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A Study on the Impact of Refugee Influx on the Agricultural Service, Systems and Products; The Case of Rohingya Refugees in Teknaf, Bangladesh

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ABSTRACT

   The Teknaf region in Bangladesh experienced a massive Rohingya refugee influx from Myanmar in 2017, where more than a million refugees fled to Bangladesh. This influx exerted considerable pressure on the local socioeconomic structures, livelihood activities, and environmental resources. This study evaluates the refugees' impact on the agricultural dynamics in Teknaf where farming is the major livelihood means for the local community. Based on primary data from interviews with a representative sample of 98 farming households, the study elucidates shifts in agricultural practice post-influx. It was observed that while the acreage of crop cultivation contracted, enhanced agricultural methods and the introduction of modern crop varieties facilitated a rise in production. Consequently, there was a modest 4% increase in annual household income from agriculture. The cropping pattern shifted from rice dominant to vegetable based. The shift was facilitated by the available of lower waged (450-500 BDT vs 350-400 BDT daily wage) refugee laborers compared to local laborers. The employment of Rohingya laborers at wages below the local standard was prevalent, yet approximately 44% of farmers reported dissatisfaction with the laborers' productivity. The agriculture sector faced notable adversities, including diminished arable land, environmental resource depletion, inflated input costs, and a scarcity of irrigation resources, which collectively compound the challenges faced by the farming community. Addressing the challenges identified, the study advocates for the creation of targeted agricultural support programs to enhance the value addition within host communities. Additionally, fostering small-scale farming projects for the refugees and host community could be instrumental in promoting sustainable livelihoods and engendering economic resilience at the local level.

Keywords: Agriculture, Rohingya, Refugee, Farming community, Teknaf

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1. Introduction

The Rohingya people, a minor community of Myanmar, were rendered stateless by the Burmese 1982 Citizenship Law [1]. Consequently, due to state-sponsored oppression for decades, nearly a million Rohingya refugees have fled to Bangladesh since August 2017 due to violent attacks in their homeland [2]. As a result, Bangladesh now hosts a significant number of the world's total refugees [3]. According to the UNHCR, currently, there are a total of 861,545 Rohingya refugees living in 34 congested camps in Teknaf and Ukhia Upazila under Cox's Bazar district, among which 826,485 are Forcibly Displaced Myanmar Nationals (FDMN), and 35,060 are Undocumented Nationals of Myanmar (UNM) [2]. The Rohingya situation is called the world's fastest-growing refugee crisis [4]. Initially, host communities welcomed the Rohingya refugees from the standpoints of humanity and shared culture. However, the repatriation of Rohingya refugees has failed, and it is said that camps will stay in Bangladesh for an extended period, facing the possibility of a complex local integration process [2,5,6]. The Rohingya refugee situation in Bangladesh is shaping up to be a long-term crisis with no viable solution on the horizon. The massive increase of the refugee population within a brief period, concentrated in the southeast subdistricts Teknaf and Ukhia, has reportedly had a substantial impact on Bangladeshi host communities' food security, economic vulnerability, market access, security aspects, labor opportunities, and environment [7-9].

Hosting of Rohingya refugees has raised concerns over local environmental degradation, falling wages, and rising prices, exerting pressures on communities where public services and infrastructure were already lagging behind the national average [10,11]. Therefore, tensions have been raised between Rohingya refugees and host communities due to the regional social and environmental degradation [12]. As the crisis moves beyond the initial emergency phase, it is essential to have a comprehensive understanding of the needs and vulnerabilities of the host communities. These understandings are necessary to formulate the design and implementation of effective inter-sectoral programming that focuses on managing externalities and enhancing the overall well-being, dignity, and self-reliance of host communities. When a refugee crisis breaks out, the host community suffers a lot and yet has less attention, which is also happening in the case of the Rohingya crisis, where international donors, INGOs, and NGOs are mostly focusing on the refugees [13]. When a region hosts such a massive refugee influx, it has a negative impact on the local community as well as the environment. Rapid deforestation is the most prominent and visible impact of this crisis, threatening the livelihood of the forest-dependent local people. Local communities in Teknaf are highly dependent on forests, and the major livelihoods are related to agricultural activities, including farming, labor, and business related to agricultural products. The Rohingya refugee crisis is affecting the agricultural system in the Teknaf region, but there is a lack of research-based understanding of the extent and status of the impact. However, in the case of understanding the impact of the Rohingya refugee influx, several studies have covered the environmental degradation and economic issues, but there needs to be more empirical research regarding the impact on agricultural systems and the host community [8,14-17]. But so far no studies have focused on the impact on agricultural systems. This study aims to address the problem and explore the impact of refugee influx on the agricultural system in Teknaf.

Although agriculture is among the major livelihood sectors for Teknaf, there are areas requiring improvement to be better developed like other regions of Bangladesh and Teknaf is at the margin of food surplus [18]. Despite facing a lack of technology support for cropping, proper management operation skills, and input shortage (seed, fertilizer, and irrigation facility), a wide range of crops such as rice, seasonal vegetables, fruits, and betel leaf are grown in this area by the local farmers. Shortage of cultivable land is the major challenge faced by the farmers because of the forest-covered hilly terrain in the Teknaf region. In this area, 28% of the farmers have less than 1.5 acres of farmland, and 16% are landless. After the

refugee influx in 2017, it is estimated that about 100 ha of cropland was damaged due to refugee hosting initiatives, including house construction, between 2017 and 2018. Moreover, refugee settlements and humanitarian agencies have occupied 76 ha of arable land. Around 5,000 acres of land have been rendered useless because of sandy soil flowing down from the mountain slopes, which are being used for refugee housing purposes[19]. Besides the decrease of arable lands, agriculture in Teknaf also faces a lack of irrigation, post-harvest facilities, market, and technological know-how, which poses a considerable challenge to the local farmers. Under the above circumstances regarding agriculture in Teknaf, it is important to assess the impact of the refugee influx on agriculture and prepare future strategic plans accordingly to protect and prosper the agriculture and farming community. Therefore, this study will pursue the following objectives – 1) to assess the impact of refugees on agricultural systems and cropping patterns, 2) to determine the level of involvement of the refugees in local agricultural practices, 3) to explore the impact of refugees on the local labor market and 4) to explore the problems in the agricultural sector due to refugee influx in Teknaf. The findings from this study will generate useful understanding regarding refugee impact in local agriculture, which will be also significant to develop strategic refugee management plans in regional, national and global scales.

2. Material and methods

2.1. Study area

The study was carried out in the Teknaf sub-district (also called Upazila) under Cox's Bazar district in the southeastern part of Bangladesh. It is bordered by Ukhia Upazila to the north, the Naf River and Myanmar to the east, and the Bay of Bengal along its western and southern borders. The area is located between 20°45′ and 21°15′ North latitudes and between 92°05′ and 92°15′ East longitudes. This area is diverse: agriculture, coastal and hill ecosystems are the narrow coastal zone of Bangladesh that directly connects with the Bay of Bengal. Fishing, agriculture, and day labor are the major occupations in this area. Teknaf has an area of 388.68 sq. km with 147 villages[18]. The population density in Teknaf is 680 persons per km2, almost half the national average (BBS, 2020). Among farm families, the highest proportion of farmers (31.8%) belong to the small farm category, followed by the marginal farm (28.40%), medium farm (20.41%), the landless (16.30%) and large farm (3.12%). About 29.5% of the total land is under cultivation, with a cropping intensity of 137%, well below the national average of 193%[20]. Paddy, seasonal vegetables, corn and betel leaf are some common crops cultivated in the area. The climate is sub-tropical, with more than 4000 mm of annual mean rainfall and an average temperature of 25.5 °C [21]. The total Rohingya refugee population in Cox's Bazar is estimated at 882,676 of which 111,647 refugees live in 20 camps in Teknaf Upazila[22]. Two villages close to the Shamlapur Rohingya camp were selected for data collection (Fig. 1).

2.2. Sampling procedure

A multistage sampling technique was used for this study in Teknaf. Two villages, namely - Shamlapur and Marishbania, were selected because they have a large number of authorized and a few unauthorized Rohingya camps. Most households in these areas depend on agriculture, fishing, and salt farming. The population of the study was comprised of farm households involved in agriculture farming. According to the Upazila Agriculture Office (UAO), there were 876 households engaged in farming[18]. The sampling size was targeted to be 10% of the total farming household list, i.e., 88 households out of 876. From the list of the farmers, 105 households were randomly selected for data collection. We wanted to sample out some extra households for the incidences of unavailability or incomplete response. The random selection of

105 households was made by using SPSS, where the function Data > Select Cases > Random sample of cases was used to draw random samples from the farmer's list. However, initially, we interviewed 102 households (3 households did not respond or agree to the interview), and after data checking, 98 farming households were fit for final analysis.

2.3. Data collection and analysis

To gain insight into the current challenges faced by farmers and others in the farming industry due to the Rohingya influx, two focus group discussions (FGDs) were organized. Participants included farmers, local leaders, teachers, and concerned individuals. The insights gained from these discussions helped us create a structured interview schedule. The survey was conducted from October to December 2020 using face-to-face interviews. During the interview process, first, the survey team requested the household head for a time and explained to the household head the purpose of the interview. When the household head agrees to participate, we ensure that the questionnaire's contents are clearly explained, and we take permission to disseminate the information while maintaining strict anonymity to protect the participant's privacy and confidentiality. After completing the interview, the information were checked with the respondents for clarity and transparency. While the interview process, some respondents shared their emotions and experience regarding refugee influx. However, a structured questionnaire was used during the interview and data relevant to agricultural systems were recorded. In addition, secondary data was gathered from agriculture officers, government reports, and scientific articles. The interview schedule was composed of a wide range of variables concerning socio-demographic characteristics, agricultural and food-related information[24]. Socio-demographic variables included the farmer's age, education, family size, involvement in agriculture, secondary occupation and annual income. Agricultural activities included the farm size, paddy growing area, paddy production, major cropping patterns, use of local and Rohingya labor in agriculture, efficiency of local and Rohingya labor, labor wage, hiring mechanisms of Rohingya labor and price of major food items. Information on agricultural activities was compared between the time before and after the refugee influx in 2017. Both descriptive and analytical statistics were used for data analysis. The socio-demographic characteristics of the respondents were measured using descriptive statistics such as mean, standard deviation (SD) and percentage. Descriptive statistics help explain the characteristics and basic features of the respondents in a study[23,25]. While comparing mean differences, T-tests were performed. Data analysis was undertaken using R-Studio (Version 1.1.383).
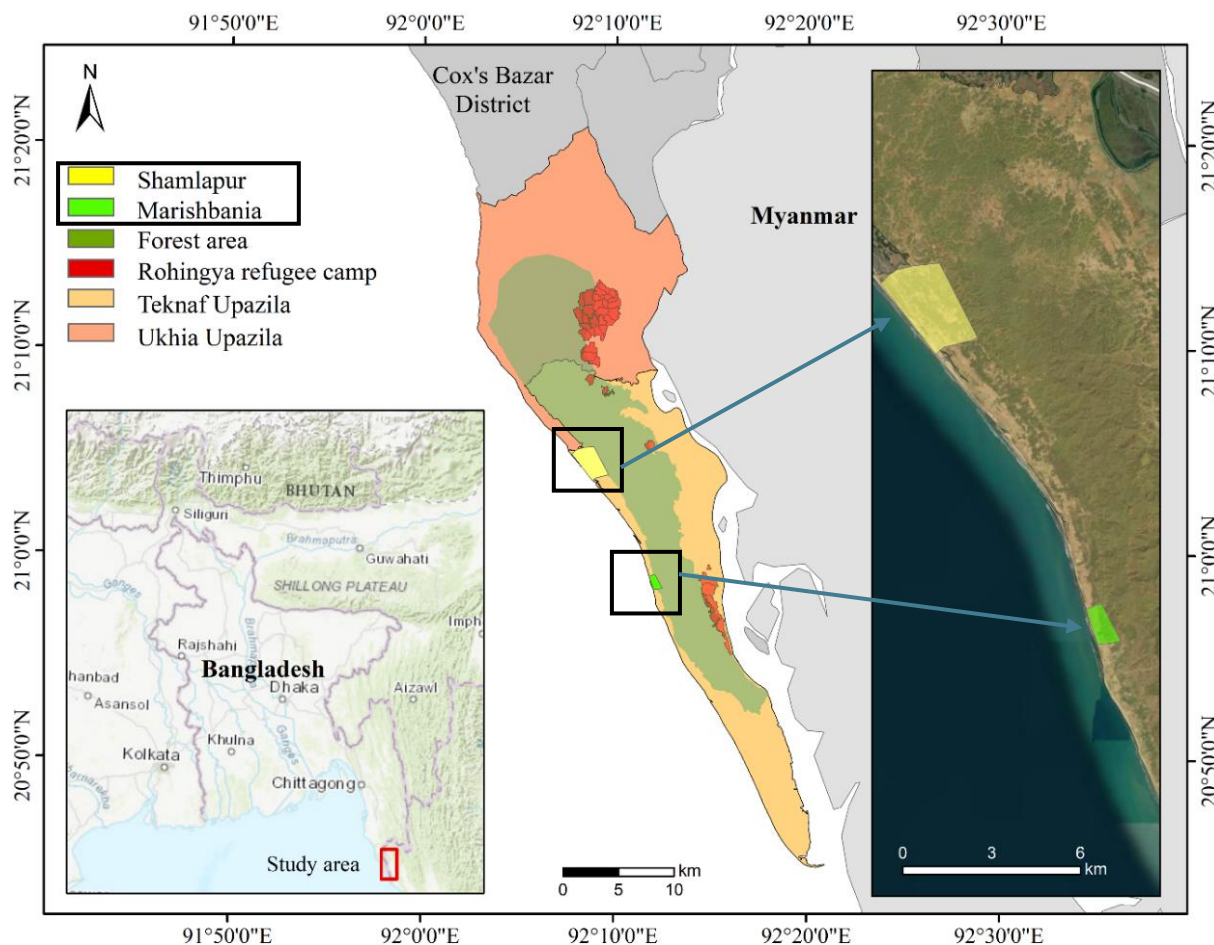
Figure 1. Map showing the Teknaf Peninsula. The study was conducted in two villages (Shamlapur and Marishbania) on the western side of the peninsula. Shamlapur (yellow polygon on map) is bigger than Marishbania (green polygon on map)

3. Results

3.1. Socio-demographic characteristics of the farmers

The average age of the respondent farmers was 42.72 years, ranging from 18 to 75 years. Many farmers only know how to read and sign, having yet to complete elementary education. The average schooling year below 1 reflects the farming community's poor educational status and lack of formal education. The average household size was 6.4 members, ranging from 3 to 13. Larger families were likely due to the need for more labor on farms. The average farming experience of the respondents was 26.14 years, the lowest farming experience was 5 years, and the highest was 50 years. The high experience in agriculture reflects the main livelihood of the region where people are heavily dependent on agriculture and its related services for their livelihood.

Table 1. Socio-demographic characteristics of the farmers (n = 98)

Characteristics	Range	Mean (± SE)
Age (years)	18 – 75	42.72 (±3.02)
Education (years of school)	0 – 4	0.66 (±0.16)
Family size (number)	3 – 13	6.4 (±0.45)
Agriculture involvement (years)	5 – 50	26.14 (±2.35)

Fig. 2 depicts the secondary occupations of the respondents, in addition to agriculture, which is the primary occupation. Almost all farmers engaged in secondary occupations. In Teknaf, there are few large farms, and most of the farmers own small to medium-sized farms that are insufficient to sustain their families. Therefore, farmers require alternative livelihood options. Among them, 38% of farmers worked as labor, followed by small business (20%), fishing (12%), service (10%), driving (10%), and salt farming (4%). Despite owning land, many small and medium-sized farmers work as farming laborers to earn extra income.
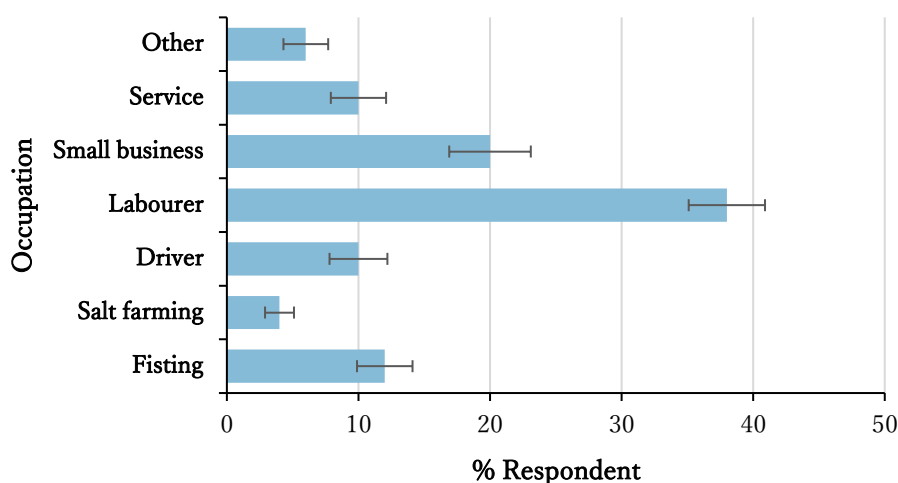
Figure 2. Secondary occupation of the farmers. Bars indicate ±SD (n = 98)

3.2. Impact of refugee influx on local agricultural and cropping pattern

After the refugee influx in 2017, there were reports of sudden changes in various social and economic aspects in the region besides environmental degradation. The farm size of the households decreased by 9.42% after the mass influx of Rohingya refugees. The average farm size was 204 decimals before the influx of Rohingya (in 2016), which was reduced to 185 decimals in 2020. Paddy-cultivated areas decreased by 8% after the influx (Table 2). After the refugee influx due to the new social challenges, some of the large farming families migrated out to safer places and rented farming lands to other farming families. Besides, after the refugee influx many of the farming lands inside forests were inaccessible, which resulted in less cultivable land. Though the area decreased after the influx, the production of paddy increased. Before, on

average per capita paddy production was 2501 kg, which grew to 2653 kg after the influx. The annual income of the farmers slightly increased (4%) after the Rohingya influx (Table 2).

Table 2. Farm size, annual income, paddy growing area and production before and after the Rohingya influx in the Teknaf (n = 98)

Village	Year	Mean (±SE)
Farm size (decimal)**	After influx (2020)	184.56 (±14.74)
	Before influx (2016)	203.76 (±25.89)
Paddy Area (decimal)*	After influx (2020)	127.6 (±8.59)
	Before influx (2016)	135.2 (±10.67)
Paddy Production (Kg)	After influx (2020)	2653 (±350.68)
	Before influx (2016)	2501 (±220.15)
Total annual income (BDT)*	After influx (2020)	303200 (±28688.9)
	Before influx (2016)	291080 (±24344.3)

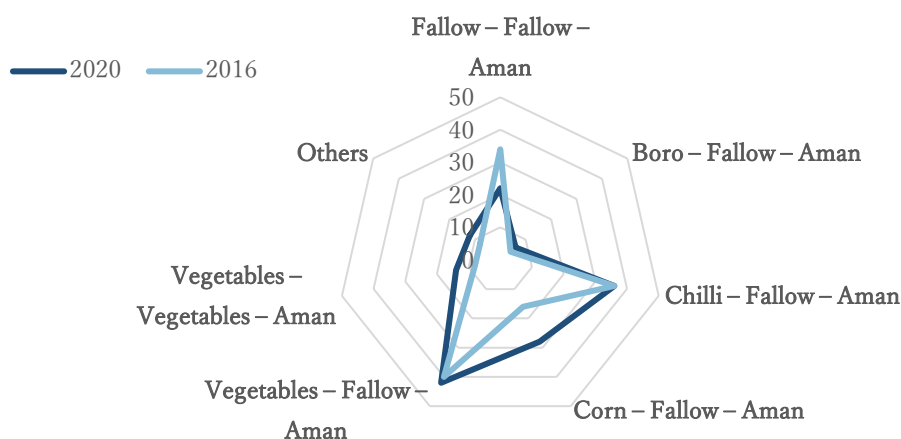*T-test significance level * p< 0.05, ** p <0.01*

Figure 3. Changing cropping patterns in the Teknaf peninsula over time.

There are three cropping seasons in Bangladesh, namely Robi/Boro paddy (mid-November to mid-March), Kharif-1/Aus paddy (mid-March to mid-July); Kharif-2/Aman paddy (mid-July to mid-November). Before the influx, the major cropping patterns were Vegetables-Fallow-Aman, Chilli-Fallow-Aman, Fallow-Fallow-Aman, Corn-Fallow-Aman, Vegetables-Vegetables-Aman, and Boro-Fallow-Aman. After influx, the major cropping pattern changed to Vegetables-Fallow-Aman followed by Chilli-Fallow-Aman, Corn-Fallow-Aman, Fallow-Fallow-Aman, Vegetables-Vegetables-Aman, and Boro-Fallow-Aman. Therefore, after the refugee influx, winter cereals and vegetable cultivation increased and the region experienced a total increase in vegetable cultivation (Fig. 3).

3.3. Involvement of refugees in local agriculture services and their comparative efficacy

In Fig. 4, we can see how Rohingya refugees, local farming laborers, and farmers with their families participated in various agricultural activities. According to the study, Rohingya refugee laborers took on 38-44% of the workforce for the most laborious tasks such as harvesting, transporting crops, and land preparation. Meanwhile, family members were responsible for processing, management, and sowing, which accounted for 46%-56% of the labor force, as these tasks require more skills. In summary, the Rohingya refugees were more involved in the laborious agricultural tasks, whereas local farmers had a higher participation rate in skilled tasks that require knowledge and expertise.
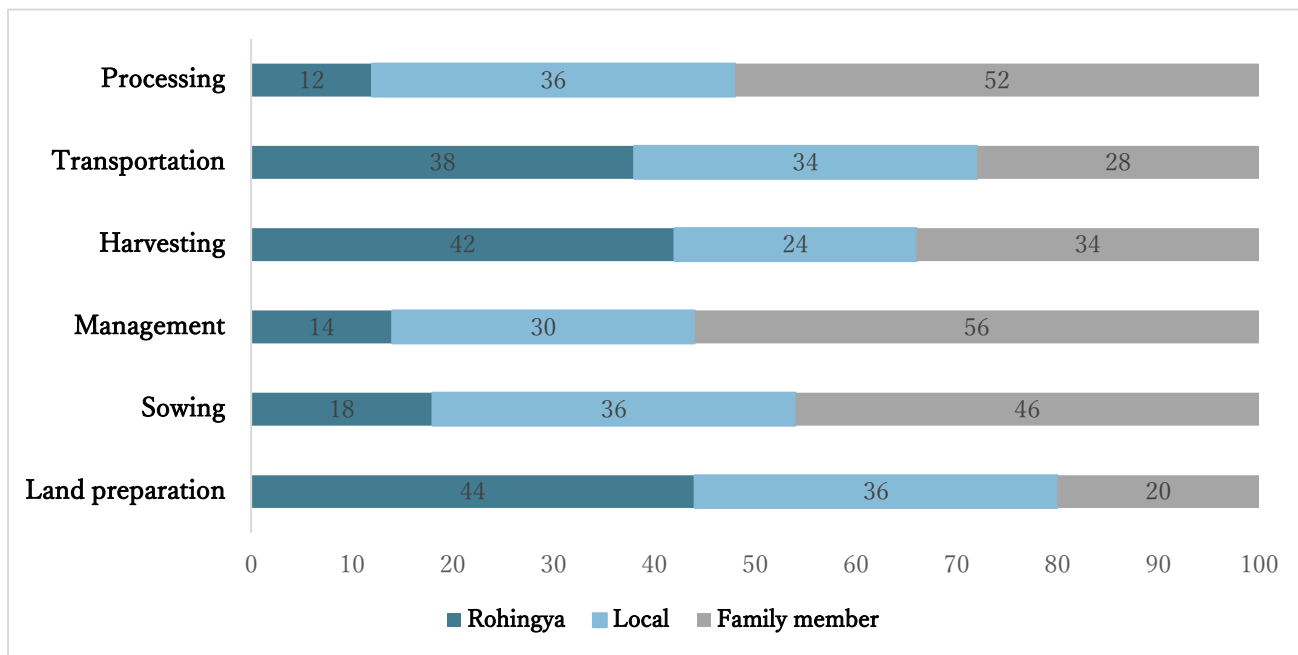

Figure 4. Use of local and Rohingya labor in different agricultural activities (n = 98)

Efficient agricultural labor is crucial for commercial farming, and it is important to understand the perception and belief regarding labor efficiency while deciding the wage of laborers. In Teknaf, a survey shows that 44% of respondents believed that both Rohingya and local labor had the same efficiency (Fig. 5). However, 32% of respondents believed that Bengali laborers were more efficient than Rohingya, and 24% thought the opposite. A significant portion of the respondents believed in equal efficiency of refugee laborers, which can facilitate easier contributions to the local economy.
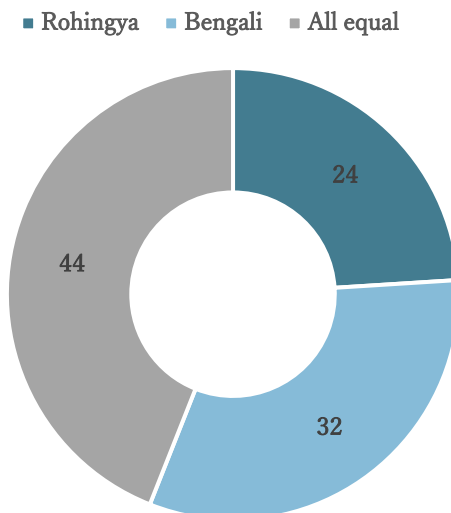
Figure 5. Efficiency of local and Rohingya laborer (n = 98)

3.4. Impact of refugee influx on the local labor market

When a community hosts more than double the number of refugees compared to the host community, it is expected to impact the labor market significantly. With an excess of refugee laborers, they tend to become cheap and easily accessible. In Fig. 6, we can see a comparison of the labor wages between locals and refugees, while Fig. 7 shows the hiring system of refugee laborers. The study revealed that local laborers were paid 450-500 BDT daily, while refugee laborers were paid 350-400 BDT daily. BDT is the local currency of Bangladesh, where the conversion rate is around 1 USD, equal to 100 BDT as of November 2023. In the Teknaf region, there was a significant wage gap (mean difference by T-test, significant $p <0.01$) between local and refugee laborers which is presented in Fig. 6. The lower wage gap can be associated with the abundance of a large number of refugee laborers with almost similar skill set and the complicated legal issues related to work permit. Due to the fact that they are not permitted to work legally, the Rohingya refugees are unable to obtain a legal contract for employment. As a result, the best option for them is to work as daily laborers, where a formal contract is not required and payment is made in cash at the end of the day.
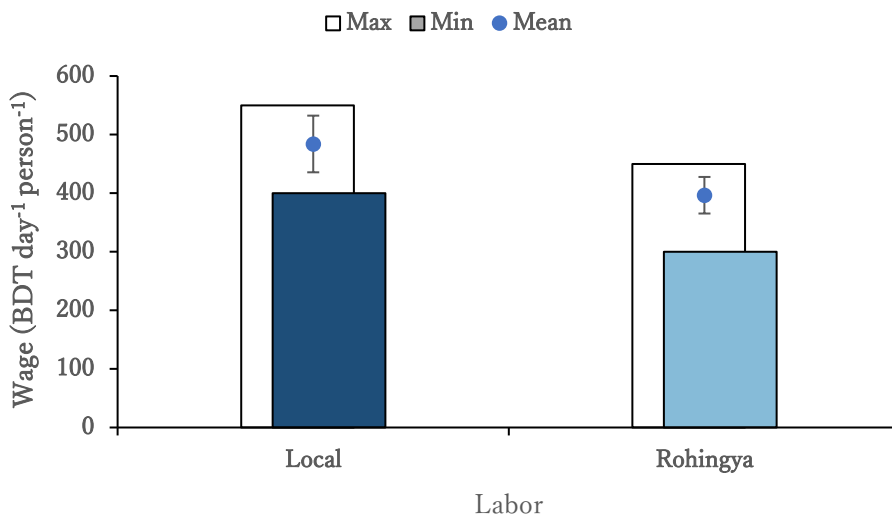
Figure 6. Wages of local and Rohingya laborers. Vertical bars indicate ±SD (n = 98)

Fig. 7 shows the hiring process of the refugee laborers. Most respondents (76%) reported that they first searched for Rohingya laborers when needed. This reflects the easy abundance of refugee labors in the local community. In general, Rohingya laborers were found to walk around the locality for daily basis work and 36% of respondents hired Rohingya laborers at their homes and/or crop fields. About a quarter of the respondents (24%) hired labor through brokers (Fig. 7).
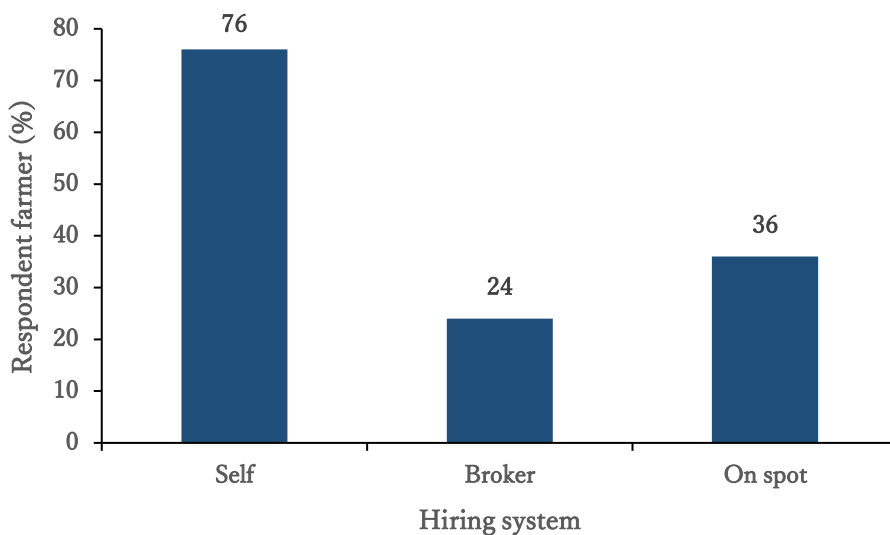

Figure 7. Distribution of the respondent farmers according to hiring system of Rohingya labor (n = 98)

3.5. Major challenges in the local agricultural systems due to refugee influx

The survey respondents in Teknaf were requested to identify and rank the major challenges they are facing due to the refugee influx. The farmers pointed out several problems that are negatively impacting the local agriculture systems and services. The most common problem mentioned by the farming community was the reduction of arable lands. This reduction happened in various ways. Some of the large farming families migrated to other places due to social security crisis, leaving their farms as absentee lands. Besides, in Teknaf, many farmers grow crops in forests and other government lands. However, following the influx, those lands were mostly used for refugee camps and, in some areas, restricted to locals due to security issues. Consequently, the available land for cultivation decreased. After the refugee influx, security concerns inside the forests limited the local community's access to forest resources. Unfortunately, the local community heavily depends on forests for fuelwood and agricultural input materials. The restricted access to forests severely impacted the farming community, especially those growing betel leaves as cash crops. The full ranking from 1 to 7 is presented in Table 3. The problems indicate that many people depend on limited resources, creating pressure on refugees' and hosts' livelihoods.

Table 3. Major challenges of Rohingya influence on agriculture

Challenges	Rank
Decrease of arable land	1
Limited access to forest and other resources	2
High input cost	3
Scarcity of irrigation water	4
Unavailability of skilled labor	5
Lack of materials for betel leaf cultivation	6
Theft of agricultural products by Rohingya people	7

3.6. Price changes of major food items

The respondents were asked about the price change of food items over time. The price trends for selected food items between 2016 and 2020 demonstrate an increase in costs. As shown in Fig. 8, the most pronounced price escalation occurred for onions, with an increase of nearly 50%. Tomatoes and lentils also experienced significant price rises, at approximately 40% and 39%, respectively. Wheat and rice, two staple food items, witnessed increases close to 36% for both. Potatoes, while less affected, still showed a notable price rise of around 34%. Mangoes, with the smallest increase, had their prices go up by over 18%. Among the products, rice is cultivated locally but yet requires import from other regions. The error bars on the graph suggest a degree of variability which could reflect market fluctuations and other economic factors. These findings indicate a considerable inflationary pattern in the costs of key food items before and after the refugee influx in the region.
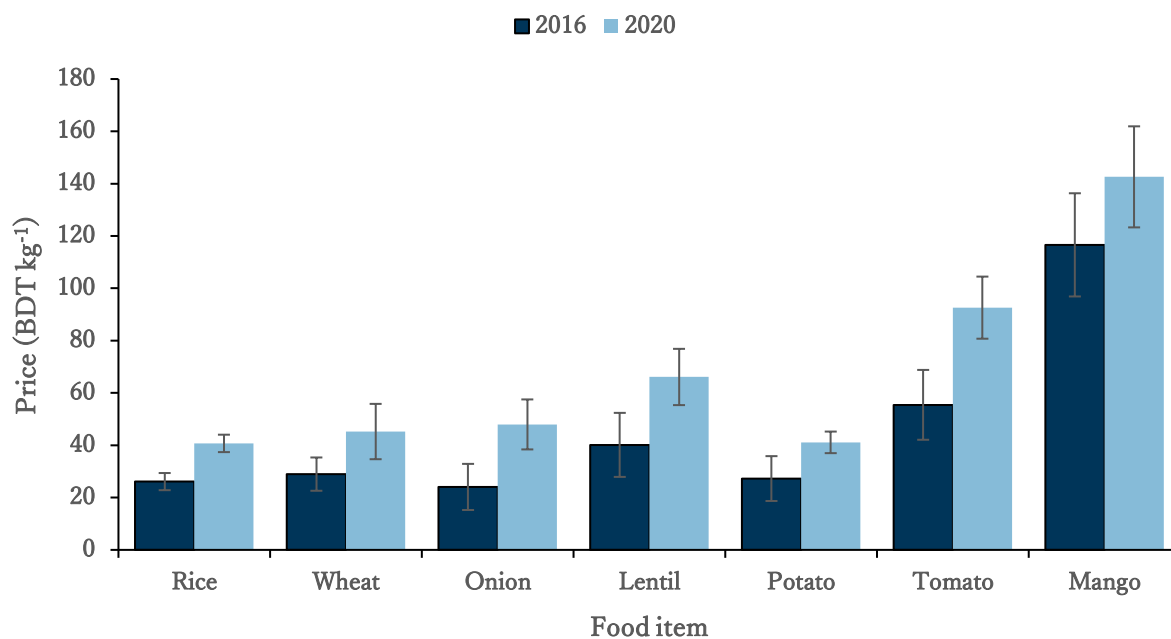
Figure 8. Comparison of prices of major foods in Teknaf before (2016) and after (2020) Rohingya influx. Vertical bars indicate ±SD.

4. Discussion

This study determined the impacts of the Rohingya refugee influx on the agricultural systems and services in Teknaf. To analyze the impact of refugee influx on local agriculture, it is important to understand the socioeconomic status of the farming community, who are mostly engaged in agricultural activities. The study revealed that the farmer community had low formal education, which can be related to the overall poverty and the lack of educational institutions in that region. The average household size was 6.4, larger than the national average of 4.4[26]. It is common among the farming-dependent community to have large families, and in Teknaf, our study found the domination of large families. This study found that farmers have moderate to high experience in farming but the agricultural service and system is not well developed compared to the country's other regions. Rahman et al. (2014)[27] reported that agriculture in Teknaf showed a significant increase after 1990 following extensive clearing of forests to create many settlements. Moslehuddin et al. (2018)[21] reported that agricultural productivity is lower in Teknaf than in many other parts of Bangladesh because of the use of conventional crop varieties and the lack of know-how. As a result, the region was listed to be a marginally food-surplus area[18]. The underdeveloped agricultural sector with lower education and large families indicates the vulnerability of the farming community. As farming cannot fully support their livelihood, all the respondents had secondary occupations other than agriculture. It was also found that the day laborers in agriculture and fishing were at a proportional rate, which is also a good agreement of Ullah et al. (2021)[28].

This study found that farm size diminished significantly after the refugee influx. Similarly, the area for paddy cultivation experienced a decrease in a similar time period. The Rohingya crisis had an environmental impact on the region, which also led to agricultural land loss[29]. Besides the agricultural land loss due to environmental degradation, it was also found that significant areas were inaccessible due to the construction of refugee hosting infrastructures and security concerns.

Interestingly, the per capita production of paddy was increased in the study area. An increase in paddy production can be associated with intensive cropping, hybrid variety use, increased use of fertilizers and availability of extra refugee labors. Consequently, the annual income of the farmers in the region also increased. This might be due to the price hike of crops in that region after the Rohingya influx related to the extra demand of food in the region. Other studies also found that rice prices have risen in Cox's Bazar due to the Rohingya crisis[30]. Ullah et al. (2021)[28] reported that the income from farming in the study area increased by 29% which can be associated with the increased crop production after refugee influx[7,19]. Therefore, due to the increased food demand and food price, the annual income of the farmers increased even though the total cultivable land in the area experienced a decline.

After the refugee influx, the cropping pattern in the region change. This change can be associated with increased cropping intensity, elevated crop prices, availability of extra labor, and resource scarcity. A trend of shifting towards vegetable-based cultivation in recent times was observed in the region. Rice cultivation during the dry winter season was found to be decreased due to constraints in irrigation water availability. After the refugee influx, the region's population increased by nearly a million, which had a strain on the local water resources[29]. The availability of a cheaper labor pool also facilitated the shift toward more intensive cropping practices, particularly in high-value, vegetable-based crops. The lowered labor costs made it financially viable for farmers to invest in crops that may require more labor but yield higher returns, effectively altering the traditional rice-dominant cropping patterns. Many Rohingya refugees, constrained by employment restrictions, were found to be engaged in agricultural services. They are often tasked with labor-intensive duties like land preparation and harvesting, thereby freeing up local skilled labor to specialize in tasks such as sowing and planting. Additionally, the high number of Rohingya laborers has suppressed agricultural wages in comparison to local rates, with Teknaf seeing an 11% wage decline due to the Rohingya influx[8,31]. Despite a rise in production and intensified cropping, farmers observed higher commodity prices post the refugee influx in the Teknaf region. This influx led to a population surge of about a million in the area, triggering increased commodity demand and higher prices. This observation is consistent with Ahmad and Naeem's (2020)[8] findings. Nationally, Bangladesh saw a rise in daily commodity prices, driven by increased per capita income. Certain commodities, like onions and potatoes, saw even steeper price hikes due to limited availability and import restrictions from India. For the Teknaf region, these prices were even higher due to transportation costs and a supply-demand imbalance. As a result of the refugee influx in Teknaf, farmers experienced increased income and shifted their focus towards vegetable cultivation, benefiting from lower labor costs. Concurrently, they encountered higher prices for local goods. This situation tends to favor farmers with extensive farmland and higher socioeconomic status. However, small-scale farmers, particularly those with minimal or no land and who rely primarily on secondary occupations such as labor work, may find it challenging to sustain their livelihoods.

The impacts of refugee influx on the agricultural systems, services and products are exacerbated by the impoverished socioeconomic status and deteriorating environment in the region. Although the annual income increased and the agricultural products experienced price hike, the cheap refugee labor force and decreased cultivable land had put pressure on small farms and farming labors. The local community in Teknaf highly depend on agriculture and natural resources. Teknaf was declared an ecologically critical area in 1999[32] and the local forests are considered as protected areas with limited access inside. However, local communities depend on natural resources with very limited alternatives for their livelihoods [28]. Severe damage to natural resources has been reported due to large-scale forced migration in poor countries[33]. After the refugee influx, natural resources paid a toll to meet the extra demand. Water availability for household

consumption and irrigation decreased remarkably due to the over-lifting of groundwater for the Rohingya people and the blocking of the water channel for Rohingya settlements[14,22]. All the refugee camps were established inside forest areas, resulting in deforestation[34]. IC Net (2018)[35] reported a few challenges to agriculture due to the Rohingya influx in Bangladesh, such as a decrease in cultivable land, scarcity of water supply and damage to crops.

The influx of refugees into Teknaf has significantly affected the agricultural landscape, exerting pressure within an already impoverished socioeconomic context and a vulnerable environment. The increase in annual income for farmers and the consequent rise in agricultural product prices has not uniformly benefited the local community. The availability of cheap refugee labor, while potentially beneficial for some agricultural practices, has imposed additional strains on small-scale farms and local laborers due to the concomitant reduction in arable land. The dependency of the Teknaf community on agriculture and natural resources is profound. Despite the designation of the region as an ecologically critical area in 1999 [32,36] and the protective status afforded to local forests, community reliance on these resources persists with few alternative means of livelihood[28,37]. The pressures on natural resources have been accentuated by the refugee presence[33,34], with water sources for both domestic use and irrigation being notably over-exploited to accommodate the needs of the Rohingya settlements. Additionally, the establishment of refugee camps within forested areas has led to considerable deforestation, further depleting the environmental assets that the local agricultural systems depend upon. In summary, while the refugee crisis has introduced a paradox where agricultural income has risen due to higher product prices and intensified cropping aided by an influx of labor, it has also precipitated a degradation of the environmental foundation essential for sustainable agricultural practices. The diminished availability of cultivable land and the depletion of natural resources, present critical challenges that must be addressed to ensure the resilience of the agricultural sector and the broader ecosystem in Teknaf.

5. Conclusion

The Rohingya refugee influx had impact on the agricultural landscape and food systems in Teknaf, both positively and negatively. Cultivable land deceased due to Rohingya settlement and related other activities. However, income from the agriculture sector increased due to the increasing production by using modern verities and technologies, despite the decrease in farmland. The wage of Rohingya laborers was lower than local labor which influenced farmers to hire Rohingya labor on a large scale, even though many farmers were not satisfied with their efficiency. Farmers in the study area experienced various challenges in agriculture such as decreased arable land, lack of irrigation, high input cost, post-harvest facilities, skilled labor crisis and technological know-how. The Rohingya influx increased the total population and created a wide gap between food supply and demand that may be responsible for the high market prices of foods. It is recommended that technical and logistic support programs for agriculture would promote income generation sustainably. Small-scale farming for Rohingya people would help improve the overall agriculture production and ensure food and nutrition security. Fallow lands can be brought under cultivation with proper design and cultivation plan. In conclusion, while the influx of refugees into Teknaf has led to a complex alteration in agricultural practices and outcomes, it is essential to balance the economic benefits with the social and environmental costs. Strategies to mitigate these impacts must consider the need for agricultural development, resource conservation, and socio-economic stabilization to ensure the resilience of both the host and refugee communities.

Declaration of competing interest

Acknowledgment

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