



(RESEARCH ARTICLE)



## Comparative study on paddy harvesting technologies in Sylhet region

Shermin Aktar \*, Warasa Mostafa, Muhammad Rashed Al Mamun and Khairul Islam

*Department of Farm Power and Machinery, Sylhet Agricultural University, Sylhet-3100, Bangladesh.*

GSC Advanced Research and Reviews, 2024, 19(02), 093–103

Publication history: Received on 22 January 2024; revised on 05 March 2024; accepted on 08 March 2024

Article DOI: <https://doi.org/10.30574/gscarr.2024.19.2.0092>

### Abstract

Mechanized paddy harvesting is currently limited in Bangladesh, but the pace of mechanization is increasing. Harvesting must be done on time to minimize losses and timely harvesting depends on the availability of harvesting machinery. The aim of this study was to find out the state of mechanized paddy harvesting technologies in Sylhet region over the last five years. The study was conducted in all upazilas under the Sylhet region to compare mechanized and manual paddy harvesting technologies. Structured questionnaire was used to collect data. The survey revealed the changes in mechanization status in 2022 compared to the previous four years. In the study area, the average paddy cultivable area was 0.91 million hectares. The pace of mechanized harvesting in Sylhet, Sunamganj, Habiganj, and Moulvibazar district were 31.49%, 24.41%, 19.59%, and 15.95%, respectively. On the basis of the provided data, from 2018 to 2022 the number of harvesting machines increased from 547 to 1852. The manual method, combine harvester, and reaper were used to harvest 76.20%, 21.90%, and 1.90% of the total projected area respectively in 2021-2022. The study revealed that combine harvester covered around 87.47% area than reaper. In 2022, among the 40 upazilas, the most machines were found at Nabiganj upazila in Habiganj district =106, and the fewest machines were found at Barlekha upazila in Moulvibazar district =10. The trend of manual paddy harvesting has declined in Sylhet region due to the increase in the number of harvesting machines. So, harvesting machineries are needed in this region to update paddy harvesting mechanization status.

**Keywords:** Mechanization; Harvesting machinery; Mechanized harvesting; Manual harvesting

### 1. Introduction

Bangladesh is primarily an agrarian country where the agriculture sector contributes significantly to rising productivity, maintaining long-term food security, and creating job opportunities. According to the BBS's provisional estimate, in FY 2020-21 agriculture contributes around 11.50 percent to the GDP (2). About 87 percent of Bangladesh's rural households rely on agriculture for at least some of their income, while nearly half of all workers in the country and two thirds of workers in rural regions are directly employed in agriculture (14). But agricultural labors are decreased from 63% in 2007 to 47% in 2012. Due to manpower scarcity, timeliness of operation cannot be maintained, which reduces yield (6). Significant amount of field losses of paddy in every year has been occurred due to unavailability of mechanical harvesting system, natural calamities and shortage of time during harvesting period (10). Paddy harvesting is manually done by sickle by both male and female farmers in Bangladesh (11). In Bangladesh, traditional paddy harvesting with a sickle is a time-consuming, expensive, and labor-intensive task. Nowadays, workers migrate to cities or abroad to engage in more remunerative employment, particularly in the garments and construction sectors and high labor wages in peak harvesting season (15). Developed countries like South and Southeast Asia are using automatic combine harvester for harvesting cereal grains, and as a medium grade technology, and many developing countries are using a reaper for harvesting rice to minimizing production cost and are thereby, making agricultural production economical (1). Mechanical harvesting machinery must be introduced to reduce crop losses and raise cropping intensity. According to projections, the output of rice and wheat would need to expand by 0.4 and 2.17% yearly to keep up with the two

\* Corresponding author: Shermin Aktar

million people who will be added to the population each year (4). Bangladesh has to increase food production from the same amount of land, while also reducing the demand for farm labor as a result of the nation's increasingly lucrative alternative types of employment (15). Every year, natural disasters and a lack of time during the harvesting period cause a significant amount of field losses of rice (10). In Bangladesh, rice harvesting can be done using one of three types of harvesting equipment: reapers, mini-combines, and small to medium size combine harvesters (3).

Agricultural mechanization is the method of transferring energy in a farm production system utilizing engines or motorized machinery. It simplifies and gets rid of labor-intensive processes, makes up for manpower shortages, and increases productivity (12). Suitable technology, particularly harvesting machinery, is urgently needed to develop and implement for agricultural mechanization in order to improve productivity with less drudgery and more efficiency (1). The labor demand for rice harvesting reaches its highest between 170-200 man-hours per hectare when employing sickles. (13). Additionally, it was noted that 240 man-hours were needed to harvest one hectare of rice using a sickle (11). However, it is estimated that utilizing a reaper for harvesting operations saved around one-third of overall labor. Proper crop management strategies would enhance rice production (13). Mechanical harvesting is absolutely necessary to improve agricultural yield with the least number of inputs (9).

According to FAO (1988), the Sylhet agricultural region is a complex area with a wide variety of microenvironments and a varied geography that ranges from hills to very lowlands. This region is comprising of six prominent agro-ecological zones namely, Old Meghna Estuarine Floodplain, Eastern Surma Kusiara Floodplain, Sylhet Basin, Northern and Eastern Piedmont Plains, Northern and Eastern Hills and Akhaura Terrace (FAO, 1988). The haor region surrounding Sylhet, which is below the northeastern Himalayan foothills and has a tremendous potential for crop growth, receives the most rainfall in the globe, making the area vulnerable to flash floods (8). Among Bangladesh's 64 districts, Sunamganj, Habiganj, Moulvibazar, and Sylhet all contribute significantly to crop output. In this area, many kinds of agricultural equipment are employed to cultivate crops. But in this area, not all machinery is used to its full potential (5). Because of this, the yield produced per hectare varies over the growing season.

According to the Department of Agricultural Extension (DAE), Natural calamities, including the flash floods in 2022 in Sylhet have caused the most damage to the paddy and seedbed. Flash floods and heavy rain have damaged the production of 78,987 tons of this season in haor areas. Paddy losses during this flash flood could have minimized by using machinery like combine harvester and reaper for harvesting. Because harvesting paddy with combine harvester and reaper is faster than manual harvesting. Considering the aforementioned matters, it is vitally necessary to adopt mechanical harvesting techniques to ensure timeliness in harvesting operation, to reduce harvesting losses and increase crop intensity, crop productivity in Sylhet region. Furthermore, automated paddy harvesting might be a great opportunity to increase the percentage of GDP in Bangladesh, which will help to boost food security in Bangladesh's Sylhet region and will greatly contribute to the development of Bangladesh's socioeconomic status. Hence, this research aimed to evaluate the modern technologies used for harvesting paddy and show an exact scenario of the existing paddy harvesting practices for better improvement in Sylhet region.

---

## 2. Materials and Methods

### 2.1. Study area

For conducting any research study area selection is an important step. Forty upazilas of Sylhet, Sunamganj, Moulvibazar and Habiganj district under Sylhet agricultural region were the location of this study. The objectives were related with selection of study area.

### 2.2. Harvesting processes

Two methods were used for paddy harvesting in Sylhet region. These were:

- Traditional paddy harvesting method (sickle) and
- Mechanical paddy harvesting method (like combine harvester and reaper)

### 2.3. Preparation of survey schedule

The survey schedule and Structured questionnaires were used with active consultation with the respective supervisor, relevant field experts, and secondary data. For the purpose of collecting data, the draft schedule was prepared and necessary corrections, modifications and switching or exchanging information were made.

## 2.4. Collection of data

A set of structured questionnaires was prepared for the purpose of collecting data from the upazila office. Structured questionnaires were prepared for each upazila to collect information. Secondary data were used for the study. Data were collected from 40 predetermined SAAO of each upazila during July to November, 2022 at upazila level. The SAAOs were selected by AEO or UAO. Data were checked and analyzed by agricultural engineer at each Deputy Director's office of DAE. Before data collection, each question was carefully explained along with proper guidelines to them. The data was gathered using a numerical approach so that after collecting data could be accumulated to find out present status of machineries for paddy harvesting available in Sylhet region (Table 1).

## 2.5. Analysis of data

The data was collected, compiled, tabulated, and analyzed concerning the study's objectives. The descriptive statistical analysis was done using MS Excel software, and findings were presented in tabular and graphical forms.

## 3. Results and Discussion

### 3.1. Land use

The status of agricultural land use for paddy cultivation as shown in Table 2 and Table 3. In 2018, The net cultivable area of the Sylhet region is 1.01 million hectares. But paddy was cultivated on 0.86 million hectares of land. The net cultivable area of the Sylhet region is 1.02 million hectares. Whereas, paddy was cultivated on 0.91 million hectares of land in 2022. The highest paddy cropped area stand in Sylhet district while the lowest is in Moulvibazar district. The Sylhet agricultural region's cropping intensity has essentially stagnated at roughly 150% over the past three decades and is substantially lower than the 192% national average (BBS,2018).

**Table 1** Land use of different districts in Sylhet region, 2018-19

District	Total cultivable area (million ha)	Total cultivable area under paddy (million ha)
Sylhet	0.30	0.28
Sunamganj	0.28	0.21
Moulvibazar	0.21	0.17
Habiganj	0.22	0.20
Total	1.01	0.86

**Table 2** Land use of different districts in Sylhet region, 2021-22

District	Total cultivable area (million ha)	Total cultivable area under paddy (million ha)
Sylhet	0.31	0.29
Sunamganj	0.28	0.22
Moulvibazar	0.21	0.19
Habiganj	0.22	0.21
Total	1.02	0.91

### 3.2. Status of paddy harvesting machinery in the selected areas

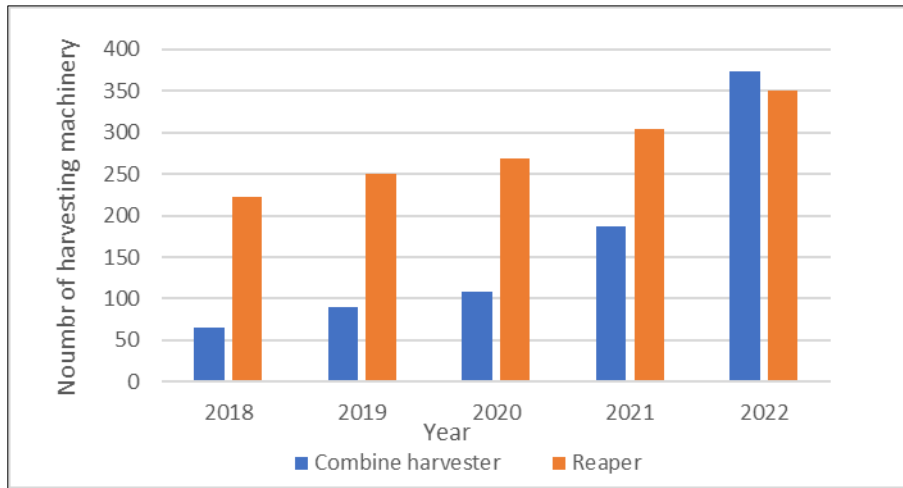
The state of paddy harvesting machinery in Sylhet region was unevenly distributed.

The statistics of paddy harvesting machinery of different upazilas in Sylhet region from 2018 to 2022 is presented in Table 1. From this, it indicates that the use of agricultural machinery for paddy harvesting sharply increased from 547 to 1852 between 2018 to 2022.

### 3.2.1. Sylhet district

The availability of machineries in Sylhet district as shown in Figure 1. It shows that the availability of reaper was maximum and combine harvester was minimum till 2021. The fact that less awareness and high prices influenced the minimal use of combine harvesters. In 2018, there were only 222 number of reapers and 65 number of combine harvesters in Sylhet district. But in 2022, the number of reapers and combine harvesters increased by 350 and 373, respectively. In the area of Metropolitan, there was no paddy harvesting machinery. Among the 14 upazilas under Sylhet

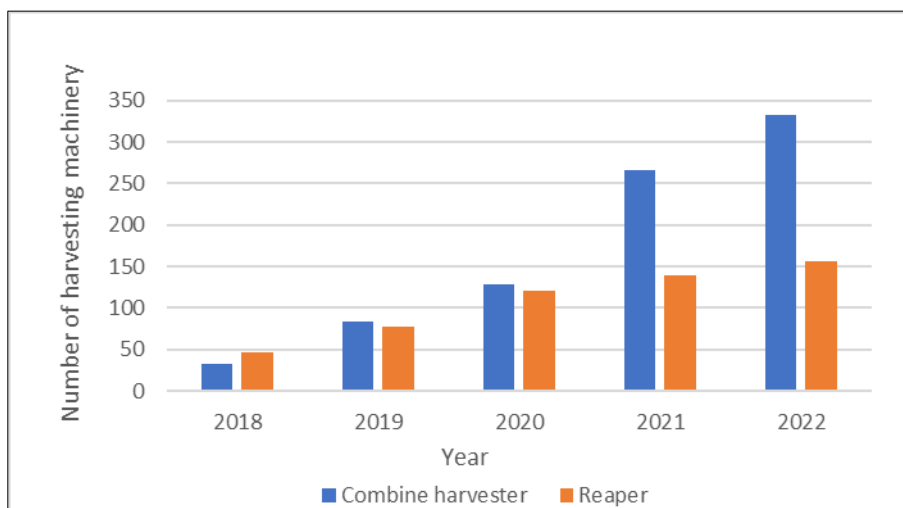
district, the most combine harvesters were found at Goainghat upazila {46}, and the least were found at Zakiganj {14} in the year 2022. The most reapers were found at Kanaighat upazila {46}, and the fewest at Zakiganj {5}.



**Figure 1** Number of harvesting machineries in Sylhet district

### 3.2.2. Sunamganj district

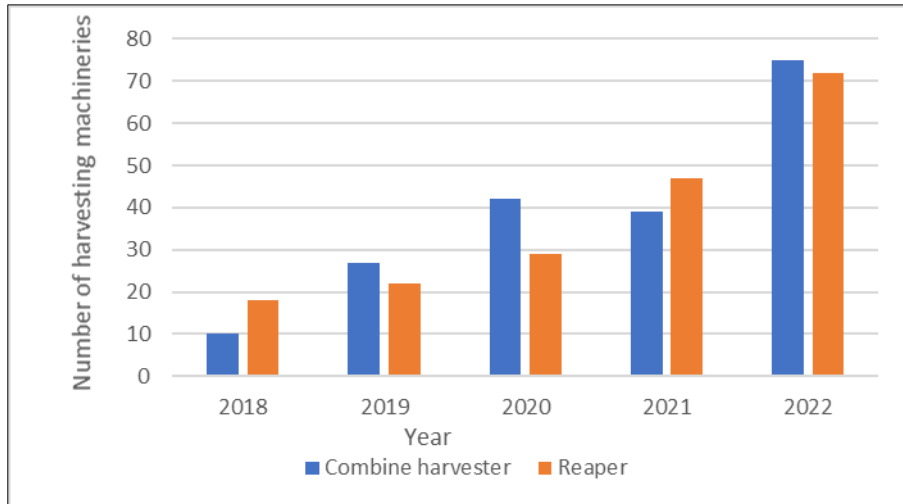
In the year 2022, a large number of combine harvesters were available in Sunamganj district compared to the previous four years. In 2018, there were only 47 number of reapers and 32 number of combine harvesters in this study area. In 2022, the number of reapers and combine harvesters increased by 157 and 333, respectively (Figure 2). In Sunamganj district at Derai upazila in 2022, there were 60 number of combine harvesters, whereas there were only 14 at Dowarabazar upazila. The most reapers were found at Shalla upazila {44}, whereas the least were found at Dharmapasha upazila {1}. Harvesting machinery utilization increased from 2018 to 2022.



**Figure 2** Number of harvesting machineries in Sunamgang district

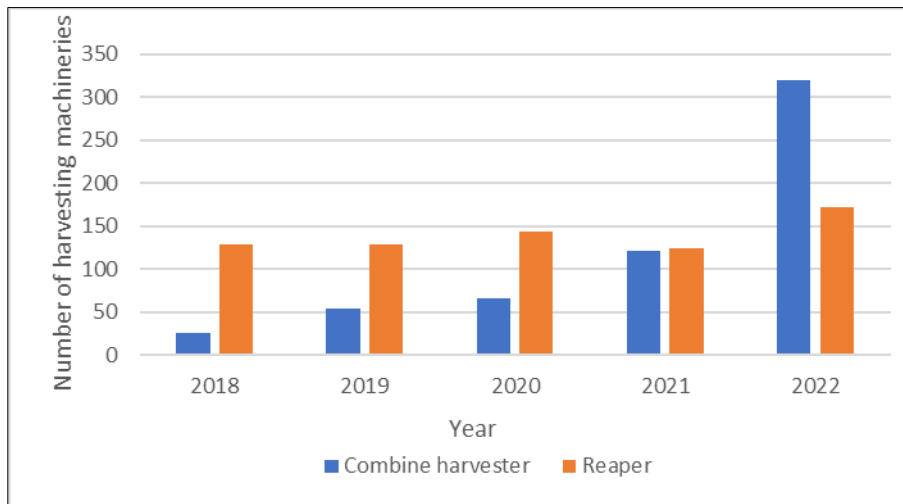
### 3.2.3. Moulvibazar district

In 2018, there were only 18 number of reapers and 10 number of combine harvesters in Moulvibazar area, which was extremely low. In 2022, the number of reapers and combine harvesters increased by 75 and 72, respectively in Moulvibazar district (Figure 3). It is noticeable that the number of combine harvesters decreased in 2021 due to a lack of replacement parts. That's why some combine harvesters were inactive at this time. According to 2022, the highest reapers were found at Kulaura upazila (22) and the fewest were seen at Barlekha upazila (3) in the Moulvibazar area. There were 17 number of combine harvesters at Moulvibazar sadar upazila, whereas there were only 8 at Juri upazila. The rate of Machinery use in harvesting has increased gradually.



**Figure 3** Number of harvesting machineries in Moulvibazar district

### 3.2.4. Habiganj district



**Figure 4** Number of harvesting machineries in Habiganj district

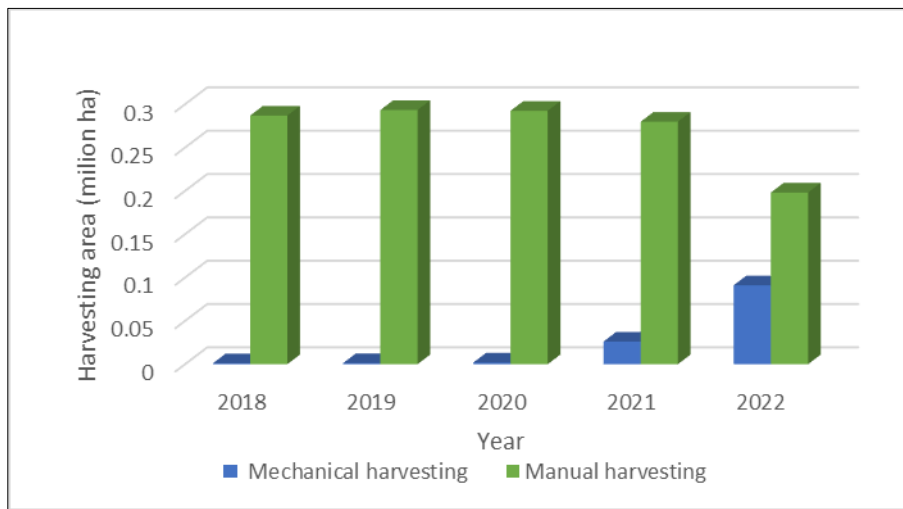
Each year, the availability of combine harvesters and reapers has increased significantly in the Habiganj district as represented in Figure 4. Out of 1101 number of combine harvesters and 751 number of reapers, respectively, 320 and 172 were found in this district in the year 2022. Due to a lack of proper management, the availability of machinery was minimal in previous four years. In the year 2022, there were 61 number of reapers at Chunarughat upazila, whereas there were only 5 at Bahubal upazila in Habiganj district. The most combine harvesters were at Nabiganj upazila (78) and the fewest at Madhabpur upazila (16).

### 3.3. Status of paddy harvesting practices

Most of the area's paddy was harvested manually using sickle which indicated relatively slow rates of mechanized harvesting in the investigated area. Reapers and combine harvesters were used for mechanical paddy harvesting. Paddy harvesting area by machinery has increased, but only slightly more than manual harvesting. The is of paddy harvesting area of different upazilas in Sylhet region from 2018 to 2022 is presented in.

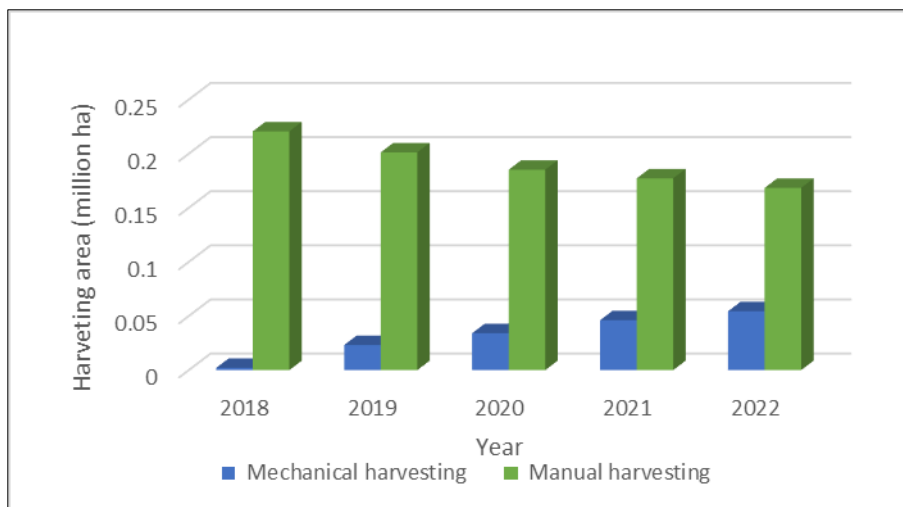
#### 3.3.1. Sylhet district

The manual paddy harvesting tendency was waning in the Sylhet district due to the rise in the use of harvesting machines as shown in Figure 5. It is clearly seen that from 2018 to 2022, the manual paddy harvesting area decreased from 0.2869 million hectares to 0.1981 million hectares. On the other hand, the mechanized harvesting area increased from 0.0011 million hectares to 0.0911 million hectares. Among the 14 upazilas under Sylhet district, the percent of mechanized harvesting was highest at Fenchuganj upazila, which was 85.7% in the year 2022. In the metropolitan area, 100% manual paddy harvesting has been done for the past few years. Because there were no available machines for harvesting paddy.



**Figure 5** Paddy harvesting area in Sylhet district

#### 3.3.2. Sunamganj district



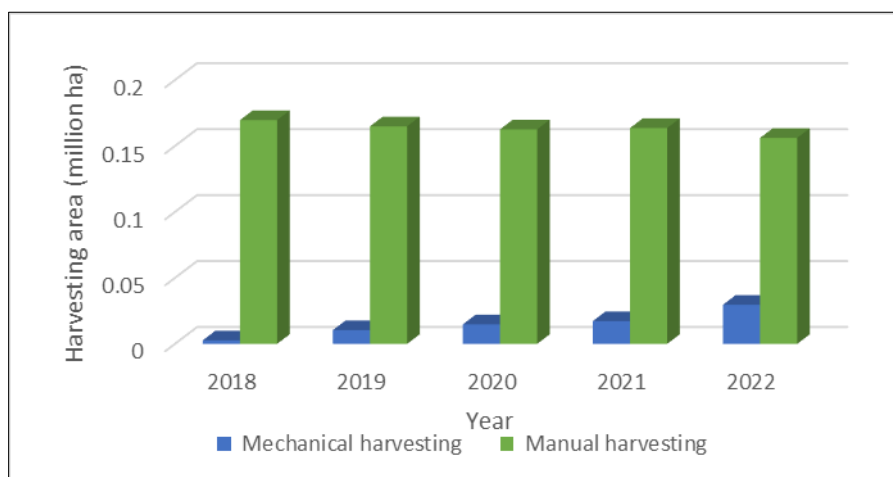
**Figure 6** Paddy harvesting area in Sunamganj district

Figure 6 shows that from 2018 to 2022, the manual paddy harvesting area declined from 0.2206 million hectares to 0.1684 million hectares in Sunamganj district. The mechanical harvesting area, on the other hand, went from 0.0021 million hectares to 0.0544 million hectares. The use of agricultural machinery sharply increased from 2018 to 2022.

That’s why farmers were able to harvest more area than before. Among the 11 upazilas under Sunamganj district, the percent of mechanized harvesting was highest at Bishwamvarpur upazila, which was 32.50%, and lowest at Jamalganj upazila, which was 21.76% in the year 2022.

### 3.3.3. Moulvibazar district

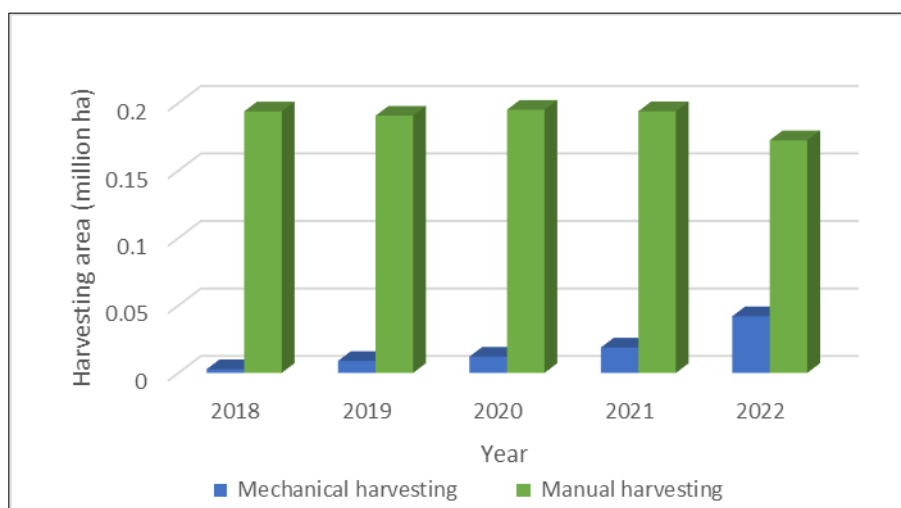
Each year, the harvesting area under machineries increased in the Moulvibazar district as shown in Figure 7. In 2018, mechanized harvesting area was 0.0027 million hectares and 0.0296 million hectares was in 2022. From 2018 to 2022, the manual paddy harvesting area declined from 0.1696 million hectares to 0.1561 million hectares in Moulvibazar district. The percentage of mechanized harvesting was highest at Barlekha upazila, which was 36.87%, and lowest at Kulaura upazila, which was 4.14%, among the 7 upazilas in the Moulvibazar district (Table 3).



**Figure 7** Paddy harvesting area in Moulvibazar district

### 3.3.4. Habiganj district

According to Figure 8, the manual paddy harvesting area in Habiganj district decreased from 0.1938 million hectares to 0.1724 million hectares from 2018 to 2022. Mechanized harvesting areas increased from 0.0028 million hectares in 2018 to 0.0420 million hectares in 2022. The percentage of mechanical harvesting varied greatly among the 8 upazilas in the Habiganj district, with the highest percentage at Nabiganj upazila (30.61%) and the lowest percentage at Chunarughat upazila (6.24%).

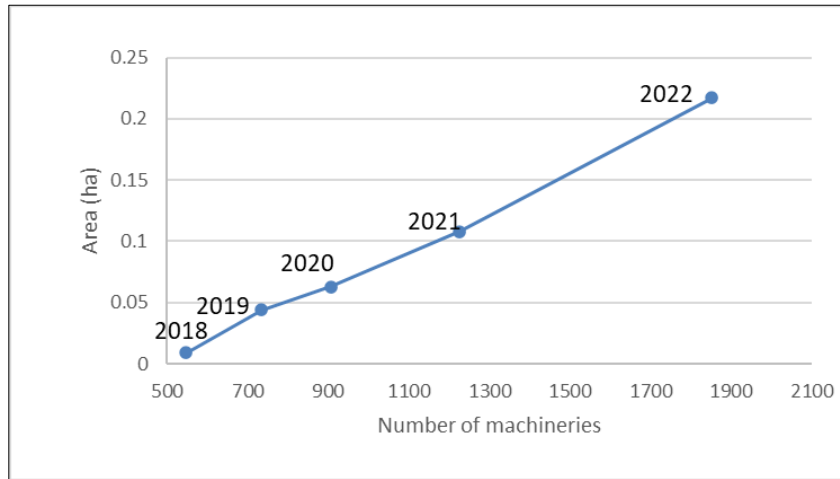


**Figure 8** Paddy harvesting area in Habiganj district

### 3.4. Trends of modern harvesting technologies

Mechanical paddy harvesting was conducted by using reapers and combine harvesters in the study area. Mechanized harvesting technologies are capable of doing the work of several individuals in a short period of time. It is clearly visible from the Figure 9 that the mechanized harvesting area increased with the increase of machines. In the previous years from 2018 to 2022, the number of harvesting machines increased by 547, 734, 907, 1227, and 1852, respectively, in Sylhet region.

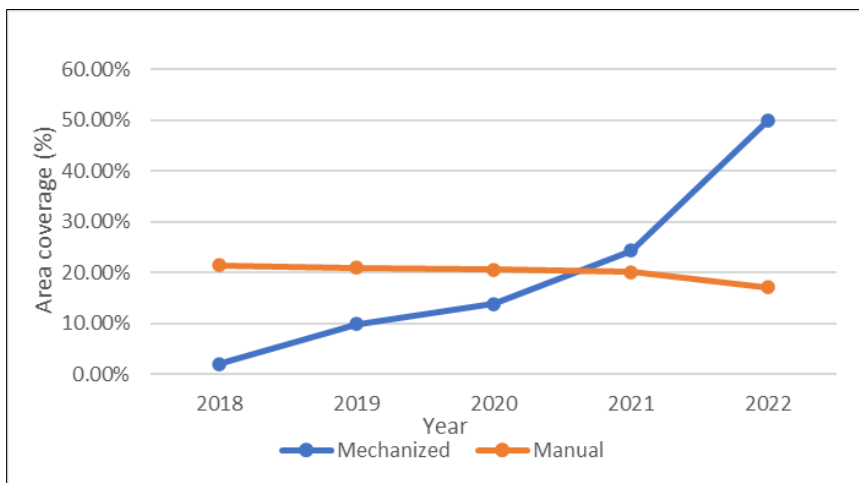
The mechanized paddy harvesting area in the Sylhet region increased by 0.0088 million hectares, 0.0439 million hectares, 0.0629 million hectares, 0.1082 million hectares, and 0.2171 million hectares, respectively, between the years 2018 and 2022.



**Figure 9** Number of machineries vs harvesting area

### 3.5. Comparison between mechanized and manual paddy harvesting technologies

Previously, manual harvesting methods were widely used to harvest paddy in the selected area. However, with the introduction of different machines, the majority of areas were harvested by machines. It is clearly seen that in the previous years from 2018-2022, the trend of manual harvesting decreased by 21.43%, 20.89%, 20.55%, 20.04%, and 17.10% in the Sylhet region. The trend of mechanized harvesting in the Sylhet region increased by 1.99%, 9.86%, 13.85%, 24.31%, and 50% between the years 2018 and 2022. It is obvious that the trend of mechanized harvesting was lessening day by day. In 2022, there was an increase in the use of machinery (Figure10).

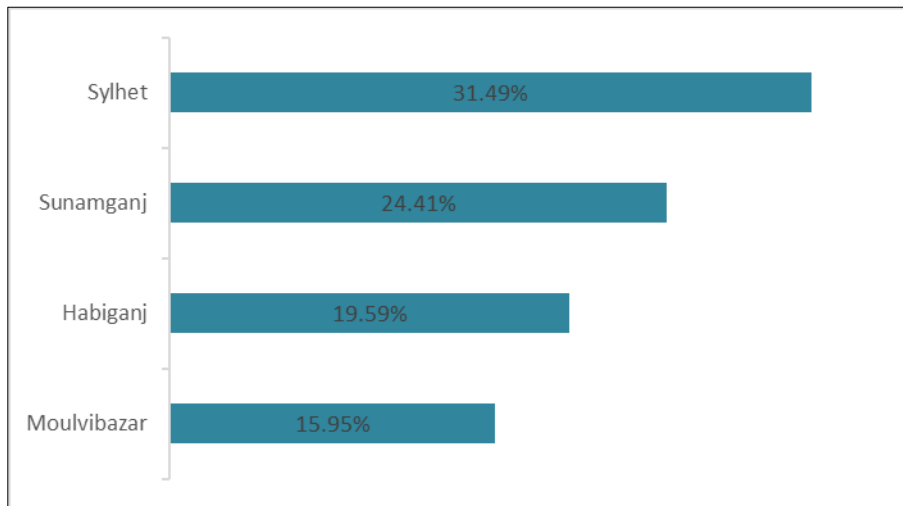


**Figure 10** Different methods used in paddy harvesting



### 3.6. Mechanized harvesting status in four districts of Sylhet, 2022

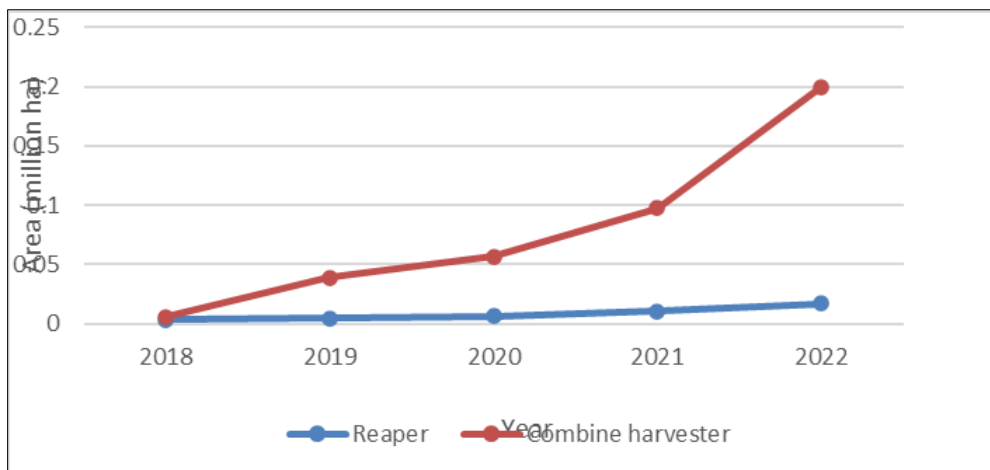
The percentage of mechanized paddy harvesting among four districts of Sylhet as shown in Figure 11. This Figure represents that among four districts, mechanized paddy harvesting rate was higher in Sylhet, which was 31.49%, and lowest in Moulvibazar, which was 15.95%. The pace of mechanization was high due to the large number of machines available in the Sylhet area. As the lowest number of machines was available in Moulvibazar district, the speed of mechanization was also lower as compared to other districts. In the remaining two districts, Sunamganj and Habiganj, the rate of mechanical harvesting was 24.41% and 19.59%, respectively. In the year 2022, the number of harvesting machines was available in Sylhet, Sunamganj, Habiganj, and Moulvibazar district which were 723, 490, 492 and 147, respectively (Table 1).



**Figure 11** Percent of mechanized harvesting of four districts in 2022

### 3.7. Comparison between combine harvester and reaper

It can be seen that more area was harvested with combine harvester as compared to reaper (Figure 12). Between 2018 and 2022, a large area of paddy was harvested with combine harvester, from 0.0058 million hectares to 0.2 million hectares.

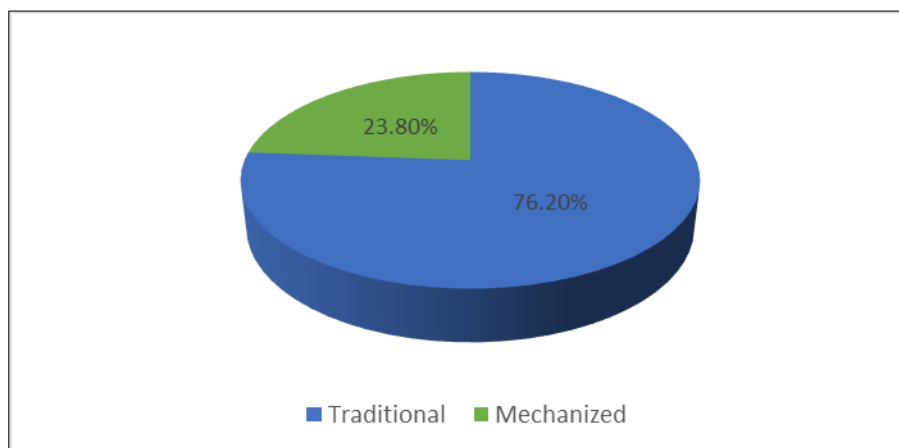


**Figure 12** Mechanized paddy harvesting last five years

Very small portion of land was harvested through reaper, from 0.0031 million hectares to 0.0171 million hectares. According to the collected data, a combine harvester harvested approximately 87.47% more area than a reaper. Introduction of suitable harvesting machinery is one of the major aspects for reducing time and labor requirements and also to help produced more paddy without losses.

### 3.8. Mechanization status in Sylhet region, 2021-22

Figure 13 shows that a large majority of the area was harvested manually, which was 76.20 percent in 2021–22, followed by 23.80 percent of the area harvested by machines. In the year 2022, the number of machines in Sylhet region was 1852. It was not possible to cover more area than that with these limited machines. So, more machines are needed to meet expectations. It is clear that harvesting in the studied area is not yet fully mechanized.



**Figure 13** Mechanization status in Sylhet region

## 4. Conclusion

Mechanized harvesting is important to protect millions of hectares of mature paddy fields from the impending risk of early flood in Sylhet region. This study was performed with the motive of identifying the present status of mechanized harvesting in the Sylhet region of Bangladesh and making comparisons of harvesting technologies among the different upazilas of Sylhet. This assessment demonstrated that mechanized harvesting program has been accelerated in recent years in the Sylhet region. The adoption of modern machineries has an increasing trend in almost all the upazilas of Sylhet region. According to this research, the following findings were discovered: in Sylhet district, 723 machines were used, which was four times more than in Moulvibazar district. The trend of manual harvesting has decreased and trend mechanized harvesting has gradually increased due to the availability of more machines in this district. The manual method, combine harvester, and reaper were used to harvest 76.20%, 21.90%, and 1.9%, respectively, in the study area in 2022. The study identified the problem that manual harvesting methods were frequently employed in the study area to harvest paddy due to a lack of adequate machines. So, it is clear that machinery was insufficient for long-term agricultural mechanization. In order to speed up the process of mechanization in agriculture, government authorities and the local machinery producers should pay attention these non-mechanized upazilas. Additionally, assuring the accessibility and availability of machine are significant challenges that need to be addressed.

### *Recommendations*

The following recommendations for policy implications are provided based on the study's results and conclusion:

- Since flash floods and heavy rain cause severe paddy loss in most years, the supply and use of modern harvesting machinery should be increased so that mature paddy can be harvested in a single day.
- The government should take the initiative to encourage farmers to adopt modern technology in order to improve their living conditions.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

---

**References**

- [1] Ali R, Hasan K, Saha CK, Alam M. Losses of paddy in harvesting practices in Bangladesh. In 2019 ASABE Annual International Meeting 2019 (p. 1). American Society of Agricultural and Biological Engineers.
- [2] Bangladesh Economic Review 2022: Chapter 7: Agriculture <https://mof.portal.gov.bd/site/page/28ba57f5-59ff-4426-970a-bf014242179e/Bangladesh-Economic-Review-2022> (Accessed 9 June 2022).
- [3] Hasan MK, Ali MR, Saha CK, Alam MM. Sustainable Paddy Harvesting Solution for the Southern Delta of Bangladesh. In 2020 ASABE Annual International Virtual Meeting 2020 (p. 1). American Society of Agricultural and Biological Engineers.
- [4] Huda MK. Experience with modern and hybrid rice varieties in haor ecosystem: Emerging Technologies for Sustainable Rice Production. In Twentieth national workshop on rice research and extension in Bangladesh. Bangladesh Rice Research Institute. Gazipur-1701 2004 Apr (Vol. 19, p. 21).
- [5] Mainuddin M, Kirby M. National food security in Bangladesh to 2050. *Food Security*. 2015 Jun, 7:633-46.
- [6] Matin MA, Alam MM, Khan EN, Khan MH, Khan MN. Problem and prospect of production of agricultural machinery in Bogra. A Research Report. Rural Development Academy, Bogra, 2008.
- [7] Hasan MT. 4. An assessment on mechanization of rice production in Nabiganj, Sylhet. *Journal of Agriculture, Food and Environment (JAFE)* | ISSN (Online Version): 2708-5694. 2021 Dec 31, 2(4):23-8.
- [8] Mondol MR. Performance evaluation and improvement of power tiller mounted cereal reaper (Doctoral dissertation, MS thesis).
- [9] Muttaleb MA, Shahidullah SM, Nasim M, Saha A. Cropping systems and land use in Sylhet region. *Bangladesh Rice Journal*. 2017, 21(2):273-88.
- [10] Niehaus C. Evaluation of corn harvesting operations with the use of geo-referenced data (Doctoral dissertation, University of Illinois at Urbana-Champaign).
- [11] Noby MM, Hasan MK, Ali MR, Saha CK, Alam MM, Hossain MM. Performance evaluation of modified BAU self-propelled reaper for paddy. *Journal of the Bangladesh Agricultural University*. 2018 Aug 23, 16(2):171-7.
- [12] Devani RS, Pandey MM. Design, development and field evaluation of vertical conveyor reaper windrower.
- [13] Rahman MM, Ali MR, Oliver MM, Hanif MA, Uddin MZ, Saha KK, Islam MH, Moniruzzaman M. Farm mechanization in Bangladesh: A review of the status, roles, policy, and potentials. *Journal of Agriculture and Food Research*. 2021 Dec 1, 6:100225.
- [14] Shelley IJ, Takahashi-Nosaka M, Kano-Nakata M, Haque MS, Inukai Y. Rice cultivation in Bangladesh: present scenario, problems, and prospects. *Journal of International Cooperation for Agricultural Development*. 2016, 14:20-9.
- [15] Mukhi N, Rana S, Mills-Knapp S, Gessesse E. World Bank Outlook 2050 Strategic Directions Note.
- [16] Zhang X, Rashid S, Ahmad K, Ahmed A. Escalation of real wages in Bangladesh: is it the beginning of structural transformation?. *World Development*. 2014 Dec 1, 64:273-85.