



Research in

ISSN : P-2409-0603, E-2409-9325

AGRICULTURE, LIVESTOCK and FISHERIES

An Open Access Peer-Reviewed International Journal

Article Code: 0295/2020/RALF

Res. Agric. Livest. Fish.

Article Type: Research Article

Vol. 7, No. 3, December 2020: 351-361.

EFFECTIVENESS OF THE TRAINING ON IMPROVED TECHNOLOGY OF POSTHARVEST HANDLING OF MANGO: AN EMPIRICAL EVIDENCE FROM CHAPAINAWABGANJ DISTRICT OF BANGLADESH

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ARTICLE INFO

ABSTRACT

Received

06 December, 2020

Revised

23 December, 2020

Accepted

27 December, 2020

Online

12 January, 2021

Key words:

Postharvest handling
Training
Mango
Chapainawabganj

The present study aims at examining the effectiveness of the training on "Application of Improved technology of postharvest handling of Mango". The research was conducted in three upazilas of Chapainawabganj district- a leading mango growing region of Bangladesh. A total of 50 respondents were selected randomly from the list of the trainees taking 25 from each of the trader's and farmer's group. The data were collected from the selected respondents employing direct interview method using pre-designed, pre-tested interview schedule. Both descriptive and statistical analysis was used in analyzing the data. The findings of the study revealed that majority of the respondents (94%) were educated and belonged to young aged group of 23-40 years. The study showed that before receiving the training, the postharvest losses at farm and traders' level accounted for 28.12% and 21.80%, respectively and after receiving training, the postharvest losses reduced to 12.68% at farm and 8.52% at traders' level which was significant at 95% level of confidence. The findings also revealed that after obtaining training, income of respondents had increased significantly by 25.47% at farm and 16.48% at traders' level. The study identified important problems faced by the respondents such as lack of capital, costly and unavailability of BARI (Bangladesh Agricultural Research Institute) mango harvester and hot water treatment plant in the market and limited access to institutional credit. If these constraints were removed, postharvest losses of mango could be reduced substantially thus ensuring increased sustainable income for both mango cultivators and traders. A pool of master trainers should be developed to train a large number of mango cultivators and stakeholders on this important issue, government should provide institutional credit to the mango farmers and traders at an ease terms and condition, BARI mango harvester and hot water treatment plant should be made available at an affordable price to the farming community and traders in mango growing regions of Bangladesh.

To cite this article: Hafeez A. S. M. G., F. A. Huda and S. M. Sayem, 2020. Effectiveness of the training on improved technology of postharvest handling of mango: an empirical evidence from Chapainawabganj district of Bangladesh. Res. Agric. Livest. Fish., 7 (3): 351-361.



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INTRODUCTION

Mango is one of the most important fruits in Bangladesh in terms of area, production and commercial value. Bangladesh ranks the 7th position as a mango producing country in the world with a production of 1.28 million metric tons of mangos in an area of 102939 acres of land (BBS, 2017). The fruit is very popular to the people due to its taste, preference and nutritional value. This important fruit is grown well in Chapainawabganj district of Bangladesh and many people both in urban and rural areas depend on this fruit for their livelihood. Mango now has been recognized as one of the important commercial fruits in that area. Due to its nutritional fact and nice taste, it has huge business potential both in country and abroad. Postharvest management of fruits in Bangladesh is far from satisfactory level as in the most developing countries of the region. Due to inadequate knowledge on postharvest handling of this important fruit, a bulk portion of this important fruit is spoiled every year leading to huge economic losses for the farming as well as trading community. Bangladesh is lacking with the reliable data on postharvest losses of this important fruit. The estimated postharvest losses of fruits and vegetables vary between 20-40% (Wills *et al.* 2004). Postharvest losses of fresh fruits and vegetables are estimated to be 30% and even reaches up to 50% for some products due to lack of postharvest technology in developing Asian countries (Anonymous, 2016). Postharvest losses of fruits and vegetables were estimated at 24-40% in developing countries and between 2-10% in developed countries (Sirivatanapa, 2006). Studies by some researchers showed that estimated postharvest losses of mango were 16.3% (Quroshi and Meah, 1991), 30-35% (Mondal, *et al.* 1995). In Bangladesh post-harvest losses of fresh fruits and vegetables were estimated by a number of researchers at 25-50% (Amiruzzaman, 1990), at 25-40% (Miaruddin and Shahjahan, 2008) and at 23.6-43.5% (Hassan, 2010). Another study conducted by Hossain *et al.* (2017) found that postharvest losses of mango accounted for 24% in the hilly region. Around 441.28 million US \$ are lost every year due to post harvest spoilage of some selected fruits and vegetables in Bangladesh (Anonymous, 2016).

Mango is a perishable fruit and due to lack of knowledge on improved method of harvesting, packaging, transportation, storage and distribution, farmers and traders in our country have to incur huge economic losses. Minimizing postharvest losses of mango is more sustainable and environment friendly way of production than increasing the area of cultivation in order to compensate for these losses. Therefore, quality maintenance is of prime importance to farmers, traders and consumers and it becomes a key factor for consumers in evaluating the fruits. A study found that only improved method of harvesting of mango can save at least 3.5% harvesting loss over traditional method (Alam *et al.* 2019). The postharvest losses of mango must be reduced for sustainable production and better availability in the market, better nutrition for the people, higher income for farmers and stakeholders in the market chain. Very recently mango is being exported from Bangladesh to many European and Middle East countries amid there are many problems in mango industry of Bangladesh. Considering the situation, Asian Food and Agriculture Cooperation Initiative (AFACI) has included mango in their project to improve the overall postharvest management activities of this fruit in Bangladesh. With this end in view, AFACI-postharvest project funded by Rural Development Administration (RDA), Korea has undertaken a program to train the mango producers, traders and other stakeholders in Chapainawabganj district of Bangladesh with a view to increase farm income through reducing postharvest losses. From the AFACI-Postharvest project, a day long training on "Application of Improved Technology of Postharvest Handling of Mango" was organized and coordinated by Bangladesh Agricultural Research Council (BARC) in Chapainawabganj district during 2016 and 2017. The mango farmers, traders and staff of the Department of Agriculture Extension (DAE) and BARI in Chapainawabganj district were selected as participants of the training programme and a total of one hundred forty participants had been trained in five batches (24 participants for each batch). At the end of the project, the funding agency wanted to know the effectiveness of the training on the reduction of postharvest losses of mango both at farm and traders' level. Therefore, the present study was undertaken to examine the impact of the training on the extent of reducing post harvest losses of mango as well as the income of different stakeholders with the following specific objectives.

Objectives

- i. to know the socio-economic characteristics of the training participants;
- ii. to identify the technology practiced in postharvest handling of mango before and after training;
- iii. to compare the extent of postharvest losses of mango before and after training;
- iv. to identify the constraints faced by the respondents in adopting the improved technology of postharvest handling of mango

Research hypothesis

1. H_0 : The training has no significant effect on income
2. H_0 : There is no significant difference in postharvest losses of mango before and after training

METHODOLOGY

Selection of the study area

Shibganj, Gomostapur and Sadar upazila of Chapainawabganj district were selected purposively for the study since the activities of "AFACI- Postharvest Project" was carried out in those areas. In fact the selected areas are the main mango producing hubs in Bangladesh.

Selection of sample and sampling technique

The total number of participants in the training program from different stakeholders was 140. The trainees of that training were considered to be the population of the study. A total of 50 trainees were selected from the list of the participants as sample of the study taking 25 from each of trader's and farmer's category. To keep the sample number at fifty, the number of sample (of farmers and traders) drawn from Chapainawabganj sadar upazila and Gomostapur upazila was same (8) but number of sample drawn from Shibganj upazila was 9 for each category because the number of area was three. Simple random sampling technique was followed to select the sample of the study. The following table shows how the sample of the study was drawn (Table1).

Table 1. Areas, population and sample of the study

Category of Trainees	Areas from where trainees were selected			Total
	Chapainawabganj SadarUpazila	Gomostapur Upazila	Shibganj Upazila	
Sample				
Mango Traders	8	8	9	25
Farmers	8	8	9	25
Total	16	16	18	50
Population				
Officials of DAE and BARI	17	5	5	27
Mango Traders	20	18	21	59
Farmers	18	19	17	54
Total	55	42	43	140

Source: Based on the study framework.

Method of Data collection

The required data were collected by the trained enumerators under the guidance of lead researcher through direct interview with the sampled respondents using pre-tested and pre-designed interview schedule. Data were collected during 5-27 December, 2018.

Analytical Technique

Both tabular and statistical technique was used to analyze the data. Descriptive statistics such as sum, average, ratio, percentage etc were estimated by using Microsoft Excel. The Wilcoxon Signed Ranks Test (Newbold, *et al.* 2012) and 't' test were used to test the null hypothesis. Collected data were processed and analyzed by using SPSS.20 software.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

It reveals (Table 2) that the range of the age of respondents was 23 to 61 years where majority of the respondents (28%) belonged to the age group of both 31-40 years and 51-60 years followed by 26% belonged to the age group of 41-50 years, 16% belonged to the age group of 23-30 years and the lowest segment of the respondent (2%) belonged to age group of 60 years and above. It is evident that 6% respondent had no education (illiterate), 50% of the respondents had education at secondary level, 12% respondent had primary level education, 18% respondent was graduate and the lowest portion of the respondent (4%) was masters' degree holder. According to the number of members in a family, family size was categorized into three groups viz. small having family member upto 3, medium (members up to 6) and large (more than 6 members). It reveals that majority of the respondent (60%) had medium size family, 26% of the respondent had large size and only 16% had small size family in the study areas (Table 2).

Table 2. Socio-economic characteristics of the respondents

Characteristics	No.	Respondent (%)
Age group (in years)		
23-30	08	16
31-40	14	28
41-50	13	26
51-60	14	28
>60	01	02
Level of education		
Illiterate	03	06
Primary level	06	12
Secondary level	25	50
Higher secondary	05	10
Degree	09	18
Masters	02	04
Size of family		
Small	08	16
Medium	30	60
Large	12	24
Total	50	100

Source: Field survey, 2018

Impact of application of improved technology in postharvest operation

Technology practiced by the respondents before and after training

Respondents were asked regarding the technology practiced in postharvest handling of mango before and after receiving the training and the answer by the respondents are summarized in the following table (Table 3). It reveals that before training, cent percent of the respondents harvested mango using traditional method (with a knife setting at the top of bamboo stick and a bag beneath the knife and more than 8 mangoes collected at a time without peduncle) and after training the respondents harvested mango using modern method (described in the following table). Before training, respondents used to collect 8-10 mangoes at a time in a bag which resulted in mixing of latex on the surface of the mango, after training respondents harvest only 2-3 mangoes in a bag at one time which resulted in no mixing of latex on the surface of the mango. Before training about 100% of the respondents kept mango directly on the ground with no paper or straw and stack the harvested mangoes in a haphazard way. After training, they now keep mangoes on paper or straw spread on the ground and stack them in a scientific manner. Before training, cent percent of the respondents collected mango from trees without stalk which caused to dropping the latex. Mixing latex on the surface of the mango caused to

physical and nutritional damage of the fruit. After training, they collect mango from trees with stalk or peduncle which protects to dropping the latex that has led to reduce the damage of fruits. Respondents, before training did not use BARI mango harvester (one kind of cutter) and hot water treatment plant at all. However, only 4% of the respondent used BARI mango harvester and 96% of the respondent used locally made knife (like BARI mango harvester) or cutter in collecting mango from trees. Hot water treatment-plant was used by only 5% of the respondent but they used this technique only for their own consumption. Before training, about 95% of the respondents used bamboo made basket and sometimes sacks (made of jute) for carrying mango to market, but now respondents use plastic crates for carrying mango to the distant market. About 98% of the respondent did not practice pre-cooling, sorting, grading, washing of mango before training but after receiving training, cent percent respondents follow pre-cooling, sorting, grading and washing technique. Loading and unloading was done by cent percent of the respondent without any care which caused to physical damage of mango but now cent percent respondent do it with more care which has led to protect mango from physical damage (Table 3).

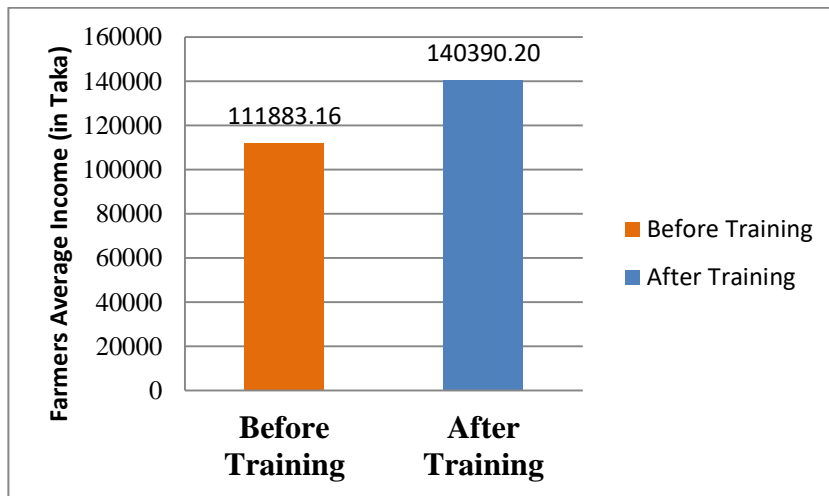
Table 3. Technology practiced by the respondents in postharvest handling before and after training

Technology practiced before training	Technology practiced after training
Mango was harvested following traditional method (100) Generally, 8-10 mangoes were harvested at a time in a net bag setting on the top of bamboo made stick which resulted mixing of latex on the surface of the mango (100)	Mango is harvested following modern method (100) Collected only 2-3 mangoes at a time by a harvester (locally made knife) setting at the top of a bamboo made stick and setting a bag beneath the cutter to put mango (100)
Harvested mangoes were kept directly on the ground in the orchard without paper or straw and stacking haphazardly (100) Mangoes were detached from the stalk which led to dropping of latex (100)	After harvesting mangoes are kept on the paper or straw in the orchard and stacking with more care (100) Collect mango from the trees with stalk (100)
Collection of mango with latex on the surface of mango which caused to physical and nutritional damage of the fruit (100) BARI mango harvester was not used in harvesting (100)	Collect mango without latex and in such a way that latex drops on the paper (100) Traders use BARI harvester in harvesting mango from trees (5)
Hot water treatment of mango was not practiced at all (100)	After harvesting from trees, hot water treatment of mango is practiced (4)
Plastic crates were not used for carrying mango to the market (100)	Farmers use plastic crates to carry mango to the distance market for marketing (48)
Mangoes were kept in a bamboo made basket and brought to distant market either by van or bi-cycle (100)	Traders use plastic crates to carry mango to the distance market for marketing (96)
Loading and unloading was done with less care as they did not know the technique (98) Farmers did not practice pre-cooling, sorting, grading, washing (98)	Loading and unloading is done with more care for protecting mango from physical damage. (100) Practice pre-cooling, sorting, washing, grading, cleaning just after harvest (100)

Sources: Field Survey, 2018. Figures in the parenthesis indicate percentage of responses

Income of farmers from mango selling (before and after training)

It is evident from the following figure (Figure 1) that before obtaining the training, the farmer's mean income from mango selling was Tk.111883.16 (US\$ 1347.98) / season and after receiving training, income has increased to Tk. 140390.20 (US\$ 1691.45)/season. The difference in income of the farmers between two periods was observed to be positive and income of farmers has increased by 25.47%. Due to application of improved technology in postharvest operation, farmers had been able to increase their income.

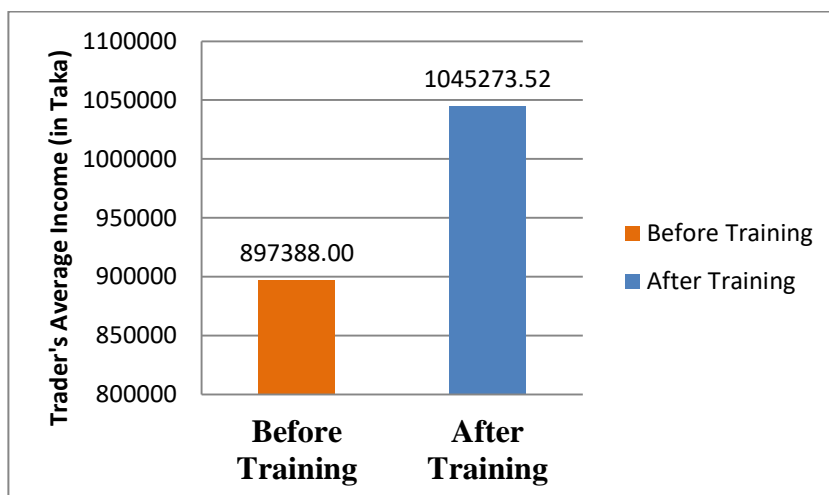


Source: Field survey, 2018

Figure 1. Income of farmers (in Tk.) /Season (before and after training)

Income of mango traders (before and after training)

The following figure (Figure 2) revealed that before obtaining the training, average income of sampled mango traders was Tk.897388/season and after obtaining the training, the income of the same traders has increased to Tk. 1045273.52/ season. The difference in income of the traders between two periods was observed to be positive and income of traders has increased by 16.48%. After application of technology in postharvest operation, traders had been able to increase their income.



Source: Field survey, 2018

Figure 2. Income of mango traders (in Tk)/Season (before and after training)

Descriptive statistics of income of farmers and traders

The following descriptive table (Table 4) shows current scenario of farmer's and trader's income with standard deviation and standard error. The positive impact of the training program is that the mean income of both the farmers and traders increased after training. Differences in income between two periods (before and after training) were observed to be Tk. 28507.04 and Tk. 147885.52 for farmers and traders, respectively.

Table 4. Descriptive statistics of farmer's and trader's income

Indicators	Period	Mean	N	SD	SEM
Farmer's Income	B.T.	111883.16	25	134710.769	26942.154
	A.T.	140390.20	25	178362.203	35672.441
Trader's Income	B.T.	897388.00	25	1099776.431	219955.286
	A.T.	1045273.52	25	1269585.626	253917.125

N=Number of sample; B.T.= Before Training; A.T.=After Training; SD=Standard Deviation; SEM=Standard Error Mean

Testing of hypothesis in the case of income

Since the distribution of income of mango farmers and traders was not normal, non-parametric Wilcoxon Signed Ranks Test was applied to test the significance of training on increased income. The following table (Table 5) shows the result of Wilcoxon Signed Ranks Test. Since the 'z' value for difference in income between two period at farmers' level is -4.372 which is significant at 5% level, there is enough evidence to conclude that training had significant and positive effect on increased income of farmers. Similarly, the 'z' value for difference in income of mango traders (before training and after training) is -4.373 which is significant at 95% level of confidence ($P\text{-value}<0.05$) and pointed out that there is a positive and significant effect of training on traders income (Table 5).

Table 5. Effectiveness of training on income of respondents (Ho: The efficacy of training on income was zero)

Wilcoxon Signed Ranks Test	Income After Training - Income Before Training	
	Farmers	Traders
Z	-4.372 ^b	-4.373 ^b
P-value	.000	.000

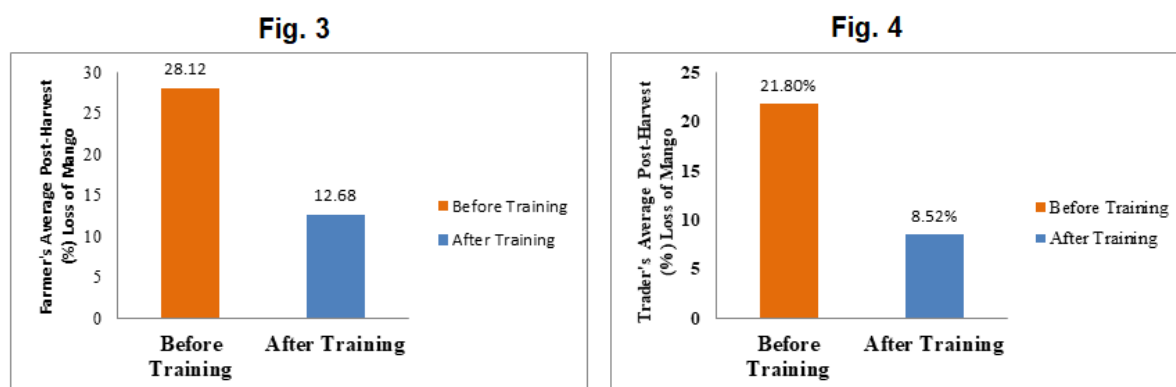
b. Based on negative rank

Postharvest losses of mango at farmers' level between two periods

An attempt was made to estimate the postharvest losses of mango at farm level. The following figure (Figure 3) shows the comparison of postharvest losses of mango at farm level between two periods (before and after training). Before obtaining the training, postharvest losses of mango at farmers' level were estimated at 28.12% and after training, the postharvest losses came down to 12.68% in the study areas.

Postharvest losses of mango at traders' level between two periods

The following figure (Figure 4) shows the comparison of postharvest losses of mango at traders' level between two periods (before and after training). Before participating in the training, the postharvest losses of mango were estimated at 21.80% and after obtaining training, the losses had reduced to 8.52%. The postharvest losses were observed positive at the traders' level implying that the training had an impact on reducing the postharvest losses of mango. After applying the technology in postharvest operation of mango, the traders had been able to reduce postharvest losses of mango in the study areas.



Source: Field survey, 2018

Figure 3. Postharvest losses (in %) of mango at farmers' level (before and after training);
Figure 4. Postharvest losses (in %) of mango at traders' level (Before and after training)

Descriptive statistics of postharvest losses

The following descriptive table (Table 6) shows the postharvest losses (in %) of mango both at farmers' and traders' level with standard deviation and standard error. The postharvest losses at both the levels had reduced after obtaining the training. The reduction of postharvest losses was observed to be 54.90% at farm level and 60.91% at traders' level implying that the training had positive impact on reducing postharvest losses. Whether the reduction in postharvest losses is statistically valid or not, this was further examined by paired 't' test, since the distribution of data of postharvest losses was normal.

Table 6. Descriptive statistics of postharvest losses at farmers' and traders' level

Indicator	Period	Mean	N	SD	SEM
Phl at farm level (%)	B.T.	28.12	25	11.802	2.360
	A.T.	12.68	25	5.129	1.026
Phl at traders' level (%)	B.T.	21.80	25	6.752	1.350
	A.T.	8.52	25	2.535	.507

Phl= Postharvest losses; N=Number of sample; B.T.= Before Training; A.T.=After Training; SD=Standard Deviation; SEM=Standard Error Mean

Testing of hypothesis in the case of postharvest losses

The following table (Table 7) shows the result of the 't' test. Since the 't' value for difference of postharvest losses of mango between two periods at farm level is 9.569 which is significant (p value <0.05), there is positive and significant effect of training in reducing postharvest losses of mango at farm level. The 't' value for difference in postharvest losses of mango (before training and after training) at traders' level is 13.074 which is significant at 95% level of confidence and there is enough evidence to conclude that the training had significant effect in reducing postharvest losses at traders' level.

Benefits of the training as opined by the respondents

The respondents were asked about the benefits gained from the training and the answers of the respondents are summarized in the following table (Table 8). It is evident that cent percent of the respondents (both traders and farmers) received higher price of mango in the market. About 98% of the respondent replied that demand for their mango has increased in the market, 95% respondent told that their mango looks fresh and more attractive in color than that of other sellers, 98% told that self-life of mango has increased and cent percent of the respondent told that they had been able to reduce postharvest losses of mango after receiving the training.

Table 7. Significance test of postharvest losses at farm and traders' level

Paired Samples Test (Ho: The efficacy of training on postharvest loss was zero)									
Phi	Difference of Phi	Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Farmers'	BT (%) – AT (%)	15.440	8.068	1.614	12.110	18.770	9.569	24	.000
Traders'	BT (%) – AT (%)	13.280	5.079	1.016	11.184	15.376	13.074	24	.000

Phi= Postharvest losses; BT=Before Training; AT=After Training

Table 8. Benefits of training as reported by the respondents (%)

Types of benefit	Respondent (%)
Farmers and traders received higher prices of mango	100
Demand for respondent's mango increased in the market	98
Looks fresh and more attractive in color	95
Self-life of mango increased	98
Able to reduce postharvest loss	100

Source: Field survey, 2018

Constraints faced by the respondents in adopting improved technology of postharvest handling

Sample respondents were asked to mention the major problems in adopting improved technology during postharvest operations and the most acute constraints faced by them are presented in the following table (Table 9). It was revealed that 98% of the respondents had no access to BARI mango harvester and cent percent of the respondents had no access to hot water treatment plant as these were not available in the market and also costly. Cent percent of the respondent opined that if they used improved technology such as BARI harvester which took more time rather they could harvest 8-10 mangoes at a time by locally made knife with less time. About 98% of the respondent told that (having a perception) mango loses its color and taste if mango is treated in hot water plant. Cent percent of the respondent mentioned that higher cost was a major constraint in adopting technology, Respondents (97%) opined that they could not apply all the technology in postharvest operations due to lack of fund. About 98% respondent mentioned that limited access to institutional credit was one of the major constraints to use improved technology of postharvest handling.

Table 9. Constraints faced by the respondents in adopting improved technology of postharvest handling

Constraints	Respondent (%)
No access to BARI mango harvester due to unavailability and costly	98
No access to hot water treatment plant due to unavailability and also costly	100
Improved technology requires higher investment, labour cost	100
Application of improved technology requires more time in postharvest activities	100
Perception about hot water treatment is that mango loses attractive colour	98
Perception is that market price of mango would fall if it is treated with hot water	100
Do not apply all the techniques learnt in training due to lack of fund	97
Limited access to institutional credit	98
Duration of training restricts the trainees to learn more and details of techniques	100

Source: Field Survey, 2018

CONCLUSION

The findings of the study showed that both mango producers and traders in the study areas were benefited from the training on application of the improved technology of postharvest handling of mango in practical field. The postharvest losses of mango at both farm and traders' level had decreased at a significant level which had led to increase the income of the mango farmers and traders. BARI mango harvester (cutter) and hot water treatment plant were not used by the respondents because these instruments are costly, not available in the market and require more time in postharvest operation which may lead to higher labour cost. If the constraints in adopting the technologies would have been removed and more farmers, traders and labourers would be trained on the improved technology of postharvest handling, the postharvest losses of mango could be reduced significantly that could lead to generate higher income to both the farmers and traders of mango in the study areas. Ultimately, the consumers would be benefited through having more supply of fresh and quality fruits in the market. The study suggests further research to be conducted on this important issue in a broader aspect

Recommendations

- Government should take proper initiative to disseminate the improved postharvest handling technology through training, distribution of booklet, manual among farmers and other stakeholders throughout mango growing areas of Bangladesh
- A pool of master trainers should be built to train more farmers, traders and especially labourers engaged in mango cultivation and trading on this important aspect
- One day training is not enough to learn, so duration of the training should be increased
- BARI mango harvester should be distributed to the farmers at subsidized cost and hot water treatment plant should be established in mango producing areas and at prominent market place so that both mango farmers and business community can use this technology
- Institutional credit should be provided to the farmers and other stakeholders at an ease terms and condition

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ACKNOWLEDGEMENT

The authors express their gratefulness to AFACI, RDA, Korea for funding the research study through AFACI-Postharvest Bangladesh Project coordinated by BARC. We are also thankful to Dr. S M Khorshed Alam, PI, AFACI- Postharvest Bangladesh Project for providing necessary support during the study.

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