods and forests in the Cox's Bazar. *E. maximus* already lost their habitat and food sources as a consequence they were in aggressive mode. Rohingya people also lost several lives and their remaining properties due to frequent elephant attacked in their camps. *E. maximus* has the right to survive in their own territory and Rohingya also has the

humanitarian right to survive in the harsh situation in the same territory. Government, aid agencies and NGOs are attempting to tackle the initial worse condition but it would not be possible to recover the original habitat of *E. maximus* without any immediate and appropriate reforestation, landscape restoration and non-forestry livelihoods programmes. As Cox's Bazar is located in a fragile and sensitive place, thus long-term conflict mitigation measures and plan should consider the safer co-existence of nature-life-livelihoods nexus. Local elephant corridors and international trans-boundary crossing points should be made safer for the movement of the critically endangered E. *maximus.* Finally, the Government of Bangladesh should develop a moral diplomatic relation with the Myanmar Government to return their Rohingya people from Cox's Bazar — the one of the remaining natural habitat and corridor of wild *E. maximus* in Bangladesh.

References

Aidan, J., Redwan, A. 2018. Smiles and slapstick as Rohingya refugees learn to corral elephants. Agence France-Presse (AFP), published on 8 April 2018. Accessed on 12 July 2018.

Campos-Arceiz, A., Steve Blake, S. 2011. Megagardeners of the forest - the role of elephants in seed dispersal. Acta Oecologia 37(6):542-553.

Choudhury, A. 2007. Impact of border fence along India-Bangladesh border on elephant movement. Gajah 26:27-30.

Enukwa E.H. 2017. Human-Elephant conflict mitigation methods: A review of effectiveness and sustainability. Journal of Wildlife and Biodiversity 1(2):69-78.

Hassan, M.M., Smith, A.C., Walker, K., Rahman, M.K., Southworth, J. 2018. Rohingya refugee crisis and forest cover change in Teknaf, Bangladesh. Remote Sensing 10: 689.

Human Rights Watch. 2018. Bangladesh is not my country: The plight of Rohingya refugees from Myanmar. New York, United States of America.

Hussain, A. 2017. Elephants vs humans: The threat to Bangladesh's natural habitats as Rohingya influx continues. DhakaTribune, published on 16 October, 2017. Accessed on 7 July 2018.

Imtiaz, S. 2018. Ecological impact of Rohingya refugees on forest resources: Remote sensing analysis of vegetation cover change in Teknaf Peninsula in Bangladesh. Ecocycles 4(1):16-19.

Inter Sector Coordination Group. 2018a. Situation report data summary: Rohingya refugee crisis, Cox's Bazar. 25 February 2018. Dhaka, Bangladesh.

Inter Sector Coordination Group. 2018b. Situation report data summary: Rohingya refugee crisis, Cox's Bazar. 16 August 2018 (covering 31st July - 13th August). Dhaka, Bangladesh.

International Organization for Migration. 2017a. NPM R6 report: Needs and population monitoring, Cox's Bazar, Bangladesh. October 2017. Dhaka, Bangladesh.

International Organization for Migration. 2017b. NPM R7 report: Needs and population monitoring, Cox's Bazar, Bangladesh. December 2017. Dhaka, Bangladesh.

Islam, M.A., Mohsanin, S., Chowdhury, G.W., Chowdhury, S.U., Aziz, M.A., Uddin, M., Saif, S., Chakma, S., Akter, R., Jahan, I., Azam, I. 2011. Current status of Asian elephants in Bangladesh. Gajah 35:21-24.

IUCN Bangladesh. 2016. Status of Asian elephants in Bangladesh. International Union for Conservation of Nature, Bangladesh Country Office, Dhaka.

IUCN Bangladesh. 2018. Survey report on elephant movement, human-elephant conflict situation, and possible intervention

sites in and around Kutupalong Camp, Cox's Bazar. International Union for Conservation of Nature, Bangladesh Country Office, Dhaka.

Joint Response Plan (JRP). 2018. JRP for Rohingya humanitarian crisis. March-December 2018. Dhaka, Bangladesh.

Khan, A. 2015. Elephas maximus, in: Red List of Bangladesh, Volume 2: Mammals. International Union for Conservation of Nature, Bangladesh Country Office, Dhaka.

McVeigh, K., Peri, D. 2018. Fatal elephant attacks on Rohingya refugees push Bangladesh to act. The Guardian, published on 9 May 2018. Accessed on 7 July 2018.

Motaleb, M.A., Ahmed, M.S., Islam, H., Haque, M.A. 2016. Atlas: Elephant routes and corridors in Bangladesh. International Union for Conservation of Nature, Bangladesh Country Office, Dhaka.

news24.com. 2018. Elephants kill 10 Rohingya refugees in Bangladesh: UN. Published on March 7, 2018. Accessed on 8 July 2018.

Rahman, M.H., Alam, K. 2016. Forest dependent indigenous communities' perception and adaptation to climate change through local knowledge in the protected area ─ A Bangladesh case study. Climate 4:12.

Sukumar, R. 2006. A Brief review of the status, distribution and biology of wild Asian elephants. International Zoo Yearbook 40(1):1-8.

Thekaekara, T. 2017. Can elephants and humans live together? The Guardian, published on 6 Mar 2017. Accessed on 8 July 2018.

UNDP Bangladesh and UN WOMEN Bangladesh. 2018. Report on environmental impact of Rohingya influx. Dhaka, Bangladesh.

Wahed, M.A., Ullah, M.R., Irfanullah, H.M. 2016. Human-elephant conflict mitigation measures: Lessons from Bangladesh. International Union for Conservation of Nature, Bangladesh Country Office, Dhaka.

World Food Programme. 2018. Refugee influx emergency vulnerability assessment (REVA) – Technical Report. Cox's Bazar, Bangladesh.