Research Paper

Assessing the postharvest losses incurred by banana cultivators- A study of North East India

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Abstract
The aim of this study was to investigate the postharvest losses experienced by banana growers in the North East Indian states of Assam and Meghalaya during three distinct time periods: pre-COVID 19, COVID 19, and post-COVID 19. The results of the present study suggested that, during both pre- and post-COVID 19 periods, the postharvest losses of banana farmer ranges between 1 to 32%, whereas, it was between 34 to 70% during COVID 19 period. The study suggests that in less developed regions such as North East India, decreasing postharvest losses could play a crucial role in reducing poverty and promoting rural development by creating more opportunities for agribusiness livelihoods.
Keywords: Banana growers; postharvest losses; COVID 19

I.   Introduction

As banana is an essential horticultural crop, in India, during the fiscal year 2020, the banana was cultivated across 877 thousand hectares of land, with the production of 297 lakh million tonnes.[1] It was reported that, 290 lakh million tonnes of banana (97%) were consumed domestically, whereas approximately 5 lakh million tonnes were lost because of its perishability.[2]Moreover, the COVID 19 pandemic had destroyed the value chains of banana in almost all countries, who were engaged in the production and export of banana.[3]A detailed study on estimating postharvest losses in banana was initiated in India through the 1989 Indo-USAID project. The study reported an average physical loss of 16.64% from farm to retail level and an average economic loss of 12.63% at the market level. The highest loss of 4.7% was recorded during the ripening stage due to inaccurate postharvest handling methods.[4] Further studies also reported gross postharvest losses of 6.60% in bananas with losses of 1.33%, 1.14%, and 2.42% during harvesting, transportation, and storage, respectively.[5] In addition, another study conducted in Karnataka observed losses of 5.53%, 6.65%, and 16.66% at the field and assembly, wholesale, and retail levels, respectively, while studying the marketing losses and its effect on marketing margins of bananas.[6]It was found that postharvest losses of banana in two districts of Tamil Nadu were 2.19 to 2.52% during transportation, while the loss was 3.9% in the farm level sorting.[7]According to this study, the primary reason for higher postharvest losses during transportation was the long distance. In Assam, postharvest handling resulted in a 22% loss of bananas,[8] while in Karnataka, the loss was between 18 to 29%,[9] and approximately 19 to 21% in Tamil Nadu.[7]The study argued that the operational efficiency of banana marketing can be enhanced by reducing the postharvest losses from 29 to 18% through the lower marketing cost, strict procurement procedure and better transportation and handling.[10]Davara and Patel (2009) assessed the postharvest losses of banana in Gujarat and found that losses from harvesting to ripening amounted to 15.43%, including losses at the field level (0.77%), during ripening (8.80%), and during transportation and handling (5.86%).[11]In the Shimoga district of Karnataka, the study reported an overall postharvest loss of 24.12% in the local market, which comprised losses at the field level (7.64%), during transit (5.09%), during ripening (4.95%), and at the retail level (6.44%).[12] In the distant market, the overall postharvest loss was 27.18%, with higher losses during transit (8.31%) and ripening (6.11%) compared to the local market.[12]

Assam and Meghalaya, located in the North Eastern (NE) region of India, have a climate that is well-suited for banana cultivation due to their humid sub-tropical nature. These two states are the major contributors to banana production in the NE region of India, accounting for approximately 4.09% of India's total banana production.The Darrangiri market, located in Goalpara district of Assam, is considered the largest market of

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banana in South Asia. In this locality, around 3,700 hectares of land are cultivated by nearly 800 farmers and produces 40,000 metric tonnes of bananas every year.[13] Nevertheless, due to the COVID 19 pandemic restrictions, this iconic market of bananas had also been affected severely in the wake of the breaking of the supply chain. It was argued that, in the Darrangiri market, during the second phase of the COVID 19 pandemic in 2020, the sale price for a bunch of bananas was ₹50 to ₹80, as compared to the normal price of ₹300 to ₹400.[13]

The literature discussed previously indicates that there are only a few studies focused on evaluating the postharvest losses of banana farmers in the NE states of India, particularly those that employ micro level data. In contrast, our area of research is distinct from most existing studies, which primarily examine the topic in other regions of India, such as the South and North Indian states. This study is an initial empirical investigation in Assam and Meghalaya to carefully evaluate the magnitude of postharvest losses among banana farmers. It is likely the first empirical research in India to quantify postharvest losses of banana farmers in the wake of the COVID 19 pandemic. Statistical data for current banana postharvest handling losses in Assam and Meghalaya is not available, which creates a crucial gap in the literature and has significant policy implications.In this context, the current research will endeavour to calculate the postharvest losses of banana farmers in the districts of Goalpara and East Garo Hills in Assam and Meghalaya during three time periods - pre-COVID 19, COVID 19, and post-COVID 19. It is important to note that Darranggiri serves as the primary trading centre for bananas from the entire region encompassing these two districts. Additional contribution of this study is to assess the vulnerability of small-scale banana farmers during the aftermath of COVID 19 pandemic. Thus, the main focus of the current study to answer the critical question-how the volume of postharvest losses of banana farmers varies across time periods (pre-COVID 19, COVID 19 and post-COVID 19 periods)?

The paper is structured as follows. Section 2 presents the data and methodology used in this study. The results and discussion are provided in Section 3. Finally, Section 4 concludes the paper and offers policy implications.

II.   Data and Methodology

2.1 Data source and the sample

To gather socio-economic information and assess postharvest losses, this study employed a household survey where banana farmers provided self-assessments. A cross-sectional approach was utilized to collect data from households growing bananas for income and food. This research took place in Assam and Meghalaya, the two major banana-producing states in the NE region of India. Figure 1 displays a map of Assam and Meghalaya, indicating the study districts and development blocks. The districts chosen for this study, Goalpara in Assam and East Garo Hills in Meghalaya, were selected purposefully because they are located close to each other and to the main areas where bananas are produced in both states. Darranggiri, which is the primary trading center for bananas from the region that includes these two districts, is also noteworthy. According to the National Horticulture Board, both Goalpara and East Garo Hills districts are among the most promising areas for banana production in India. Thus, this study focused on a cluster area that included four Community Development Blocks (CDBs), with two from each district.The reason for selecting the four Community Development Blocks (CDBs) as the study area is because they are among the main areas where bananas are produced in the districts, and most of the banana growers are concentrated in these localities. Therefore, a multi-stage random sampling technique was used to collect primary data. Firstly, Kushdhowa and Rangjuli CDBs in Goalpara district of Assam, and Kharkhutta and Resubelpara CDBs in East Garo Hills district of Meghalaya were chosen in the first stage. Then, in the second stage, 10 villages were randomly selected from the chosen CDBs.The sample villages were chosen based on the population of the selected Community Development Blocks (CDBs). Two, three, two, and three villages were selected from Kushdhowa, Rangjuli, Kharkhutta, and Resubelpara CDBs, respectively. The households that were involved in banana cultivation were the units of observation for this study. Farmers in each of the selected villages were classified as small or large based on the size of their landholdings. In the third stage, a random selection of sample farmers was conducted. A sample of 100 households, with 10 households per village, was randomly selected from all the chosen villages. In the final stage, the selected sample of farmers was interviewed using a pre-tested questionnaire. The questionnaire was used to collect postharvest activities and practices, and the farmers' own assessment of quantitative postharvest losses over three time periods: pre-COVID 19 (January 2019 to December 2020), COVID 19 (March 2020 to May 2021), and post-COVID 19 (October 2021 to September 2022).

Figure 1: Map of Sampled Districts and Development Blocks in Assam and Meghalaya
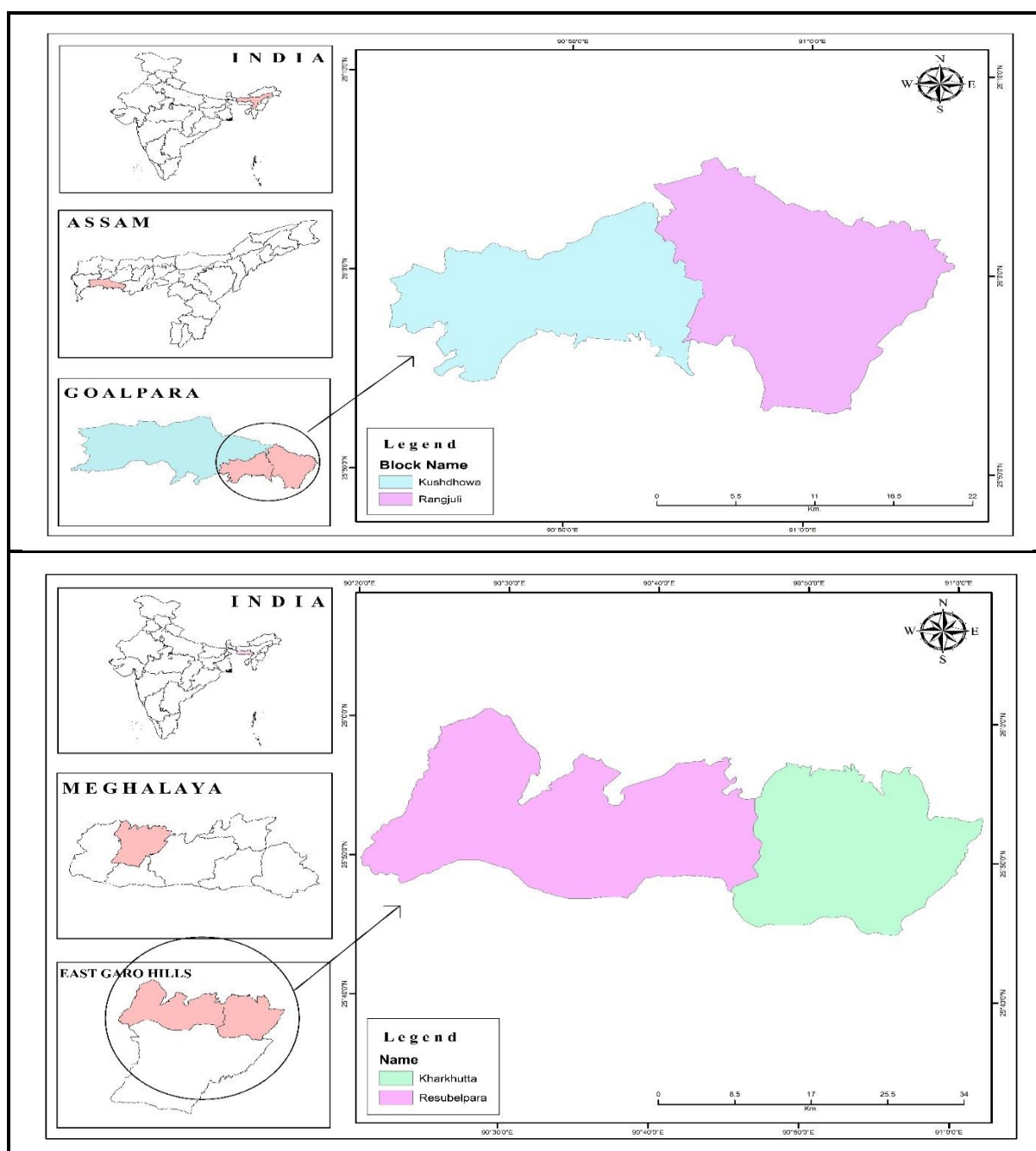
2.2 Data analysis

In the present study, the evaluation of perceived quantitative postharvest losses was extracted by a participatory 'bean exercise', where 100 farmerswere asked to represent their overall banana production in terms of bunches across three time periods, viz. pre-COVID 19, COVID 19 and post-COVID 19.Later, the farmers who were accountable for postharvest activities was asked to indicate how manybunches of bananas,they lost before sending to the market for sale.Thus, the current study calculated the percentage of postharvest losses of farmers in three time periods, separately,withthe volume of banana production and total postharvest losses in each period. Further, the postharvest losses were presented into four categories,namely- % of farmers with minimal loss, % of farmers with low loss, % of farmers with moderate losses, and % of farmers with high loss.Although, the criteria for this categorization are similar in both pre- and post-COVID 19 periods, but the different criteria were used for COVID 19 period because of the extent of the volume of postharvest losses.

III. Results and Discussion

Table1 presents the percentage of respondents reporting four postharvest loss categories in pre- and post-COVID 19 period across study districts. It can be pointed from Table 1 that the postharvest losses of banana ranges from 1 to 32% during both time periods. It shows that, during pre-COVID 19 period, overall, 55% of the respondents reported losses to be on 'low loss' category, followed by 28% on 'minimal loss' category. Thus, the study highlights that, most of the farmers (78%) postharvest losses ranges between 1 to 16%. It can be shown that during the same time period, 64% and 46% farmers perceive to be on the low loss category in Goalpara and East Garo Hills districts, respectively.At the post-COVID 19 period, both survey districts as a whole, about 46% of respondents reported losses to be 'low loss' and another 37% respondents reported their losses to in the 'minimal loss' category. Thus, like pre-COVID 19 period, in post-COVID 19 period, the majority of the farmers (83%) placed on the 1 to 16% postharvest loss category. In the East Garo Hills district of Meghalaya, 54% respondents perceived their losses to be 'low loss' range, while in Goalpara district of Assam, 42% farmers placed on the 'minimal loss' category. Thus, the current study found relatively high postharvest losses of banana farmers during both pre- and post-COVID 19 period in comparison with the existing studies. It has been reported a farmer level loss of 6.81% when investigating postharvest losses of bananas in the Jalgaon district of Maharashtra, which differs from the findings of our study.[14]It has been showed that the average farm level postharvest loss of bananas in sample farms in Assam was found to be 0.309% of total production, with marginal farms experiencing losses of 0.315% and medium farms experiencing losses of 0.305%.[15] In the Tangail district of Bangladesh, the loss estimation at the farmer's level was noted 3.33% of total production.[16]One study conducted in the Boyo Division of the North West Region of Cameroon reported a farm level loss of 37.99% for smallholder farmers, which is similar to the findings of the current study.[17]According to previous studies, losses in banana production in Indian states ranged from 4.00% to 28.84%, with an average of 18.42% between 1994 and 2002.[4,18]It suggests that the reasons behind the high postharvest losses experienced by banana farmers in Assam and Meghalaya can include mechanical, physiological, pathological, and environmental factors.[19] Additionally, socio-economic factors, such as gender, farming experience, decision-making about harvest timing, level of education, marketing experience, and other factors, can significantly affect postharvest losses for banana farmers in the studied states. It can also be argued that the poor postharvest handling practices of the farmeralso influence the banana loss of the farmer in the study area.In contrast to other states in India, the farmers in the studied districts do not have access to appropriate storage facilities. This means that they must store their produce in simple sheds, which can lead to high levels of spoilage. Furthermore, the assembling points in the study villages are open spaces without any structures. Moreover, because there are no processing units for adding value to raw bananas, postharvest residues in the study area may go to waste.

Table 1: Percent of banana farmers indicating postharvest losses across different loss categories

Banana loss category	During pre-COVID 19 period			During post-COVID 19 period		
	Goalpara	East Garo Hills	Overall	Goalpara	East Garo Hills	Overall
Minimal loss (1-8%)	36	20	28	42	32	37
Low loss (9-16%)	64	46	55	38	54	46
Moderate loss (17-24%)	0	18	9	16	8	12
High loss (25-32%)	0	16	8	4	6	5
Number of observations	**50**	**50**	**100**	**50**	**50**	**100**

Source: Authors' estimation based on field survey, 2022

Table 2indicates that during COVID 19 period, the postharvest losses of banana farmers ranges between 34 to 70%. In can be shown that, overall, 50% of the respondents reported 'moderate losses, as against 24% farmers on the 'high loss' category. At disaggregate level, in Goalpara district, 56% farmers report on the 'moderate loss' category, whereas it is 44% in the East Garo Hills district. It is worth mentioning here that, in the East Garo Hills district, 30% farmers placed on the 'high loss' category, as against 18% in Goalpara district. Thus, this indicates the more vulnerable position of the farmers of the East Garo Hills district of Meghalaya during COVID 19 pandemic, in compare with the Goalpara district of Assam. Thus, thisenormous postharvest losses of farmers during COVID 19 period indicates the reduction of household income in the study area, which further may reduce the purchasing power, and prevented them from investing in farming activities.Experts in the field have suggested that during the COVID 19 period, food waste may increase due to broken supply chains, lack of labor, and storage problems.[20]According to experts, the COVID-19 pandemic has caused significant postharvest losses as a result of restrictions on transportation and distribution, which have made it difficult for farmers to sell their produce in local and urban markets.[21]Subsequently, the disruption in demand and the price of bananas within the countrymay also cause considerable postharvest losses in the study states. Further, Kyeyune (2020)[22]classified the causes of postharvest losses of horticultural crops during COVID 19 period into four: disruption in processing activities, disruptions in steady supply of produce, disruptions in consumer demand and the subsequent disruption in prices of bananas across the country.According to the NABARD

(2020)[23] study, during COVID 19 period, the extent of the postharvest losses of horticulture products was different across Indian states.Because the prices of horticulture sector products were impacted unevenly by COVID 19. While some states, such as Arunachal Pradesh, Kerala, and Mizoram, observed a rise in prices (15%, 13%, and 10.7% respectively), others like Karnataka, Tamil Nadu, Telangana, and Madhya Pradesh saw a drop in prices (23%, 15.8%, 15%, and 13.3% respectively). The study also revealed that overall, there was a 7.6% decrease in horticulture product prices at the national level in India.

Table 2: Percent of banana farmers indicating postharvest losses across different loss categories during COVID 19 period

Banana loss category	Goalpara	East Garo Hills	Overall
Minimal loss (34-42%)	2	10	6
Low loss (43-51%)	24	16	20
Moderate loss (52-60%)	56	44	50
High loss (61-70%)	18	30	24
Number of observations	**50**	**50**	**100**

Source: Authors' estimation based on field survey, 2022

IV.   Conclusions and policy implication

The study aimed to assess the postharvest losses of banana in the Indian states of Assam and Meghalaya during three different time periods, namely pre-COVID 19, COVID 19, and post-COVID 19. It was found that the postharvest losses of banana farmerranges between 1 to 32% during both pre- and post-COVID 19 periods, whereas during COVID 19 period, it was between 34 to 70%.The findings of the current study indicated the more vulnerable position of the farmers of Meghalaya during COVID 19 pandemic, in compare with the farmers of Assam. Thus, the study argued that,the enormous postharvest losses of farmers during COVID 19 period shrink the household income in the study area, which further may reduce the purchasing power, and prevented them from investing in farming activities.The results of the present study suggest that, during both pre-COVID 19 and COVID 19 periods, the small farmers of the study districts can manage the postharvest handling practices properly because of their small land size and volume of production.

Assessing the volume of postharvest losses of banana farmersis one of the initial steps towards planning suitable future loss prevention strategy.Expanding agribusiness livelihood opportunities in underdeveloped regions such as NE India can help reduce poverty and promote rural development. This can enhance the competitiveness and growth potential of the banana industry, ultimately contributing to broader economic growth in the NE region of India. The current study did not assess the postharvest losses and the factors that determine them across various stages of the value chain, and this shortcoming is an area that requires further investigation. Moreover, it would be beneficial to validate and reproduce the outcomes using a larger sample size that encompasses farmers with diverse socioeconomic backgrounds. While these limitations exist, they do not invalidate the results of this study, and future research should focus on addressing them.

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