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ASSESSMENT REPORT

Impact of LPG distribution among the Rohingya and Host communities of Cox's Bazar South Forest division on forest resources



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PREPARED BY

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1

Introduction

1.0 Introduction

Over last four decades, the Rohingya people from Rakhine State of Myanmar have experienced discrimination in all forms, statelessness and multiple episodes of military atrocities. All such violent and discriminatory events (e.g. in 1978, 1991 and 1992) forced more than 0.2 million Rohingya people to fled to nearby boarder location of Cox's Bazar in Bangladesh in between 1978 to 2016 (Amnesty International, 2017; Milton et al., 2017; Ullah, 2011). Additionally, following the latest military atrocity and persecution in Rakhine State in 2017 have forced an estimated 745,000 Rohingya people to fled into Southern part of Cox's Bazar district, Bangladesh. Cumulatively, more than one million Rohingya people are residing in the camps of Ukhiya and Teknaf Upazilla of Cox's Bazar district (UN, 2019). Both Ukhiya (total area 261.8 square kilometers) and Teknaf (total area 388.66 square kilometers) have high coverage of forest lands; nearly 60% and 41% of its respective lands are under reserve forests (BBS, 2013). Therefore, the massive influx of Rohingya people has not only overturn the physical environment and demographic features of the land but also caused severe impacts to the forest ecosystem which could result in irreversible losses of the natural process (i.e. loss of productivity, water cycles, extinction of species etc.) (UNDP, 2018). Since August 25, 2017 different national and international organizations along with different agencies of Bangladesh Government and local (host) communities are supporting the Rohingya people with their basic needs, i.e. food, drinking water, preparing makeshifts etc. (Wake & Bryant, 2018). Only for settlement of these Rohingya people, it is argued that more than an estimated 6,000-hectare forest lands have completely destroyed (UNDP, 2018). In early months another widely reported major environmental concern was extensive collection and use of forest firewood by Rohingya people to meet their daily demand for cooking fuel. An estimated over 730 tons of forest firewood (biomass) per day was required to meet the demand of cooking fuel. Since these forest resources are also shared by the local (host) communities that's why concern is growing over the demand for firewood.

Providing alternative fuel, i.e. Liquefied petroleum gas (LPG) and improved cooking stoves are one of the crosscutting mitigatory measures to address both physical and environmental impacts. The programme initiative of LPG distribution supposed to (a) eliminate the need for firewood collection from forests and protected areas, (b) improve the air quality (health-impact) and kitchen safety, (c) improve cooking efficiency, (d) improve social cohesion with host communities and so on (ISCG, Energy & Environment, & Government of Bangladesh, 2018). Ideally, LPG is supposed to completely reduce the dependency of Rohingya households

on forest for firewood collection but anecdotal information suggests that some Rohingya households are still collecting firewood from the adjacent forests. Under the same project of LPG distribution which has started since August 2018, a number of host community households have also received cooking stoves and supply of LPG for at least six months (ISCG et al., 2018). At the same time, universal coverage of LPG distribution among the Rohingya population is approaching nearly to its target. To date, the operation of LPG distribution programme has created three different sets of beneficiaries while leaving them at different states of firewood demand for cooking; (i) Rohingya households who are receiving LPG supply after a fixed interval and that should completely eliminate their forest dependency for firewood collection, (ii) a portion of host community who received free LPG supply for at least six-months, do not receive any more but continue to use LPG by their own cost – a situation likely to reduce their dependency on forest firewood for cooking, (iii) a portion of host community who received free LPG supply for at least six-months, do not receive any more and went back to firewood collection from forest – a situation resemble their pre-LPG state of dependency on forest for firewood collection.

This study is designed to assess the collection and use of firewood or other woody material by the Rohingya and local host communities. It will also highlight on the proportion of cooking fuel comes from forest; the drivers influence the use and collection of firewood, economic value of the firewood collected by the Rohingya people, tradeoff between using LPG and firewood. In addition, the study will attempt to identify the environmental footprints and assess the value of environmental impacts due to collection of fire woods by Rohingya.

1.1 Objective of the study

- Assess current fuel (both LPGs and fire wood) demand in Rohingya settlements and the host community and estimate the overall demand over the period of time
- Examine the impacts of LPGs on fuel wood supply chain and specify the supply chain or proportion of the biomass fuel come from the forests and other sources
- Assess the impacts of LPGs on fuel wood market
- Identification of the factors/drivers influencing fuel demand for household energy production in both Rohingya and Host community
- Comparison of the extent of fuel along with their nature and pattern of use by both Rohingya and host communities
- Assessing the impacts of LPGs on household behavior, opportunity cost in terms of time and money
- Focus on the environmental impacts due to introduction of LPG to the camp residents and to the host community

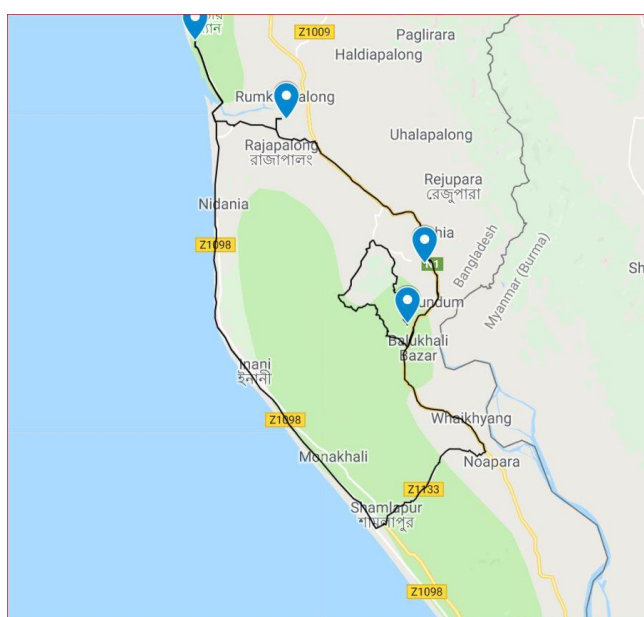
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Methodology and Data

2.1 Reconnaissance survey

A reconnaissance survey has made to perceive the pattern of using cooking fuel, family size, living condition of the Rohingya population, location of the camps adjacent to the forests, interaction of the Rohingya people with the local community, nature of collection of fuelwoods by the Rohingya people, and other issues related to the use of fuelwood. On September 18, 2019, IUCN research team went inside the camps to have its first glimpse of the gigantic effort of the world communities to house a million displaced Rohingya population from Myanmar in a small land scape in Ukhiya. This is shown in the following diagram.

Map 1: First Reconnaissance Survey Route



Source: Google map tracking on 18 September 2019

2.2 Data collection and its approach

The study is carried out through interview of the households, key informants and focused group discussion involving major stakeholders. In addition, a comprehensive household survey is conducted among both Rohingya and Host communities involving issues of pre- and post-LPG fire wood collection, fire wood demand and use of LPG as an alternative means of cooking fuel. The survey-based data is collected using the application-based software Kobotoolbox. Besides, key market agents (supplier of firewood, LPG distributors etc.) have interviewed at 10 different

markets surrounding the Rohingya camps to identify the existing market supply-chain and hence, its value chain.

2.2.1 Sampling design for household survey

Households from both Rohingya and host communities have been surveyed. Using statistical formula, a representative sample household of both Rohingya and host communities have been determined. Family size, price and availability of the fuel in the local settings may be the key factors that determine the type of fuel used for cooking. Sample size of this survey has been determined using the following formula.

$$n = \frac{p * (1 - p) * z^2 * design\ eff}{e^2}$$

Where,

n= Sample size, p= 0.5 (proportion of the households whose have characteristic)

z=1.96 (Sample variant considering 95% confidence level), e= 3.3% (margin of error) and

Design effect=1.5¹

Using this above formula, estimated total number of sample households for both Rohingya and Host community were 1,323 but to deal with missing information we have slightly increased to sample to 1400 households for the survey.

Since the objective of study at the initial phase is to understand deforestation and environmental impacts of LPG gas supply on the Rohingya and host communities, a selected number of Camps have been used to collect household data based on **(a) proximity to commercial hubs and (b) proximity to forests**. Map 2 identifies the camps from which stratified random sample of households have selected for the household survey. **Considering the proposition of population size of the Rohingya family and the host community the final selected sample size was 1,208 and 191 households respectively.**

¹ A design effect(DEFF) is an adjustment made to find a survey sample size, due to cluster sampling method resulting in larger sample sizes (or wider confidence intervals) than you would expect with simple random sampling(SRS). The DEFF tells the magnitude of these increases. The design effect is the ratio of the actual variance to the variance expected with SRS. It can more simply be stated as the actual sample size divided by the effective sample size (the effective sample size is what you would expect if you were using SRS) (<https://www.statisticshowto.datasciencecentral.com/design-effect/>)

road

1E KRC
1W 2W 2E
3 6 7
5 6
17 17 SW 8E
10 9
12 11
12
13
14
15
16
17
18
19
20
20X
4X
21
22
23

close to commercial hubs
close to forests

Choukhali

25
24
Naye
26
27

2.2.2 The Sample

Accordingly, the initial distribution of household for the sample is based on these criteria. Table 1, Table 2 and Table 3 show distribution of selected households by (a) LPG groups (family size-wise), (b) special needs, and (c) camps by commercial hub and forest areas respectively. Number of households selected in each of the camp is based on their relative proportion.

Household Size	Rohingya HH	Host HH	Total HH
1 to 3	492	32	524
4 to 5	386	67	453

6 to 7	227	64	291
8+	103	28	131
All	1208	191	1,399

Source: IUCN Survey, 2019

In Table 1, household size is clustered in accordance to the classification of LPG distribution to the Rohingya households. Within this classification, 35.45% sample household belongs to household size 4 to 5, followed by 31.52%, 22.09% and 10.94% belongs to household size 1 to 3, 6 to 7 and beyond 8 members respectively.

Table 2: Sample Size by Families with or without special needs

Households	Rohingya HH	Host HH	Total
Families without members in special needs	896	156	1,052
Families with members in special needs	312	35	347
Total	1,208	191	1,399

Source: IUCN Survey, 2019

According to Table 2, a total of 347 (nearly 25%) sample households are having members with special needs among the Rohingya households. Finally, Table 3 shows distribution of 1,399 selected households by camps. Camps 2E, 4, 5, 6, 16, 17, 18, and 23 are adjacent to commercial hubs (roads and bazars), and camps 4-Extension, 13, 15, 20, 20-Extension, and 21 are adjacent to forests (shown in Map 2). In some camps, the survey team did not find local community living close the camps and hence there were no sample from local communities.

2.2.3 Selection of sample households

Rohingya households were selected randomly using a database provided by the UNHCR and IOM offices in Cox's Bazar. Randomization were done according to a) household size, b) families with special needs, and c) camps. Host communities were selected based on proximity to clusters of the selected Rohingya households.

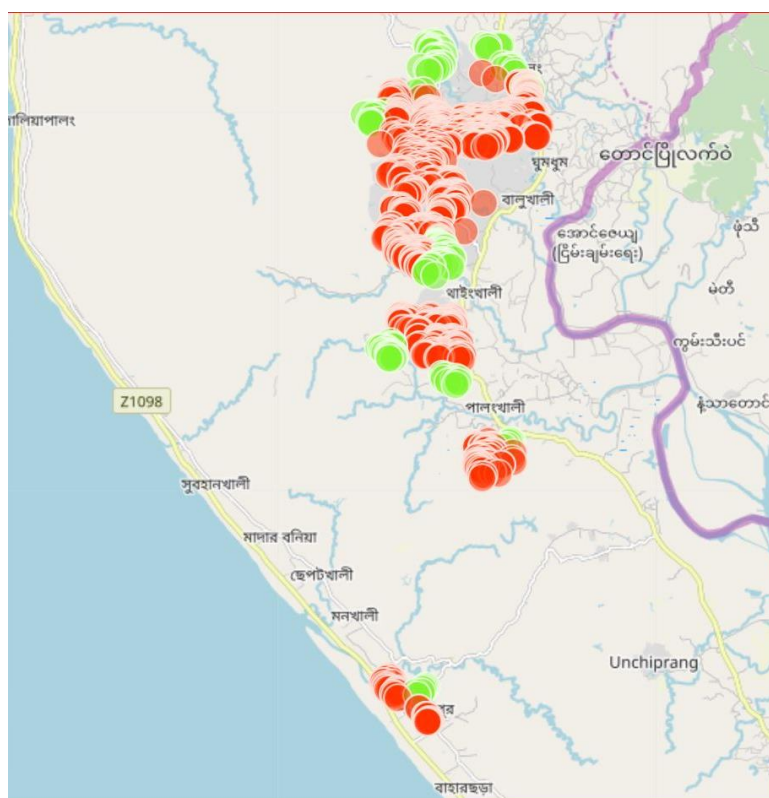
Table 3: Sample Size by Rohingya Camps, commercial hub and forest areas

Camp Number	Rohingya Household	Host community Household	Total Household	Selection criteria
2E	117	25	142	Commercial Hub
4	144	21	165	Commercial Hub
5	95	15	110	Commercial Hub
6	101	8	109	Commercial Hub
16	66	11	77	Commercial Hub
17	85	10	95	Commercial Hub
18	81	16	97	Commercial Hub
23	35	6	41	Commercial Hub
4X	44	5	49	Forest
13	122	22	144	Forest

15	150	27	177	Forest
19	66	11	77	Forest
20	25	0	25	Forest
20X	15	7	22	Forest
21	62	7	69	Forest
Total	1,208	191	1,399	-

Source: IUCN Survey, 2019

Figure 1: Sample Households



Note: Red dots are Rohingya and Green dots are Local Host Communities selected in the Survey

2.3. Market survey using FGD/KIIs

To identify the supply chain of firewood market operation, the study team has conducted 10 market surveys. Similar to household survey, these 10 market places have been selected considering its distance from the - (a) commercial hubs and (b) forest areas. The following are the names of selected market places: (i) Ukhiya bazar, (ii) Kutupalong, (iii) BTV substation bazar near Ukhiya, (iv) Gundum post-office bazar, (v) Panbazar near Balukhali, (vi) Thiangkhali bazar, (vii) Jamtoli bazar, (viii) Palongkhali bazar, (ix) Whykong bazar, and (x) Shamlapur.

The information collection method was primarily the key informant interviews (KIIs) with different market agents e.g. owners of restaurants, firewood sellers, LPG sellers etc. A semi-structured guided questionnaire has been used to conduct these market surveys. In addition, the study team have also consulted with officials from different government, non-government

and international organizations who are involved in the management of the Rohingya camps to understand the context from their experience and realization.

3

Profile of Rohingya and Host Communities

3.0 Introduction

Within the Rohingya camps and its periphery areas there are households of host (local) communities. Consequently, the lives and livelihood patterns of host communities (locals) are substantially influenced by the ongoing activities in the camps and its nearby areas. Anecdotal information suggests that the host communities at different parts of Ukhiya are pre-dominantly dependent on forest firewood to meet their fuel demands for cooking in absence of alternative source of fuel. Hence, alike other ongoing programmes in different Rohingya camps the LPG distribution programme is also expected to bring some shifts in the host community firewood demand for cooking. In this context, understanding the difference in basic household profile between Rohingya and Host community households are imperative to further delve into the objective outlined for this particular study.

3.1 Household Size

According to the latest census in Bangladesh (BBS Census 2011), the average household size in Ukhiya was 5.47 and our sample has found it to be 5.43. Similarly according to UNHCR database, average household size among Rohingya households is 4.32 and ours is 4.18. This shows representativeness of the sample in terms of a key population characteristics.

Table 4: Average Size of Household by Rohingya and Host Community in Ukhiya

Community	Household Size	
	IUCN Sample	Population Average*
Rohingya	4.18	4.32
<i>Male</i>	1.99	2.07
<i>Female</i>	2.20	2.26
Host Community	5.43	5.47
<i>Male</i>	2.85	2.76
<i>Female</i>	2.59	2.71

Source: IUCN Survey 2019; * Based on UNHCR database (for Rohingya population) and BBS Census 2011 (for Ukhiya population).

3.2.1 Total Population in Ukhiya

In 2011, the density of population in Ukhiya was 792 per square kilometer, total population was 207,379 and number of households living in Ukhiya was 37,940. The population growth was 3.35%. Using these estimates from Census 2011, the current number of households living in Ukhiya should have been 49,914. However, with massive influx of this large number of Rohingya from Myanmar the balance has been tipped. There are 211,343 Rohingya households

living in this area against 49,414 households of local population in Ukhiya. On the top of this, there are thousands of people working for UNHCR, IOM, Government of Bangladesh, NGOs, and law enforcing agencies in the area. This influx increased the pressure on the ecosystem of the area including the fact that it had increased demand for firewood in the area.

3.2 Household Composition: Families with special needs

About 31% of the Rohingya families were labelled as families with special needs and hence are vulnerable. These families include families with single mother, with serious medical condition, with older persons at risk, with disability, with separated child, with older person with child, with unaccompanied child, and with single male parent with infant. The sample has nearly 26% of the Rohingya families with at least one of the abovementioned vulnerabilities. For host communities, the number is 18%. (see Table 5).

Table 5: Families with Special Needs among Rohingya and Host Communities

Household Size	Rohingya Community		Host Community	
	Families without special needs	Families with special needs	Families without special needs	Families with special needs
1 to 3	34.26	59.29	14.1	28.57
4 to 5	33.26	28.21	37.18	25.71
6 to 7	21.76	10.26	33.33	34.29
8+	10.71	2.24	15.38	11.43
Total HH (in numbers)	896	312	156	35

Source: IUCN Survey, 2019

Among 312 Rohingya households, nearly 60% families with members in special needs belong to household size 1 to 3 (a large majority), followed by nearly 28% and 10% that belongs to household size 4 to 5 and 6-7 members respectively. On the other hand, among the host community households who have 6-7 people in the family are with the largest group with members of special needs. From a demographic viewpoint, this is normal as elderly people live in with their families but for Rohingya families this shows that scars in their life as many fled their homes in Myanmar and was not able to enter into Bangladesh with all members.

3.3 Other Household Characteristics

Table 6 shows other characteristics of the sample households in the survey. According to Table 6, the average size of children in Rohingya and host community households are 2.93 and 3.21 respectively. Corresponding child dependency ratio are 72.23% and 62.15%. On average, in a Rohingya household one in every two members of a family is an infant whereas it is one in every three members in case of host communities. Apparently, in contrast to Rohingya households where children and infant are more vulnerable, older people are more in need of support in host community households.

Table 6: Household size, distribution of children, infants and dependencies

Household Members	Rohingya	Host Community
Household Size	4.19	5.44
Children	2.93	3.21
Infants	1.77	1.62
Child Dependency ratio (percent)	72.23	62.15
Infant Dependency ratio (percent)	51.54	35.76

Source: IUCN Survey, 2019

3.3 Educational Status

Among the Rohingya population, nearly 36% have no formal education while in the host community it is about 27%. Among the educated Rohingya, 23% have academic training from religious institutions which is twice more than the host community members. In addition, 36% Rohingya have education up to primary school and only 4% and more have completed high school and above. The corresponding numbers for host community household members are nearly 37% and 20%. A large number of Rohingya households with no education and religious education requires special attention a large number of them are children of school age.

Table 7: Percentage distribution of Educational Status by Rohingya and Host communities

Educational Status	Rohingya	Host
No education	35.88	27.33
Religious education	23.04	11.45
Primary school	36.09	37.44
High school and above	4.09	19.73
Others	0.89	4.04

Source: IUCN Survey, 2019

3.4 Marital Status

Among the populace above 18 years old, 79% female and 76% male Rohingya are married respectively. Nearly 10% female are unmarried and 23.6% male are unmarried. Among 18 years and above aged host population, nearly 87% female and 73% male household members are married while nearly 7% female and 27% male members are unmarried. Besides, about 10% female refugees from Myanmar are either widow, divorced or separated. The corresponding number of widows, divorced and separated female host community are lower; about 5% only. In addition, 5% Rohingya females were married before they turn into 18 years. In case of host community, nearly 8% female get married before they turn into 18 years old.

Table 8: Percentage distribution of marital status by Rohingya and Host households

Marital Status (above 18 years)	Rohingya		Host Community	
	Female	Male	Female	Male
Married	79.13	76.00	86.93	72.78
Never married	10.30	23.60	7.19	26.67

Widowed	8.74	0.40	3.92	0.56
Divorced	0.56	-	0.65	-
Separated	1.27	-	1.31	-
Underaged Marriage (<i>aged 18 or less in years</i>) of total married person	5.08	2.80	7.79	1.49

Source: IUCN Survey, 2019

3.5 Occupational Profile

Among the working age population (above 15 years) who are also not currently involved in education, nearly 29% Rohingya are housewife. Corresponding numbers of housewife among host communities are 43.5% meaning a large number of them may work for living in camps. In addition, 6% of Rohingya and 17% host household members are retired. About 29% and 14% household members are unemployed respectively from Rohingya and host communities. Apart from them, among the Rohingya population 10.6% are involved as day laborer followed by 5% who are involved in camp activities. Besides, 2.5% Rohingya have delivering service as NGO workers, and 1.8% as shopkeepers. Among the host community, about 14% are agricultural workers, 10.7% are day-labourer, 3.6% are businessmen.

Table 9: Occupation profile of Rohingya and Host community households in percentage of cases

Occupation	Rohingya	Host Community
Involved in Camp activities	5.19	0.58
Involved as Day Laborer	10.61	10.68
Transport worker	0.06	1.25
Barber/Tailor	0.58	1.92
Shopkeeper/worker	1.77	2.21
Agricultural worker	0.08	14.05
NGO worker	2.48	0.00
Professional Job (Health	0.52	0.58
Business	0.46	3.56
Local Leader	0.14	2.12
Housewife	29.28	43.50
Retired	6.02	17.71
Unemployed	28.70	14.14
Others	1.85	4.23

Source: IUCN Survey 2019

3.6 Monthly Household Income and Expenditure

Nearly 52.2% Rohingya households have reported about their month household income. The average household income for the Rohingya is 4,564 taka per month. Among the host community, 89% have mentioned about their household income and on average it is estimated to be 10,682 taka per month. In contrast, about 96.5% refugees and only 35% host community household have mentioned about their monthly expenditure. The average expenditure by

Rohingya and host community households are 5,552 taka and 11,008 taka per month respectively. Here, it is important to note that Rohingya families do receive rice, oil and pulses as their food ration at free of charges.

Table 10: Household income and expenditure by Rohingya and Host communities

Community	Income				Expenditure			
	n	% of HH Reported	Monthly income	Standard Deviation	n	% of HH Reported	Monthly expenditure	Standard Deviation
Rohingya	630	52.15	4,563	3,473.73	1,166	96.52	5,552	3,720.04
Host	170	89.01	10,682	9,735.36	66	34.55	11,008	5,495.80

Source: Calculation using IUCN Survey, 2019

3.7 General Food Basket

Analysis of daily food intake by Rohingya and host community at household level reveals that – the consumption of carbohydrate, fat and protein are common in their food basket. The consumption of food items that contain vitamin is relative higher among host communities. Consumption of betel leaf is very common in both Rohingya (38.4%) and host community households (44%).

Table 11: Percentage distribution of daily (on average) food intake by Rohingya and Host community households

Food Intakes	Rohingya	Host
Carbohydrate	99.25	100.00
Fat	95.61	96.86
Protein	94.21	95.29
Vitamin	60.35	71.20
Milk/Curd	0.41	3.66
Fruits	1.74	5.24
Sweet	92.3	95.81
Betel leaf (Paan)	38.41	43.98
Tea	11.01	18.85
Soft Drinks or Juice	2.40	7.33
Energy Drinks	0.58	0.52

Source: IUCN Survey, 2019 Note: Carbohydrate food items include rice, wheat, maize, millet and potato. Fat includes edible oil. Protein includes all types of meat, all types of fish, egg and pulses. Vitamin includes all types of vegetables.

3.8 Characteristics of their living space

More than 90% Rohingya households have one or two households in their house. In contrast, over a one-third of host community households have more two bed-rooms in their house. In addition, one-third of Rohingya houses have a single door while in 40% houses there is no window facility. In the host community households, nearly 80% households have one or two doors as well as windows. Two-third of Rohingya household and one-third of local houses are made of cement floor respectively. In Rohingya houses, majority (56%) have solar as major

source of lighting while it is 33% in case of host community houses. In the host community 47% houses have the electricity connection.

Table 12: Percentage distribution of selected dwelling features by Rohingya and Host households

Dwelling Features	Rohingya Household	Host Household
Bed room		
<i>Single</i>	28.36	9.42
<i>Two</i>	63.39	53.40
<i>Multiple</i>	8.26	37.17
Doors		
<i>Single</i>	75.21	40.84
<i>Two</i>	24.04	41.88
<i>Multiple</i>	0.75	17.28
Windows		
<i>No</i>	43.34	20.94
<i>Single</i>	41.93	19.90
<i>Two</i>	11.31	35.08
<i>Multiple</i>	3.41	24.08
Cement Floor	66.81	32.98
Source of lighting		
<i>Solar or Grid Solar</i>	55.66	33.51
<i>Rechargeable</i>	31.36	5.76
<i>Kerosene</i>	5.74	13.09
<i>Electric</i>	0.83	47.12
<i>Others</i>	6.41	0.52

Source: IUCN Survey, 2019

3.9 Features of kitchen and cooking stoves

In the Rohingya camps, only one-fifth of houses have separate kitchen. In 48% of Rohingya houses, they have a kitchen with door from outside while 49% kitchen have opening for air circulation or smoke exit. Among the host communities, 78% have kitchen with a door to go outside while 75% have air circulation windows/openings. Despite having LPG connections, In half of the Rohingya shelters, there were separate place for storing firewood while in one-third of houses we observed stacks of firewood.

Nearly 60% Rohingya households had only LPG cooking stove, while 37% have alternative cooking stoves beside the LPG stove. Among the host community, only 15% have LPG cooking stove only while 33% use LPG plus another cooking stove.

Table 13: Percentage distribution of selected kitchen and cooking features by Rohingya and Host households

Kitchen and Cooking Features	Rohingya Household	Host Household
	percent	

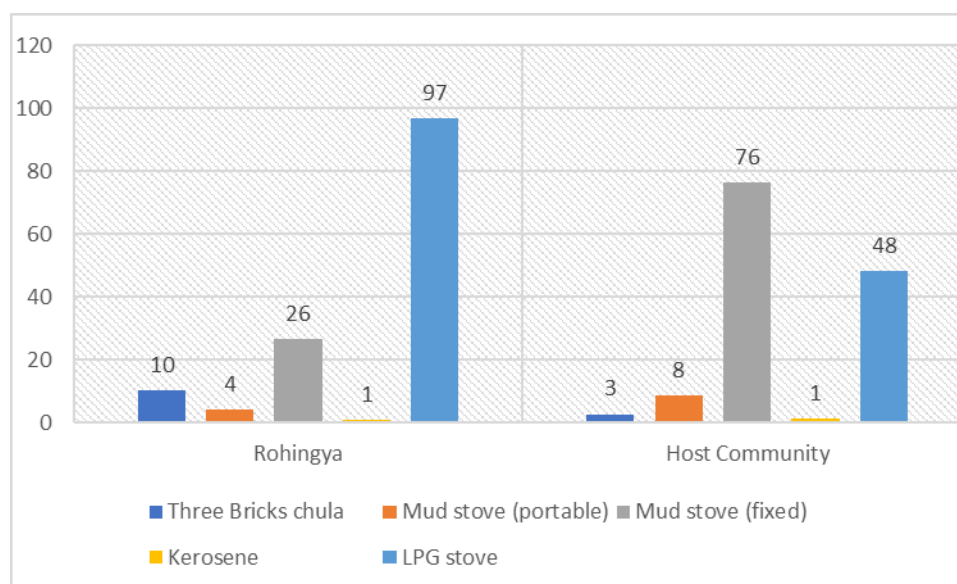
Kitchen Characteristics		
Separate Kitchen	21.71	64.92
Kitchen with doors to go outside	31.28	78.01
Kitchen with space for air circulation	48.67	74.87
Separate place for storing firewood	51.33	86.91
Stack of Firewood	33.69	82.20
Cooking Stoves		
Only LPG	59.95	15.18
LPG and Other types	36.87	32.98
Only other types	3.18	51.83
Cooking-ware		
Clay-ware	5.24	8.38
Aluminum-ware	99.67	100.00
Iron/hot plate	16.89	37.17
Others	2.25	4.19

Source: IUCN Survey, 2019

3.10 Types of Stoves in use

Among the types of stoves, 97% have LPG stove in Rohingya communities while it is 48% in Host Communities. Since only 35% of host communities reported receiving LPG cylinder, this means additional 13% of them have procured LPG stove on their own. The next popular stove is the mud-stove (fixed) which is common in rural Bangladesh. Among the host communities, portable mud-stove is the next popular one but among the Rohingya it is a make-shift stove made by three bricks (see Figure 2).

Figure 2: Type of Chula in Rohingya and in Host Communities



Source: IUCN Survey 2019.

4

LPG Use and Impact on Food Intake

4.1 Introduction

LPG was introduced to the Rohingya household to reduce pressure on the forests which was on the verge of depletion because of huge volume of firewood collection for cooking and feeding 211,000 Rohingya families who were forcibly evicted out of their homeland.

Ukhiya had its nearly 50,000 families who previously were dependent on forests. The Department of Forests of the Government of Bangladesh in order to reduce dependence of Ukhiya people of forests to collect firewood had programs of social forestry under which communities were given rights to grow trees in degraded forest land. Kutupalong Camp, the largest one – is located by vacating some of these plots.

Degradation of forest land due to excessive collection of firewood threatened not only the plants but it also threatened many wild animals living in the reserve forests of Ukhiya. This was evident as Rohingya camps ran into conflict with wild elephant herds living in the forests. Similarly, as many people began to explore the forests for firewood, they also were attacked by wild elephants and the incidents were rising. On the top of this, as many of the Rohingya camps were between the hills, snake intrusion was also rising in the area. These are general symptoms of a degraded forest land where animals living inside came in conflict with the Rohingya.

4.2 Use of LPG for cooking

To reduce the pressure, UNHCR and IOM introduced a scheme of LPG distribution among Rohingya households for free as a part of their regular ration. Households with a family size of 1-3 received a refill every 45 days, households with 4-5 persons in the family received a refill in every 36 days. Families with 6-7 members received a refill in every 30 days and household with 8 or more members received refill in every 26 days. The process began in 2018 and it was being implemented in phases as the NGOs and the companies supplying LPG cylinders began to build infrastructure for this. Table 14 shows the status of LPG use among Rohingya and Host Communities in our sample. It should be noted that host communities – living nearby were also given LPG cylinder but it was discontinued after 6 months.

Table 14: Status of LPG Use

Current Status of LPG use	Percentage		
	Rohingya	Host Community	Total
Using LPG for cooking	97.42	21.47	87.01
Never used LPG for cooking	2.58	65.45	11.20
Previously used but not using now	-	13.09	1.79
Total	100.00	100.00	100.00

Source: IUCN Survey, 2019

Table 14 shows that 97% Rohingya households in our survey were found to have been using LPG for cooking. The rest have not received LPG gas yet. Among the Host Communities, 35% were given LPG under the free LPG distribution scheme for 6 months. However, 22% are still using LPG for cooking while 13% have discontinued after the free scheme was withdrawn for host communities.

4.3 Are Rohingya families using firewood?

Despite having LPG cylinder, we observed that nearly 51% Rohingya families have a place to store firewood or charcoal for cooking in their kitchen while 33% had stacks of firewood in these places. This led us to query on the reasons behind it. About 56% of the household reported that they still use firewood for cooking (although occasionally). Nearly 99% of them reported that they need firewood as gas finishes before the due date for refill. Table 15 shows that about 22% of them still collect firewood from the forest and another 54% from nearby places (social forest, homestead forests, etc.).

Table 15: Additional use of firewood by LPG received Rohingya Households

Description	Percent
Do you still use firewood?	57.64
Reason for use	Percent
<i>Gas Finished Early</i>	<i>99.41</i>
Source of firewood collection	Percent
<i>Market</i>	<i>55.70</i>
<i>Forest</i>	<i>21.63</i>
<i>Nearby places</i>	<i>54.37</i>
<i>Others</i>	<i>6.22</i>

Source: IUCN Survey 2019

4.4 Are they continue to use LPG if refill stops?

Since nearly 51% of Rohingya families still have another kind of stove to cook, we wanted to know in our survey whether they will continue to use LPG if the free refill stops. Only 13% of the Rohingya families said that they may continue with LPG even it stops. Table 16 shows the

details. Of the 87% who will not use LPG if refill stops are mainly due to financial reasons as they cannot afford the cost.

Table 16: Will you continue to use LPG if free refill stops?

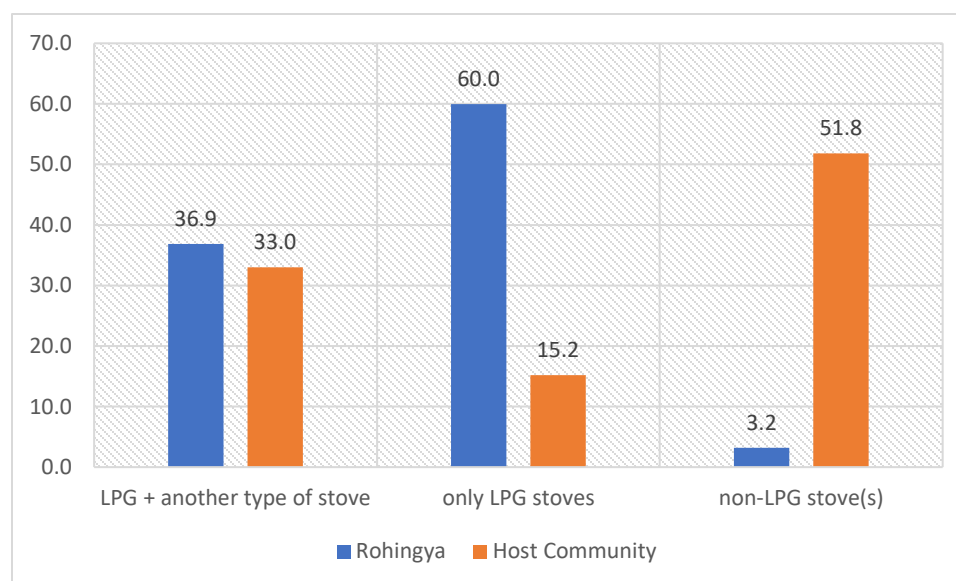
Will continue using LPG		Will not use LPG if refill stops	
Percent of Rohingya Families	13.27		86.73
Reasons	Percent	Reasons	Percent
Because used to cook with LPG	43.87	Cannot afford it	99.31
Pollution Free	28.39	Others	0.69
Comfortable to Use	60.00		
Available in the Market	56.77		
Others	3.23		

Source: IUCN survey 2019.

4.5 Type of Stoves in Use

Survey results show that nearly 60% of the Rohingya and 15% of the Host families only use LPG stoves for their cooking. About 3% of the Rohingya families (who did not receive LPG yet) are using non-LPG stoves only and it is 51% in host communities. Households who has LPG also use other stoves and it is 33% in host communities and 37% in Rohingya families (see Figure 3).

Figure 3: Composition of Stoves in Rohingya and Host Families



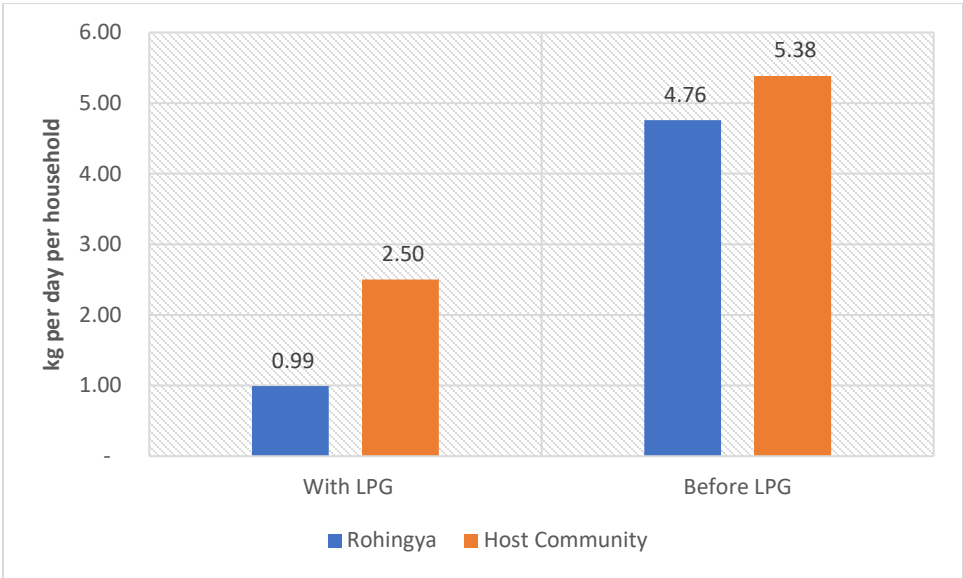
4.5.1 Impact of LPG distribution on firewood demand

As households began to use LPG for cooking, it is expected that there will be change in their daily use of firewood and hence there will be a corresponding reduction in the demand for firewood. Figure 4 shows that a Rohingya family which is currently using only one kilogram of

firewood per day, it was nearly 4.76 kilogram before LPG distribution – a reduction of 80% demand firewood per household in the Rohingya camps. Reduction in demand will, therefore, lead to reduction of collection of firewood from forests.

In the host communities, the reduction in demand is not similar (53%). Among them, daily use of firewood now is about 2.5 kg (LPG users) which was 5.38 kg previously.

Figure 4: Kilogram of firewood used per household per day



Source: IUCN Survey 2019.

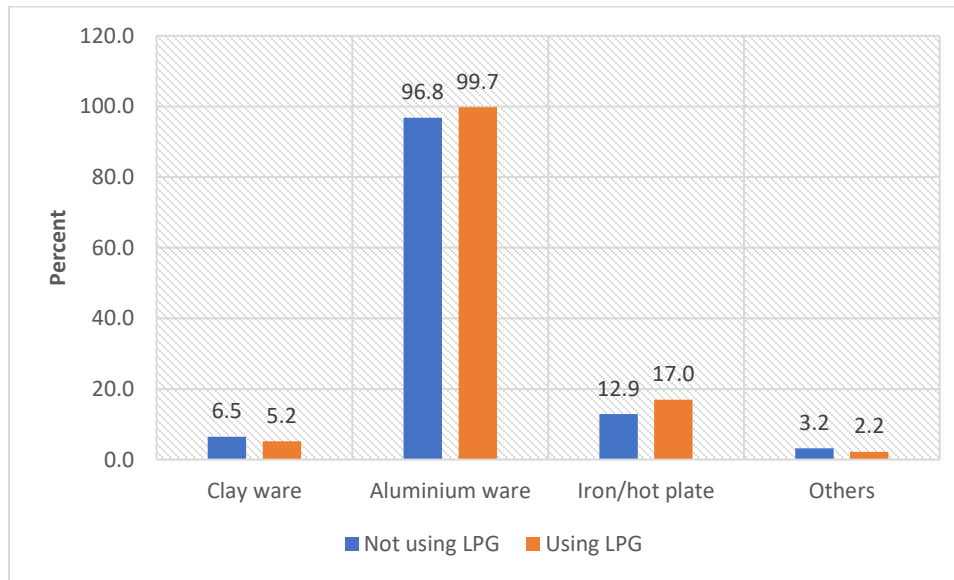
4.6 Cookware and food habit

Since the dawn of civilization, human being have been working to control fire and heat. Cooking is the first use of fire and for this introduction there were many innovations. Cooking on mud-stoves reduces ability to control fire and hence with of LPG, it is expected that both food habit and cooking utensil will begin to change in these households. The pottery used to cook in mud-stoves and in LPG are often not same and hence the survey looked into both the utensil ownership and food intake among the Rohingya and host communities.

4.6.1 Cookware

Figure 5 shows that both Rohingya and the Host Communities use very similar utensils to cooking. Cookware distribution shows that aluminum cookware is used by 100% of the families using LPG and it is 96.8% in non-LPG user families. The next popular utensils are hot plates made of iron and the next group is made of clay.

Figure 5: Type of cookware used among Rohingya and Host communities



4.6.2 Food habit

Survey data collected food consumption of all household. However, it is often difficult to recall daily food information and so to avoid recall bias, the questionnaire asked the respondents to provide the list of items in their food a day before. This information has been analyzed to calculate a Food Diversity Index. Higher the value of diversity higher is the diversity in their food. The index has been standardized using the following formula so that the lowest value is 0 and the highest value is 100. This means a score of 100 is the family with the highest degree of food diversity among all the household.

$$FI = \frac{(x - \min(x))}{(\max(x) - \min(x))} \quad (1)$$

Where x is the number of cooked food items consumed by a household a day before the interview.

Using the equation (1), the food diversity index value is shown in Table 17. It shows that on average Food Diversity Index value is much higher for LPG using families for both Rohingya and Host Community families.

Table 17: Food Diversity Index among Rohingya and Host Communities

	Rohingya	Host Community
Not using LPG	0.242	0.341
	(0.0970749)	(0.15738752)
Using LPG	0.349	0.422
	(0.1329005)	(0.1369529)

Source: Calculation based on IUCN Survey Data.

Using the t-test on this information, it can be concluded that the difference between LPG users and Non-Users within each group is significant at 1% level of significant or the confidence level is 99%.

Figure 6: Food Diversity Index of Rohingya Families

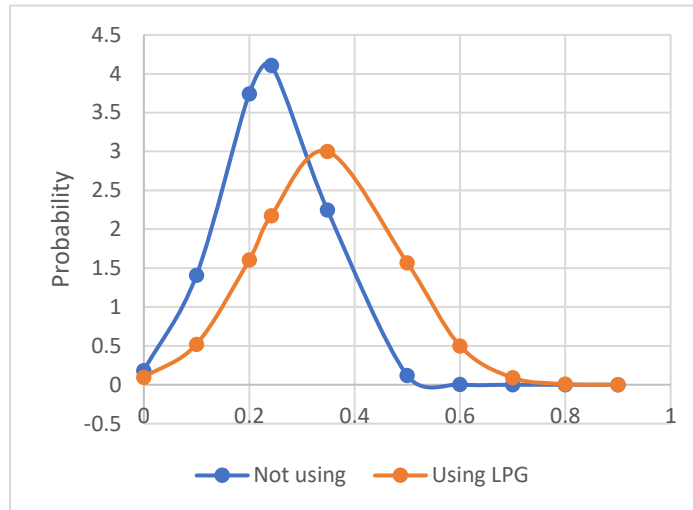


Figure 7: Food Diversity Index of Host Community Families

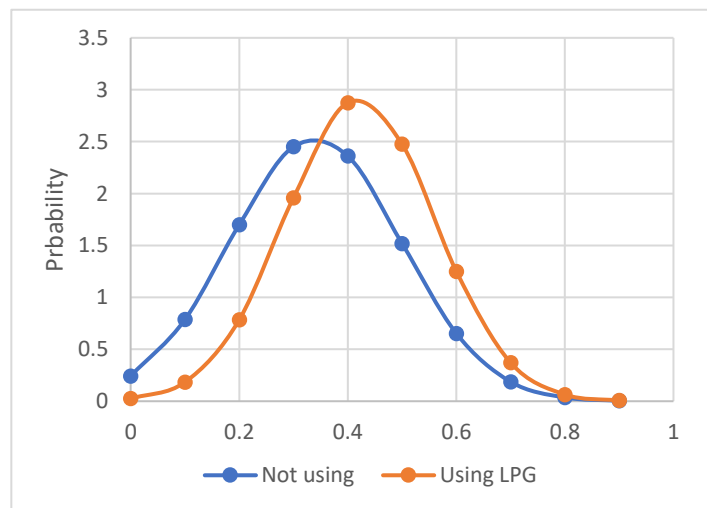


Figure 6 and Figure 7 presents the distribution of food diversity index between Rohingya and Host families respectively. It shows that the distribution of the index has shift to the right with introduction of LPG as a cooking fuel indicating that number of food items consumed by them have increased in households with LPG.

4.6.3 Nutrition Intake

With changes in the food items in their consumption, it is also expected that introduction of LPG may have had an impact on nutrition intake at the household and if so it will have positive health impact in the long run.

Items of food taken by each households were divided in basic nutrition categories. For example Carbohydrate includes rice, wheat, maize, millet, and potato. Fat includes all type of edible oil taken in food. Vitamin includes all types of vegetables, and Protein includes egg, meat and fish items. Households with increased consumption of these items will have an impact on the overall nutrition intake in the family. The study, however, did not collect data on the actual food consumed by each members of the household. Table 18 shows that Rohingya household with LPG stove have increased their intake of vegetables compared to others. The difference is also found to be statistically significant. Ironically, Milk intake (which has all the nutritional value) is almost absent among the Rohingya households but it is now positive with household with LPG cylinder.

Table 18: Percent of Rohingya household taking nutritional food in their daily diet

	with LPG stove	without LPG stove
Nutrition Intake from food	Percent of household	
Carbohydrate	100.00	100.00
Fat	96.07	96.77
Protein	94.53	100.00
Vitamin	61.06	45.16
Milk	0.43	0.00

It is therefore, expected that overall nutritional impact is likely to be positive due to this intervention.

5

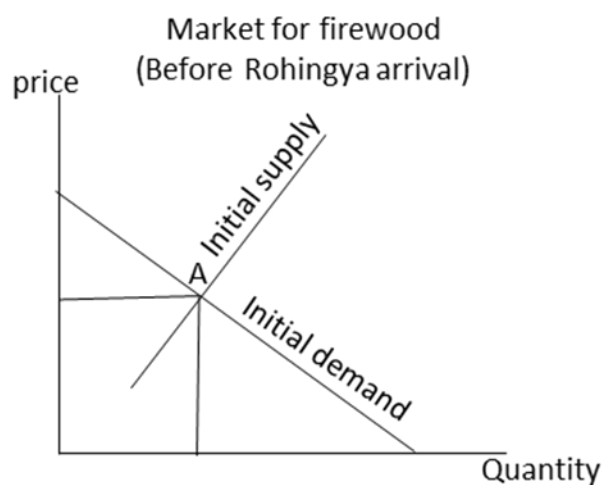
Impact on Biomass Supply and Demand

5.1 Local Market for Firewood

Influx of Rohingya is expected to change the dynamics of the market for firewood in the locality. Primarily because the population has increased from 207 thousand to more than a million in a span of a year and they need to cook food. As such, not only demand but also supply of firewood should have changed. This is shown in the following diagrams.

Figure 8 shows an initial condition of demand and supply in the firewood market. Under this situation, local people used to collect firewood for their use from several sources: a) local saw-mills (residue from timber traders), b) local charcoal suppliers; c) homestead forests; d) social forestry, and e) reserve forest. The market chain for the firewood market is shown in the figure 10.

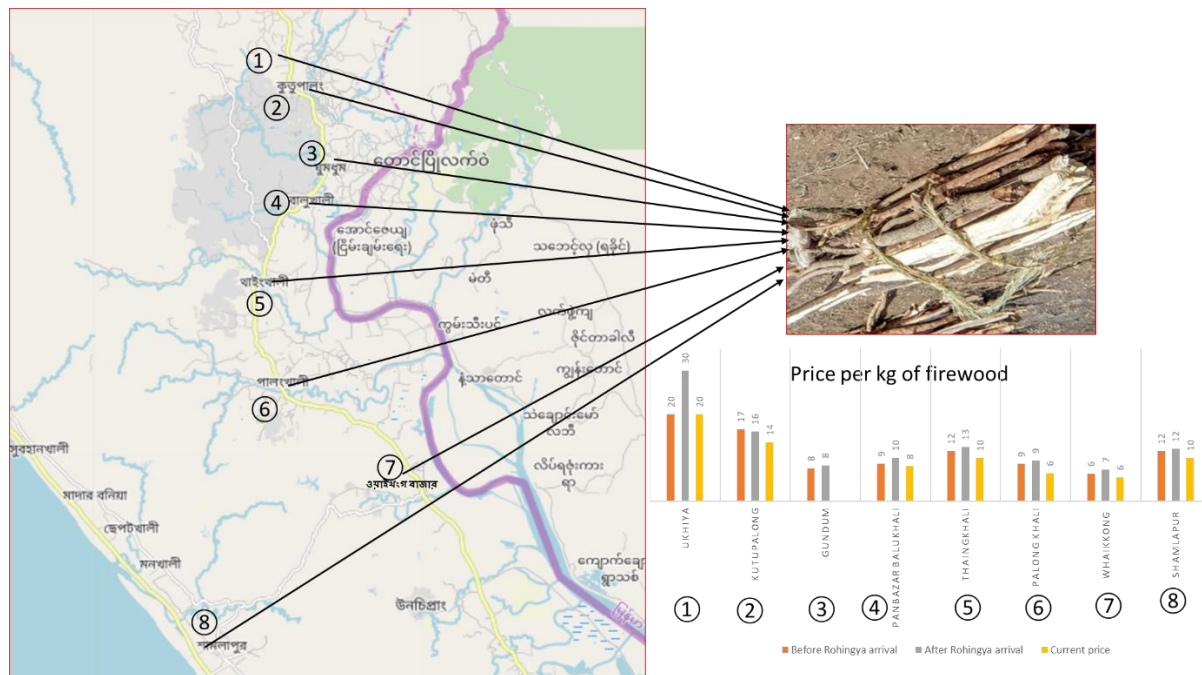
Figure 8: The Market for Firewood



Market price before arrival of Rohingya refugees was 12.37 taka per kg on average. Our estimate shows that nearly 95 thousand metric tons of firewood were collected from the forests and nearby homestead forests annually by Ukhiya people.

The market survey conducted in 10 surrounding markets namely, Ukhiya, Kutupalong, Gundum, Balukhali, Thaingkhali, Waikkang, and Shamlapur bazar reveals that average retail price in these market prior to the Rohingya influx was 12.37 taka per kg.

Figure 9: Price of firewood (per kg) in local markets – before and after Rohingya arrival and after LPG distribution began

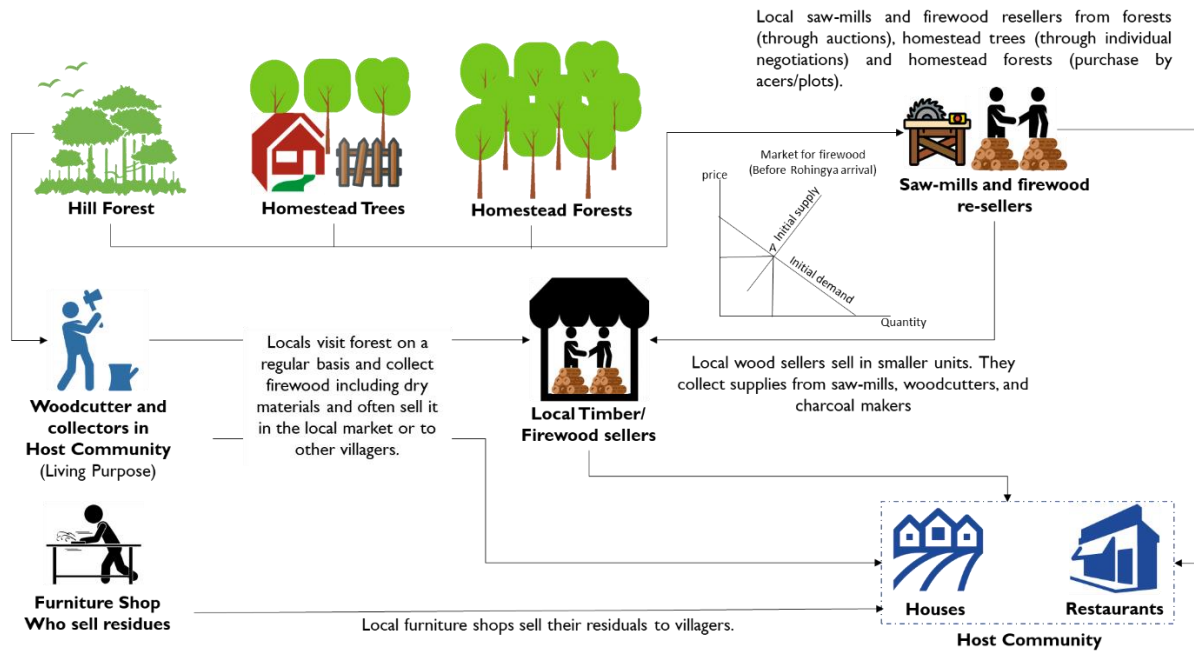


Source: Market Survey, IUCN 2019

This randomized survey on local communities (host community) shows that nearly 6.6% of the household used LPG even before the Rohingya arrival and that a household without LPG used, on average, 5.38 kg of firewood per day for cooking. Considering the population of Ukhiya, it is calculated that nearly 95 thousand tons of firewood used to be supplied through the market and/or collected from the local sources (mentioned above) for them. As such, on average, 95,000 tons of firewood were supplied locally and for that average market price was 12.37 taka per kg before the Rohingya influx in 2017. The market chain for local firewood supplies is shown in Figure 10.

The Market Chain shows that the market chain extends from the forest to the firewood retailers in the local markets. Analysis also shows that price of firewood is higher near Ukhiya and it goes down towards Waikhang Bazar in the south which is near the forests (see Figure 9).

Figure 10: Market Chain for Firewood prior to Rohingya influx



Source: Developed by the Research Team using the local market survey

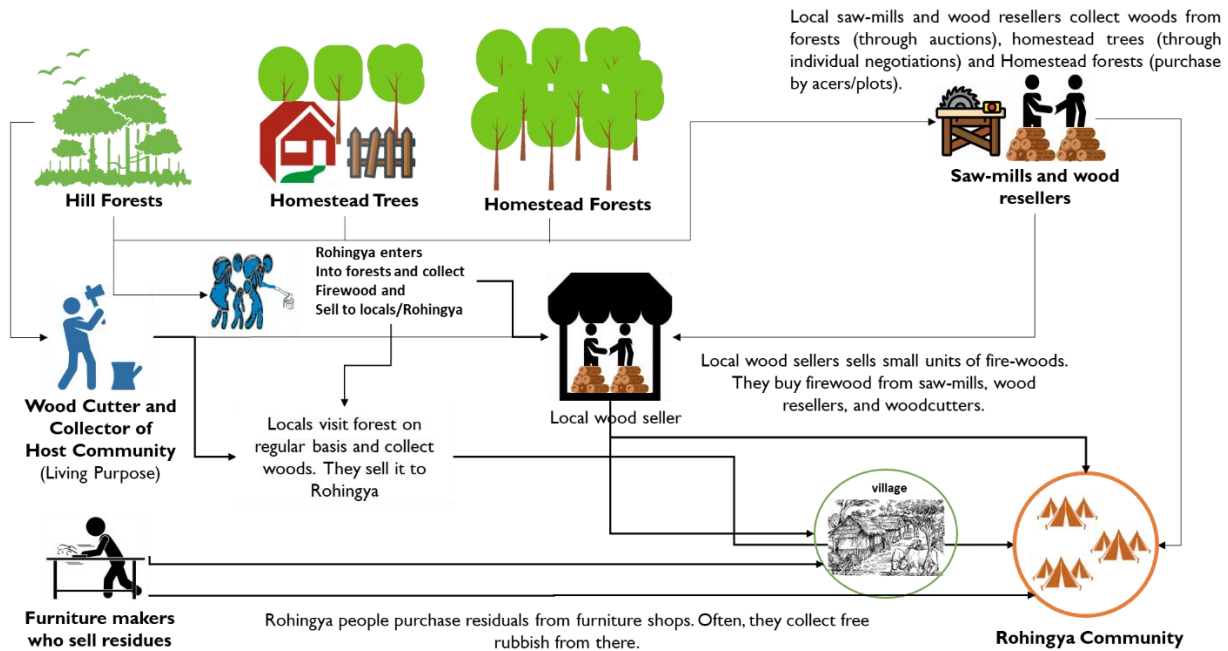
5.2 Changes in the Market for Firewood after the Rohingya influx

After the arrival of displaced Rohingya in the area (nearly 211,000 households) there has been a significant change in the demand for firewood. This came not only from the Rohingya families for cooking but also from thousands of NGOs/UN agency workers and law enforcing personnel who also arrived to maintain the law and order and to manage the largest humanitarian crisis.

As such, demand for firewood increased. At the same time, many of the Rohingya family members began to roam inside the reserve forest (the camps were located inside the forest area). The process also led to increase in the supply of firewood in the market and began to threaten the Teknaf Reserve Forest and the wildlife living in the reserve. Conflicts like human-elephant encounters, human-snake encounter began to rise. The changed market chain is shown in Figure 11.

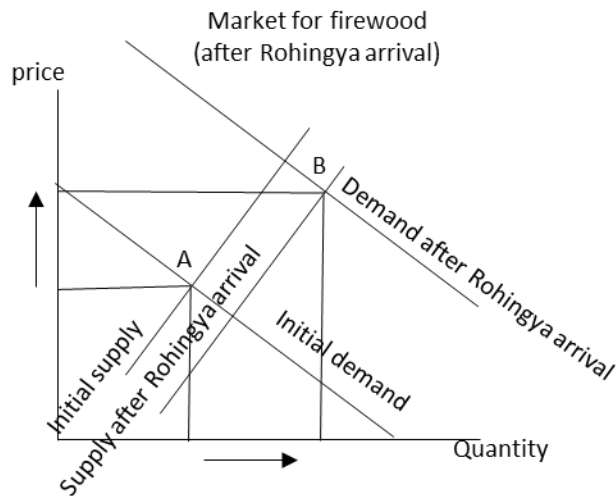
The market for firewood in the local markets began to react to the changes in the demand and supply as shown in Figure 12. It shows that after influx of Rohingya as both demand and supply shifted, the market began to supply larger amount of firewood. Estimates using the survey data shows that price rose to 14.19 taka per kg (up from 12.37 taka) and total market demand also increased from 95,000 tons to nearly 462,000 tons a year. This quantity estimates are based on estimates of daily use of firewood per household (for both Rohingya and host communities) and estimates of population using census data, and UNHCR data on number of Rohingya households. Price information were derived from KIIs and FGDs in the markets.

Figure 11: Market Chain after the Rohingya influx



Source: Developed by the Research Team using the local market survey

Figure 12: Market for Firewood after the Rohingya influx



After arrival of the refugees, demand for firewood increased. Supply also increased as many refugees were part of the supply chain and collected more firewood for them and also to the market. Price per kg of firewood increased to 14.19 taka (on average) and a total of 462 thousand tons were collected in a year.

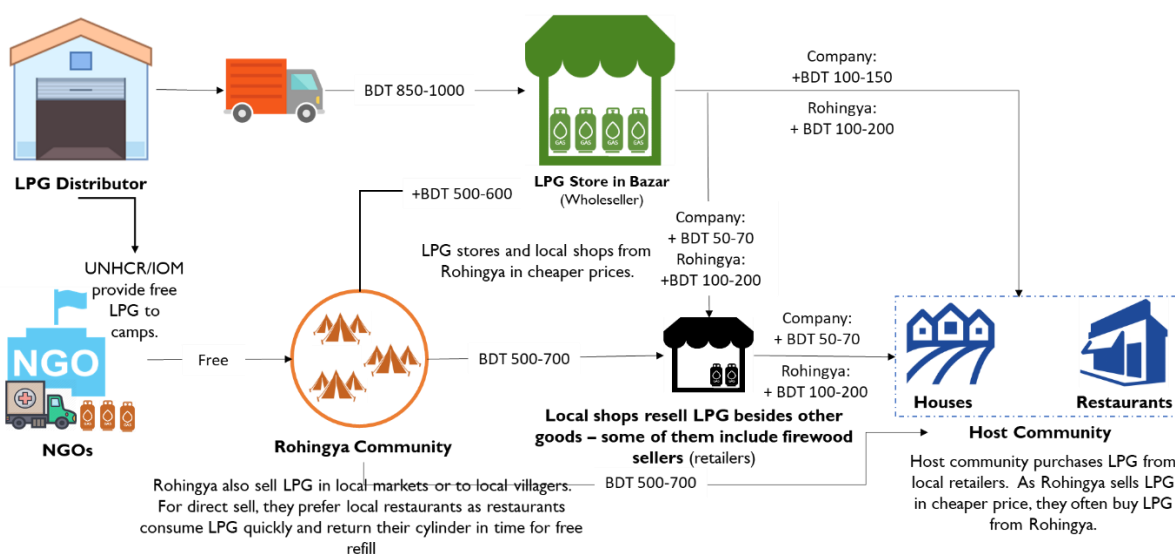
5.3 Market after LPG distribution began

The dynamics of the market began to change once again when UNHCR and IOM together mobilized supply of LPG to every Rohingya households in 2018. This has changed the entire dynamics of the firewood market. Our findings suggest that while Rohingya families began to receive the LPG with refills (explained in Chapter 4), local people also began to see the benefit. Availability of LPG dealers/shops nearby began to influence them and they also began to use LPG for cooking at homes and restaurants.

On the top of this, UNHCR also provided LPG to host communities near the camps as a confidence building measure. Free refill of LPG to them continued for six months. However, by this time, there is a vibrant market for LPG around Ukhiya. Our reconnaissance survey and FGDs and KIIs in the local market confirms that number of shops selling firewood has decreased drastically (however, it did not go to zero), On the other hand, LPG market chain began to appear in the local areas.

The market chain of LPGs is shown in Figure 13. It shows that Rohingya families also rent-out their LPG cylinders in local market and receive cash. At the end of their period, they collect them from these shops and return to NGO-managed distribution centers to receive the refill.

Figure 13: LPG Market Chain



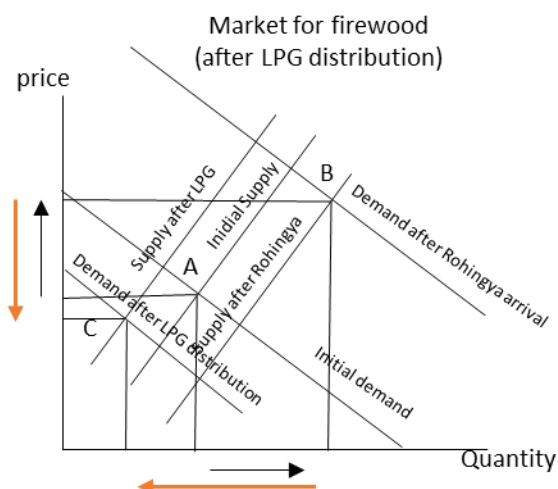
Source: Developed by the Research Team using the local market survey

5.4 Market for firewood after LPG distribution began

After introduction of LPG for the Rohingya families, there has been major change in the market for firewood. The survey results show that on Rohingya households using LPG reduced their daily requirement for firewood to nearly 1 kg from 4.72 kg after they have received LPG. For local households (or Host Community) it has become 2.5 kg per day per family from previous

5.38 kg. Furthermore, nearly 22% of local households are found to be using LPG now (increased from 6.6% before LPG distribution). In addition, almost all the restaurants in local bazars are also found to be using LPG for their cooking. However, it is to be noted that it has not come down to zero.

Figure 14: Firewood Market after LPG Distribution

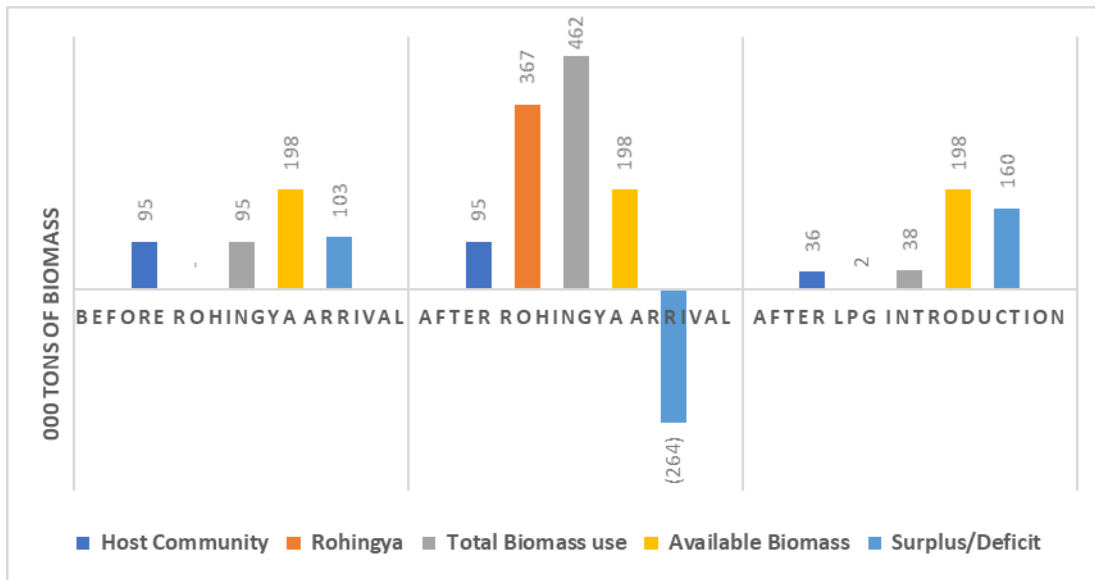


After introduction of distribution of LPG among the refugees. Market for LPG is developed and so demand for firewood decreased both for local and for refugees. This resulted in reduction in supply of firewood from forests too. Now average market price for firewood is 10.62 per kg while a total of 37 thousand tons of firewood is used in a year.

Given the population estimates from UNHCR and Census Data, we have estimated total annual demand for firewood after introduction of LPG. It shows that current demand among local communities and Rohingya households is around 37,000 tons (which was 462,000 tons before introduction of LPG). Price data from local markets show that average price per kg of firewood is now 10.62 (dropped from 14.19 taka per kg). Figure 14 provides the schematic diagram of changes in the demand and supply of firewood market.² Figure 15 shows annual extraction of biomass from different sources before arrival of Rohingya, after arrival of Rohingya and after introduction of LPG in the camps.

² Demand estimates exclude non-household demand for firewood in the local bazars, like that of restaurants, hotels, etc.

Figure 15: Extraction of Biomass

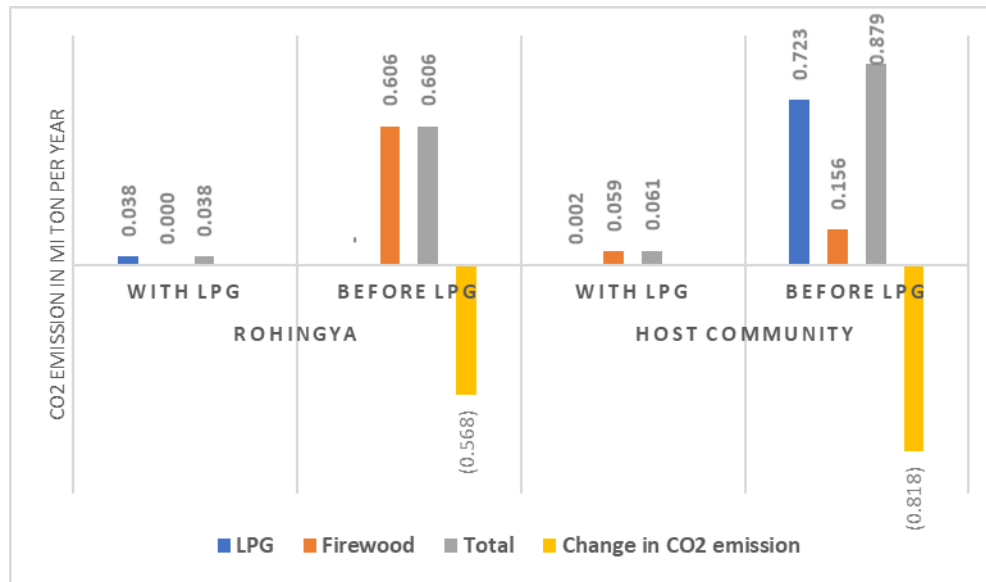


5.6 Carbon emission reduction

Reduction in extraction of firewood from forests and nearby villages (homestead forests / plantations) is expected to contribute to reduction in CO₂ emissions. However, it is also true that LPG use also emits CO₂. Therefore, there is a need to estimate net emission and see if there is reduction in emission level due to introduction of LPG. Figure 16 presents the net changes in CO₂ emission after introduction of LPG. It reveals that reduction of biomass use (negative impact on CO₂ emission) and introduction of LPG (positive CO₂ emission) have resulted in a net reduction of CO₂ emission of 0.568 million tons per year in Rohingya camps only while it has reduced 0.818 million tons per year for similar changes in local communities.

According to a IMF blog report, “to limit global warming to 2°C or less—the level deemed safe by science—large emitting countries need to take ambitious action. For example, they should introduce a carbon tax set to rise quickly to \$75 a ton in 2030”. The report further reiterates that the price of carbon should have been \$50 per ton in today’s price but today’s price is about \$2 per ton (Gaspar, Mauro, Parry, & Pattilo, 2019). Another report by EDF suggests, “the current central estimate of the social cost of carbon is over \$50 per ton in today’s dollars” (EDF, 2019).

Figure 16: CO2 emission and its changes



According to these, we estimate³ that a total benefit of \$69.27 million benefit is accrued per year in terms of carbon benefits when estimates of social cost of carbon is used (according to EDF study). On the other hand, in terms of current market price it is \$2.77 million USD in terms of cash value of the carbon saved and if it is traded as a bundle to the global communities.

5.7 Summary

It now appears that before Rohingya's arrival the community used to consume nearly 95,000 tons of firewood for their cooking. It rose to 462,000 tons a year after 200,000 or more Rohingya families took shelter in Ukhiya. As such it increased pressure on the local forest. FAO using remote sensing data estimated that total firewood available from all the forest and other land in the locality is 401,000 tons a year (FAO, 2017). Clearly, the new demand at the market is at least 462,000 tons as per our estimate.

This clearly indicates that the forest is under tremendous pressure and hence was on the verge of depletion. It was LPG distribution in the Rohingya camps which reversed this situation significantly and current extraction of firewood from the forest is about 37,000 tons a year. This means that the pressure on the forest is now been eliminated in terms of firewood collection. Both Rohingya and local communities are collecting less and less amount of firewood for their daily cooking needs and they are now moving on to use LPG for cooking their daily meals. It has also reduced CO2 emissions by 659 million tons a year.

³ Using CO2 emission of 1.51 kg per kg of LPG, and 1.65-1.85 kg of CO2 per kg of firewood.

6

Conclusion

The objectives of this assessment were to evaluate impacts of LPG supplies to the Rohingya camps that begun in 2018. The intervention was intended to reduce dependence on biomass of the Rohingya households who were blamed to have been responsible for degradation of the Teknaf Reserve Forests. The forest houses many different species of flora and fauna including elephants.

The study collected a) household level information from Rohingya and from locals (host community) from 1399 households; and b) market data from 10 markets surrounding the camps using FGDs and KIIs; The sample was drawn using random tables from the list of households living in selected camps. A total of 15 camps were selected for the survey. Local households were selected from the nearby localities using proximity to the camps.

The study found that there was a significant rise in the demand for biomass to meet the cooking needs after Rohingya influx. Estimates show that biomass demand rose to 3.86 times that of pre-Rohingya influx period. Rohingya household on average used to use 4.72 kg of firewood per day while locals use 5.38 kg per day per household. Study shows that after introduction of LPG among Rohingya people, uptake of LPG rose from 6.6% to 21% among the locals while up to the survey period in October, about 97% of the Rohingya received LPG supplies and were given refills at free of cost.

This led to a 79% drop in demand for firewood in the Rohingya families who received LPGs whereas there was also a reduction of demand for firewood by 53% in the local households who are using LPGs. As such, annual demand for firewood fell from 462 thousand tons to 37 thousand tons in a year – below the sustainable collection limit from the forests. The program not only contributed to a reduction in demand for firewood among households, restaurants, food shops, and other outlets in local bazars also adopted LPG as their primary fuel for cooking meals.

Market survey further reveals that price of firewood per kilogram rose from 12 taka to 14 taka after the Rohingya influx but has now dropped to 10 taka due to introduction of LPG. With reduction in demand and also price for fuelwood in the locality, it is expected that Rohingya and also locals will have less incentives to travel to the forests where they were challenged not only by the forest officers and others, they also were part of the human-animal conflicts in the region. The threat to the forest has been reduced and with program of afforestation taking place in the region, the negative impact on the forest and wildlife is likely to be reduced to a large extent. However, given the fact that many of the camps are located either inside or at

the edge of the forest land, it will not be fair to conclude that the threats have gone to zero due to introduction of LPG.

LPG has also had an impact on the food habit in the families due to ease of cooking as well as due to a pollution free environment in the kitchen. Data reveals that number of food items consumed by the household have increased and food diversity index rose from 0.24 to 0.34 for Rohingya households and from 0.34 to 0.48 among local households who are using LPG for cooking. In terms of nutritional balance, LPG users are found to be consuming more vitamins as their intake of vegetables have increased in the daily diet.

Finally, global benefits from carbon saving is estimated to be \$69 million when social cost of carbon emission is counted. In terms of current market price for carbon trading the benefit however is about \$2 million per year.

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Questionnaire

