Impact of Post-Harvest Training on Farmers in Lhuntse, Mongar, Trashigang and Trashiyangtse Dzongkhags

Yeshi Samdrup

Submitted in partial fulfilment of the requirements of Masters in Development Practice

7 August 2019

Royal University of Bhutan

College of Natural Resources

Lobesa: Punakha

BHUTAN

Declaration

I hereby declare that this research entitled "**Impact of Post-Harvest Training on Farmers in Lhuntse, Mongar, Trashigang and Trashiyangtse Dzongkhags**" is an original work and I have not committed, as far as to my knowledge, any academic dishonesty or remedied to plagiarism in writing the report. All the information sources, supports and assistance received during the course of the study are duly acknowledged.

Student's signature: ..... Date: .....

Acknowledgements

The success and final outcome of this research required a lot of guidance and support from many people and I would like to thank all the people who wholeheartedly spared their time in sharing what they knew on this topic.

I would like to firstly thank IFAD-MDP Universities Win-Win Partnership for funding and guiding us to complete this research.

I respect and genuinely thank my supervisor Dr. Tulsi Gurung [College of Natural Resources] and Mr. Sangay Choda [CARLEP] for their unwavering support and guidance and in every step of this study.

My sincere thanks goes to the Commercial Agriculture and Livelihood Enhancement Programme (CARLEP) and Agriculture and Research Development Centre (ARDC) for providing valuable information for the project.

I shall also remain grateful to twelve gewog's administration, specifically the gup, Tshokpas, and farmers for helping with the necessary information and cooperation and their time and patience to take part in this Survey.

And not forgetting Dr. Rekha Chettri, Program Leader of Department of Sustainable Development, and Mr. Pema Rinzin [Internship supervisor, College of Natural Resources] for moral and intellectual support in all matters concerning the research report writing.

Abstract

Post-harvest training enhances capacity building of farmers and increases farmers' income. It also helps in reducing post-harvest losses of vegetables. The post-harvest training was introduced by the Commercial Agriculture Resilience Livelihood Enhancement Program [CARLEP] in Wengkhar, under Mongar dzongkhag supported by the International Fund for Agriculture Development (IFAD). Post-harvest training have been carried out, however, no impact assessment has been done on effectiveness of post-harvest training on building the capacity of the farmers and income generation. Thus, this study was conducted to assess the impact of post-harvest training on building the capacity of the farmers on post-harvest management and consequently the income generation. This study was carried out in Lhuntse, Mongar, Trashigang, and Trashiyangtse Dzongkhags. Yamane formula was used to calculate the sample size (n=134). Data were collected using semi structured questionnaires through KoBoCollect toolbox application. T-test was used to analyze income earned before and after attending training. The results showed that most of the respondents (80%) have gained the knowledge and skills on postharvest management of vegetables and have practice it. About 70.1% responded that the best time for harvesting is either morning or evening during cooler part of the day. About 88.8% preferred room cooling because it minimizes decaying and loss and 50% preferred washing as the best cleaning method for leafy vegetables. About 70.9% of the respondents sorted the produce based on size for vegetables such as potatoes. Most of the farmers (67.9%) preferred sacks for packing large quantity for vegetables such as potatoes, cabbages, cauliflowers, broccolis, chilies, and radishes. Majority of the farmers (55.22%) transport their vegetables by motor vehicles. With the trainings they were able to manage the postharvest losses and similarly income earned differed significantly (p=<0.05) before training (Nu. 12,349.25) to (Nu. 25,595.90) after attending training.

Keywords: Income, postharvest losses, postharvest management, training

Acronyms

ARDC	Agriculture Research Development Centre
CARLEP	Commercial Agriculture and Resilient Livelihoods Enhancement Programme
FAO	Food and Agriculture Organization
FRMD	Forest Resource Management Division
GDP	Gross Domestic Product
GNHC	Gross National Happiness Commission
IFAD	International Fund for Agriculture Development
KASAP	Knowledge Attitude Skills Aspirations Practice
MoAF	Ministry of Agriculture and Forests
NBC	National Biodiversity Centre
NFE	Non Formal Education
NSB	National Statistics Bureau
PAR	Poverty Analysis Report
PHL	Post-Harvest Losses
PHMD	Post-Harvest Management Directorate
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
UNDP	United Nations Development Fund
USAID	United States Aids and International Development

Local Terminologies

Dzongkhag	District
Gewog	Block (sub-district)
(Ngultrum, Nu.)	Bhutanese currency
Tshogpa	Village leader

List of Figures

List of Tables

Tables of contents

CHAPTER ONE
INTRODUCTION

1.1 Background

Bhutan has a total geographical area of 38,394 square kilometers of which 70.46% is under forest cover with only 2.93% of the total area available for cultivation (National Soil Service Centre, 2010). Farming in Bhutan is a challenge because of small land holding and rugged topography, making mechanization difficult and labor intensive (Tobgay, 2005). The livelihood of more than 57% of population is dependent on Renewable Natural Resources [RNR] sector which comprises of agriculture, livestock and forestry (Ministry of Agriculture and Forests [MoAF], 2018). Farmers in Bhutan continue to depend substantially on the RNR sector that comprises of forest, agriculture and livestock. In 2014, agriculture sector contributed about 16.77% to the Gross Domestic Product (NSB, 2015). It is also the single largest sector that provides livelihood to over 56.70% of the population as per Labor Force Survey 2014 (NSB, 2016).

Majority of Bhutanese farmers practice a self-sustaining, integrated and subsistence agricultural production system in a small and marginal land. Rice, maize, wheat, buckwheat and millet are the staple cereals cultivated by farmers. In Bhutan, rice self-sufficiency is only 45% and the rest is imported from India and neighboring countries (United Nation Development Programme [UNDP], 2017). However, over the years agricultural practices have shifted from subsistence to semi commercial farming. With improved access to market and market information, farmers' household income is supplemented by sales of dairy, poultry and agriculture products. Horticulture crops such as mandarin, apple, potato, vegetables and spices like ginger are main cash crops (UNDP, 2017).

Food losses in industrialized countries are as high as in developing countries, but in developing countries more than 40% of the food losses occur at post-harvest and processing levels, while in industrialized countries, more than 40% of the food losses occur at retail and consumer levels (Food and Agriculture Organisation of the United Nations[FAOUN], 2011). Post-harvest losses are in terms of quantitative, qualitative, nutritional and economic losses (Gogo et al., 2017). In the SAARC countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka), the post-harvest losses in fruits and vegetables are high, ranging between 20-44% (FAOUN, 2019). In the developed region it is approximately 5-25%, in Asia pacific it is around

20-50%, in south Asia it is the maximum average of 50%. It is estimated that a total of 20-40% of all crops in developing countries is lost due to postharvest losses (Kader, 2005).

Around one third of food is lost or wasted after harvest. Losses can reach 50%, particularly in fruits, vegetables, and root crops. Losses can have a major economic impact on household food security and income levels (United States Agency for International Development [USAID], 2016). In Bhutan, due to poor drying methods, which are dependent upon the weather, a lot of grain was lost to pests, moulds and losses as high as 75% are common. There was also a lack of awareness of the farmers about the new postharvest technologies and a significant effort has to be made in order to improve their efficiency (Wangchen & Srzedruckr, n.d). The postharvest management programme was initiated in 1997 with the establishment of National Postharvest Centre (NPHC) in Paro under the Department of Agriculture to enhance market value and reduce postharvest losses. NPHC is the central organization mandated to look after postharvest activities in the country.

1.2 Problem statement

The Commercial Agriculture Resilience Livelihood Enhancement Program (CARLEP) supported by the International Fund for Agriculture Development (IFAD) in Mongar aims to facilitate the transformation of a subsistence-based rural agricultural economy into a sustainable value chain and market driven productive sector by promoting climate smart approaches in agriculture and strengthening capacities of communities and local institutions (CARLEP, 2016). It was built on prior IFAD interventions focused on increasing agricultural production and making a basic shift in approach towards marketing and climate resilient farming practices. There are numerous training availed by farmers through this project. The trainings include training on lead farmers, farmers' groups and cooperatives, postharvest management, paddy cultivation, chili powder making, vegetable cultivation, farmers exchange visits, and farmers festival which was conducted from 2017 to 2018. It is also important to monitor and evaluate the impact of the trainings and fulfillment of its objectives and overall goal of the project.

Similarly, there has been lots of improvement on the postharvest handling of horticultural crops through the use of fiberboard and plastic crates. Various trainings and demonstrations was carried out by the NPHC on postharvest handling and value addition. Additionally institutions such as the College of Natural Resources, Royal University of Bhutan, also provide trainings on

postharvest technology to the extension personnel frequently in collaboration with the Ministry of Agriculture and Forests.

There has been no accurate assessment of the postharvest losses in Bhutan. However, in Nepal, training such as recordkeeping and bench-marking training to lead farmers, who after being trained shared their knowledge to other farmers, has proven to be an effective and efficient way of capacity building (Agriterra, 2017). In Pakistan, by providing training of capacity building in farming community annual income of majority of respondents (86.70%) was increased before attending training (Yaseen et al., 2015). Training has had an impact on capacity building and income earned by participants. However, it is uncertain if it will have similar outcome in Bhutan. Although, trainings have been carried out, there was no impact assessment done on how effective post-harvest training was. Therefore, this study emphasize whether post-harvest training has positive impact on capacity building of farmers and income generation in the eastern Bhutan.

1.3 Objective

- To assess the impact of post-harvest training on building the capacity of the farmers on post-harvest management and consequently the income generation

1.4 Limitations

The result for research is limited to only Lhuntse, Mongar, Trashigang, and Trashiyangtse Dzongkhags and findings are likely to hold good for similar area where farmers have attended training on post-harvest. Therefore, the validity of responses and generalizations made out of them may be applicable only in to those farmers who have availed on similar training.

CHAPTER TWO
LITERATURE REVIEW

2.1 Post-harvest losses

Food production must increase significantly to meet the future demand of an increasing world population. Economically, food losses have a direct and negative impact on the income of both farmers and consumers. The main causes of food losses and waste in low-income countries are connected to financial management and technical limitation in harvesting, storage and processing techniques (Mada et al., 2014).

Post-Harvest Losses can be defined as the degradation in both quantity and quality of a food production from the time of harvest till the time of consumption. Quality losses include those that affect the nutrient/caloric composition, the acceptability, and the edibility of a given product. These losses are generally more common in developed countries (Kader, 2002). Post-Harvest Losses (PHL) vary greatly among commodities and production areas and seasons. As a product moves in the postharvest chain, PHL may occur from a number of causes, such as improper handling or bio deterioration by microorganisms, insects, rodents or birds (Kiaya, 2014).

Post-harvest food losses in some communities in Nigeria revealed that as much as 20%–30% of total grain production, 30%–50% of root and tuber were lost during the time of storage and fruits and vegetables lost was found higher than the loss of grain, root and tuber (Miyinyawa, 2002). during the time of storage. In Nepal, postharvest losses of these vegetables such as tomato, potato, beans, carrot, cabbage, cauliflower, turnip and leafy vegetables and citrus, pear, peach, plum, sweet pepper, apple, walnut, coffee and tea are very high as a result of inappropriate harvesting and handling practices (Dhruba, 2018). Losses were reported to vary between 20%-30% for apple, between 15%-20% for citrus, between 10%-15% for tomatoes and between 10%-15% for cauliflowers (Adhikari, 2006).

Losses in vegetables result from harvesting at an improper stage of maturity, direct packing and shipping without the removal of field heat, improper packaging and insufficient grading and sorting, poor transportation and handling and poor storage facilities (Paudel, 2006). Crop specific sizes of corrugated cardboard boxes (for apple and mandarin) and plastic trays/crates (for tomato, mandarin) suitable to local conditions are standardized and locally available wrapping/cushion materials are recommended. Nepal Government provides 25% subsidy on the price of materials

such as plastic crates or trays, corrugated cardboard boxes, locally available wrapping/cushion materials. Such subsides are not introduced in Bhutan.

2.2 Post-harvest management

Postharvest management is a set of post-production practices that includes cleaning, washing, selection, grading, disinfection, drying, packing and storage. These eliminate undesirable elements and improve product appearance, as well as ensuring that the product complies with established quality standards for fresh and processed products. Postharvest practices include the management and control of variables such as temperature and relative humidity, the selection and use of packaging, and the application of such supplementary treatments as fungicides (El-Ramady et al., 2015).

2.3 Post-harvest losses and post-harvest management in Bhutan

In Bhutan, approximately 55% of crop damage is attributed to wild animals such as elephants and wild pigs, while post-harvest losses occur mainly during storage. Several steps have been taken by the government to reduce food loss. These include electricity fencing, the construction of silos to store grains and the use of sound and light alarm systems to scare away animals (Food & Agriculture Organization [FAO], 2013). Due to poor drying methods, which are dependent upon the weather, a lot of grain such as wheat and maize is lost to pests, moulds and losses as high as 75% are common (Wangchen & Srzedruckr, n.d).

2.4 Commercial Agriculture and Resilient Livelihoods Enhancement Programme

The Commercial Agriculture and Resilient Livelihoods Enhancement Programme (CARLEP) aims to facilitate the transformation of subsistence based rural agricultural economy into a sustainable value chain and market driven productive sector by promoting climate smart approaches in agriculture and strengthening capacities of communities and local institutions (CARLEP, 2016). It builds on prior IFAD interventions focused on increased agricultural production and making a basic shift in approach towards marketing and climate resilient farming practices.

The programme is scheduled for seven years from 2015 to 2022. The programme area includes selected gewogs in six eastern dzongkhags (Lhuntse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashiyangtse and Trashigang). The programme aims to benefit 28,000 smaller households of which 5,000 households will directly benefit from vegetable and dairy value chains (CARLEP, 2016).

2.5 Number of households covered and types of training provided

There are numerous training availed by farmers from CARLEP under the financial assistance from IFAD in Wengkhar under Mongar Dzongkhag. Farmers avail various kinds of training from CARLEP every year. The trainings include training on lead farmers, farmer's groups and cooperatives, postharvest management, paddy cultivation, chili powder making, vegetable cultivation, farmers exchange visits, and farmers' festival from 2017 to 2018 (Table 2.1) for more details see appendix. As of 2017 to 2018, total of 2,265 males and 3,561 females were trained on various training (CARLEP, 2018).

Table 2.1: Support to farmer's training under CARLEP (2017-2018).

Training	**Units/ Gender**	**Lhuntse**	**Mongar**	**P/Gatshel**	**S/Jongkhar**	**T/Yangtse**	**T/gang**	**Total**
Training on	No. of training	9	14	2	10	4	7	**46**
Postharvest	Male	204	151	2	79	14	200	**650**
Management								
	Female	289	364	40	108	106	184	**1,091**
	Total	**493**	**449**	**42**	**187**	**120**	**384**	**1,675**

CHAPTER THREE
METHODOLOGY

3.1 Study area

The study was carried out in four Dzongkhags namely Lhuntse, Mongar, Trashigang and Trashiyangtse in eastern Bhutan. Lhuntse lies at an altitude of 1700 metres above sea level (masl) and located at 27º15'42.14 N, 91º17'20.77 E. Mongar lies at an altitude of 1600 masl and located at 27º39'51.71 N, 91º10'33.96 E. Trashigang lies at an altitude of 1500 masl and located at 27º19'57.01 N, 91º33'08.44 E. Trashiyangtse lies at an altitude of 1550 masl and located at 27º45'11.10 N, 91º27'46.11 E. The study area was selected based on number of postharvest trainings provided under Commercial Agriculture and Resilient Livelihoods Enhancement Programme, Mongar (Figure 3.1).

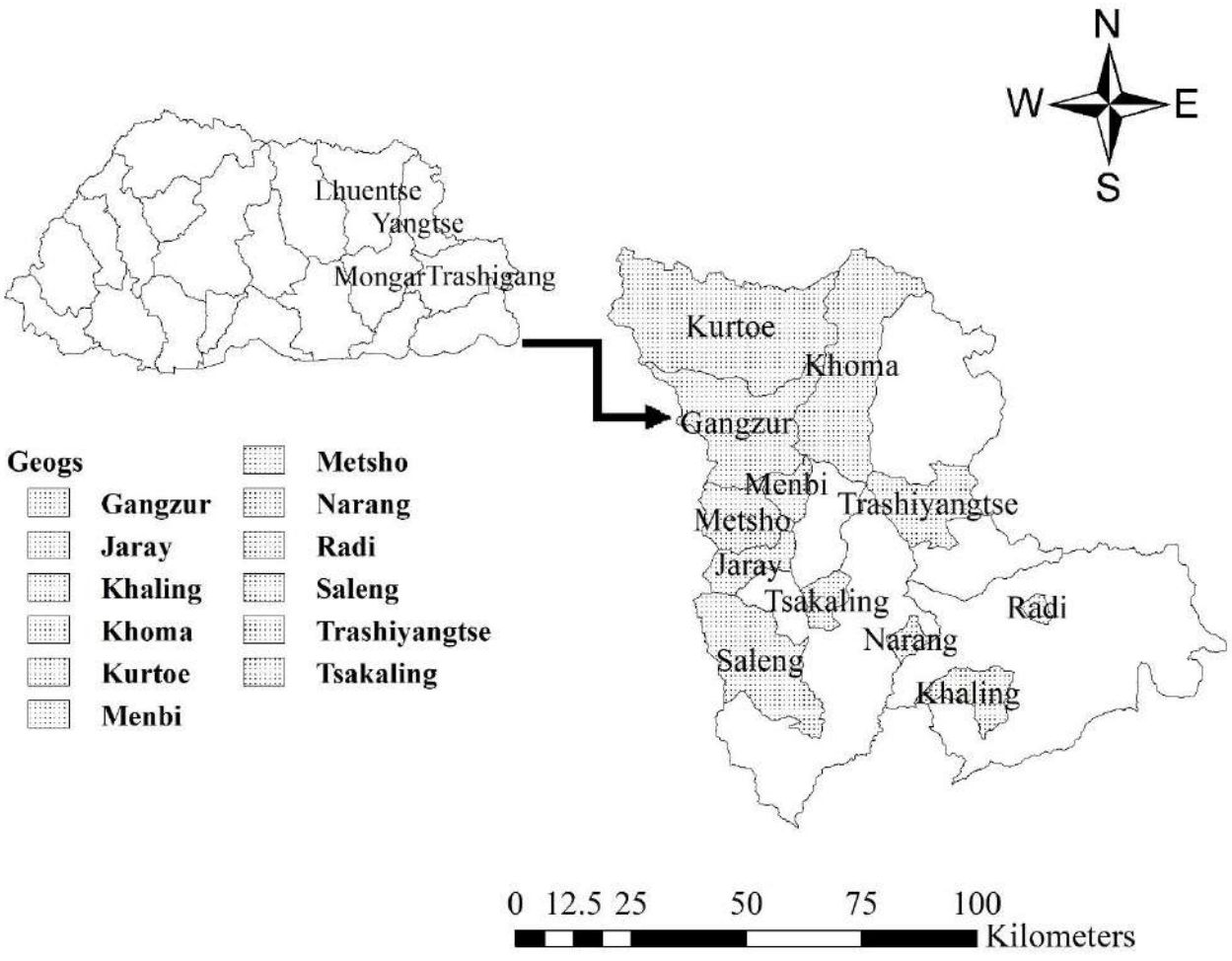

Figure 3.1: Map of the study area.

3.2 Sampling method and sample size

A simple random sampling method using Microsoft Excel was used to select respondents for the interview (Table 3.1). There were 467 farmers who had availed training on post-harvest management across 12 gewogs in four dzongkhags (Table 3.1). Yamane (1967), as cited in Israel (1992), stated that to determine sample size, three criteria are needed to fulfil such as the level of precision, the level of confidence or risk and the degree of variability. So taking this into account, total households was computed using Yamane's formula at the precision level of 5% (standard error) and 95% confidence level.

$$n = \frac{N}{1 + Ne^2}$$

Where *n* represents sample size, *N* represents total number of beneficiaries and *e* is the margin of error 5%. Using the Yamane Formula, *n=214* was selected. However, during the time interview only 134 were present. Therefore, this results was based on only 134 of them who were available during the time of an interview Table 3.1.

Table 3.1: Respondents selected using MS Excel sampling function, (n=134).

Dzongkhag	Gewog	No. of respondents	No. of trainees	
			Male (%)	Female (%)
Lhuntse	Kurtoed	17	52.9	47.0
	Gangzur	28	42.8	57.1
	Khoma	07	100.0	0.0
	Menbi	05	20.0	80.0
	Metsho	11	27.2	72.2
	Jarey	05	40.0	60.0
Mongar	Saling	08	30.0	70.0
	Tsakaling	10	0.0	100.0
	Narang	10	30.0	70.0
Trashigang	Radhi	17	82.3	17.6
Trashiyangtse	Yangtse	16	18.75	81.2

3.4 Data collection

Survey at the household level was conducted. Only one member of a household who had attended the training was interviewed. The data was collected in Samsung tablets/smart phones using KoBoCollect toolbox application.

3.4.1 Survey

The survey was administered through questionnaires with open- and closed-ended questions. The survey questionnaires has several parts. The first part solicited information on demographic characteristics of the respondents, landholdings, and income. The second part of the questionnaire explored different vegetables in terms of quantity produced, area of production and quantity sold by the farmers. The third part of questionnaire asked on PHL, quantity loss in kilograms and different ways to reduce PHL. The final part of the questionnaire asked about KASAP on different post-harvest management activities such as harvesting, cooling, cleaning, sorting, packaging, and product development.

3.5 KoBoCollect tool box application

KoBoCollect tool box application is a data collection method where data is collected through smart phones. It is paperless, efficient, reliable, and secure. It collects data and stores instantaneously into one centralized database. Researchers can access forms offline and moreover, data collected is synchronized later when connected to the internet.

3.6 Capacity building and Knowledge Attitude Skill Aspiration

Capacity building is an intervention that strengthens an organization's ability to fulfill its mission by promoting sound management, strong governance, and persistent rededication to achieving results (Beesley & Shebby, 2010). In order to evaluate capacity building Knowledge, Attitude, Skill, Aspiration, and Practice [KASA] model is used in many studies. KASA refers to knowledge, attitudes, skills, and aspirations that influence the adoption of selected practices and technologies to help achieve targeted social, economic, and environmental outcomes. Changes in KASA may occur when people react positively to their involvement in program activities (Mathison, 2005), and this model was modified by including practices to see how famers even if farmers had knowledge, attitude, skills and aspirations whether farmers practice or not.

3.7 Recall method

When there is no baseline data for impact evaluation there are other ways to evaluate impact that is an attempt to reconstruct baseline information through recall methods and a quasi-experimental approach using statistical techniques that do not strictly require baseline data. Recall techniques ask individuals or groups to provide information on their social or economic conditions, their access to services, or the conditions of their community at a particular point in time for example, project launch or over a particular period of time.

Recall is used in poverty analysis demography, and income expenditure surveys to elicit information on behavior or economic status (household income or expenditure) (Bamberger, 2010). Several comparative studies, for example, Alwin et al. (2009) have concluded that recall, when carefully designed and implemented, can be a useful estimating tool with predictable and, to some extent, controllable errors, and a potentially valuable way to reconstruct baseline data. Recall can be applied through questions in surveys and individual or group interviews. In addition to collecting numerical data such as income or farm prices, recall can also be used to obtain estimates of major changes in the welfare conditions of the household.

3.8 Data analysis

The data was coded and analyzed in SPSS version 23. Data cleaning was conducted before analyzing the data to check for any errors and missing variables. In order to assess how post-harvest training affected farmers' income earned before and after attending training paired sample *t*-test between income earned before and after attending training was used and to evaluate the effect of post-harvest training on building the capacity of the farmers on post-harvest management questions were framed based on Knowledge, Attitude, Skills and Aspirations (KASA) and was modified and added Practices (KASAP). Microsoft Office Excel 2010 was used for data entry and tabulation. Descriptive statistics [means, percentages, standard deviation and frequency distribution] was employed to summarize data into tabular forms.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

A majority of respondents (74) were from Lhuntse, 26 were from Mongar, 18 farmers from Trashigang and 16 were from Trashiyangtse. A total of 134 farmers participated in the study out of which (55) were males and (79) were females (Table 4.1). The data collection was done from January to February when agricultural activities are minimum and most of the males go away doing off-farm activities such as construction, business and other economic activities.

Table 4.1: Number of respondents in each Dzongkhag.

Dzongkhag	**Respondents**	
	Male	**Female**
1 Lhuntse	33	41
2. Mongar	05	21
3. Trashigang	14	04
4. Trashiyangtse	03	13
Total	**55**	**79**

4.1 Age of respondents

The respondents were of various age group ranging from 20 to 63 years old. Majority were into young and in active age group 21 to 41 years old (Table 4.2). The implication of the mean age on adoption of post-harvest technologies is that it is assumed that the young farmers can take risk by adopting new technologies than the older farmers (Table 4.2).

Table 4.2: Age of respondents, (n=134).

Age of the respondents	**Respondents (%)**
Below 20	0.7
Between 21 to 41	47.0
Between 42 to 62	42.5
Above 63	9.7
Total	100.0

4.2 Education attained by respondents

Data with respect to the literacy levels of sampled farmers were grouped on the basis of level of formal education attended. Education levels were grouped into eight groups that is illiterate (no school attended), monastic education, and Non formal education, primary, secondary, and higher. Most of the respondents (71) were illiterate, and there were only few (2) respondents who studied up to secondary school (Figure 4.1). The proportion of households with no formal education in rural areas is 74% (Bhutan Living Standard Survey Report [BLSS], 2017). In many cases education has direct impact on technology adoption; more literacy the higher is the level of adoption (Elemasho et al., 2017).

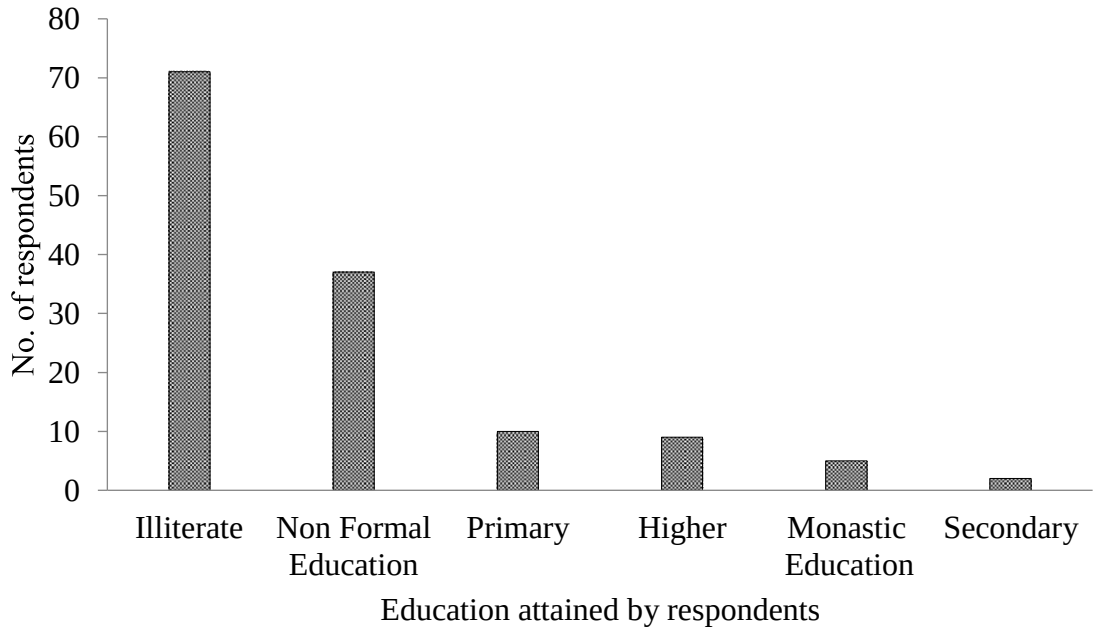

Figure 4.1: Education attained by respondents.

4.3 Source of income for the family

Most of the farmer's main source of income (91.8%) for the family in the study area were by selling vegetables. About 2.2% of the farmers also supplemented their income through dairy and 1.5% from poultry, 1.5% from handicrafts and 1.5% from business respectively as shown in the (Figure 4.2). This result aligned with the finding of BLSS (2017), which reported that in rural areas of Bhutan, the main sources of income for 40.9% people are from cereal, fruits and vegetables.

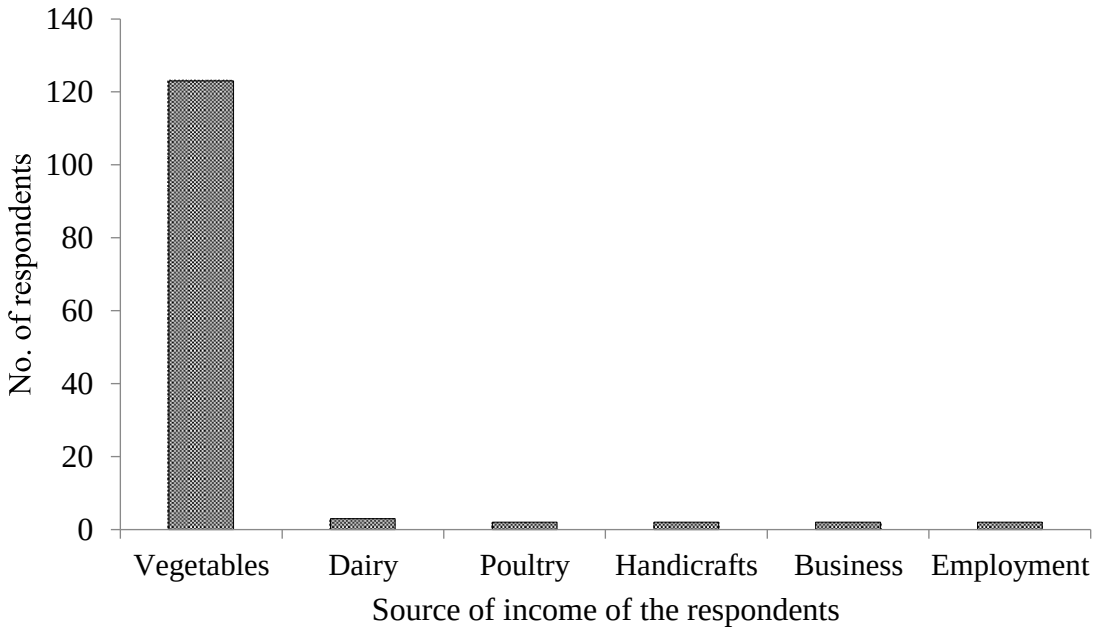

Figure 4.2: Source of income for the family.

4.4 Types of vegetable grown in the study areas

The farmers of Lhuntse, Mongar, Trashigang and Trashiyangtse grow vegetables such as chili, asparagus, potato, broccoli, cabbage, cauliflower, onion, and radish. Among the four Dzongkhags, Lhuntse produces highest 4,854.32kgs of vegetables and Trashigang Dzongkhag produces the least 1,087.35kgs yearly. The farmers from four Dzongkhags produces around 4,590.37kgs of potatoes and 4,341.66kgs of chilies yearly. Out of all the vegetables, a majority of farmers (55.8%) in Trashiyangtse produce 1,800kgs of potatoes and (53.8%) of farmers in Lhuntse produce 2,500kgs of chilies yearly. However, vegetables which are produce in large quantity such as cabbage 526.98kgs, asparagus 479.73kgs and radish 473.08kgs yearly but it do not fetch good price in the market. Onion is the least grown vegetable in the four Dzongkhags. Farmers produces around only 62.52kgs yearly as shown in Table 4.3.

Table 4.3: Households growing different types of vegetables in four Dzongkhags yearly, (*n*=134).

	Chili % farmers (Yield in Kg)	**Asparagus** % farmers (Yield in Kg)	**Potato** % farmers (Yield in Kg)	**Broccoli** % farmers (Yield in Kg)	**Cabbage** % farmers (Yield in Kg)	**Cauliflower** % farmers (Yield in Kg)	**Onion** % farmers (Yield in Kg)	**Radish** % farmers (Yield in Kg)	**Total**
Lhuntse	53.8 (2,500)	54.7 (63.30)	55.8 (1,800)	57.4 (107.50)	55.4 (179.50)	58.1 (83.80)	55.8 (26.20)	54.4 (94.02)	**4,854.32**
Mongar	22.2 (833.24)	16.9 (401.87)	20.9 (907.00)	20.2 (123.53)	19.8 (188.80)	20.9 (148.00)	20.9 (19.66)	23.7 (249.06)	**2,871.16**
Trashigang	11.1 (334.42)	7.5 (5.75)	11.6 (518.76)	8.5 (27.00)	10.8 (51.54)	9.3 (26.22)	18.6 (3.66)	10.8 (120.00)	**1,087.35**
Trashiyangtse	12.8 (674.00)	20.7 (8.81)	11.6 (1,364.61)	13.8 (42.08)	13.8 (107.14)	11.6 (61.30)	4.6 (13.00)	10.8 (10.00)	**2,280.94**
Total	**4,341.66**	**479.73**	**4,590.37**	**300.11**	**526.98**	**318.82**	**62.52**	**473.08**	

4.5 Causes of vegetables loss

4.5.1 Pre-Harvest

Figure 4.3 shows the causes of postharvest losses according to the respondents. Losses were due to pre-harvest and postharvest factors. Most of the farmers (45.52%) responded losses were because of pests and 36.57% responded that losses were because of disease. The pest includes aphids for vegetables such as cabbage, cauliflower, broccoli and radish. Pests such as black cut worm for potatoes and chilies. Diseases include club roots for vegetables such as cabbage, cauliflower, broccoli and radish and blight [early or late] for potatoes and chilies.

4.5.2 Post-harvest losses

4.5.2.1 Crops damaged by animals

Post-Harvest Losses of vegetables are mainly due to storage 3.73% and others 14.18% which include improper care during harvesting, some are eaten by animals, and some are stolen from the house by their neighbors, or damaged by heat. Approximately 55% of crop damage in Bhutan is attributed to wild animals such as elephants and wild pigs, while post-harvest losses occur mainly during storage (FAO, 2013).

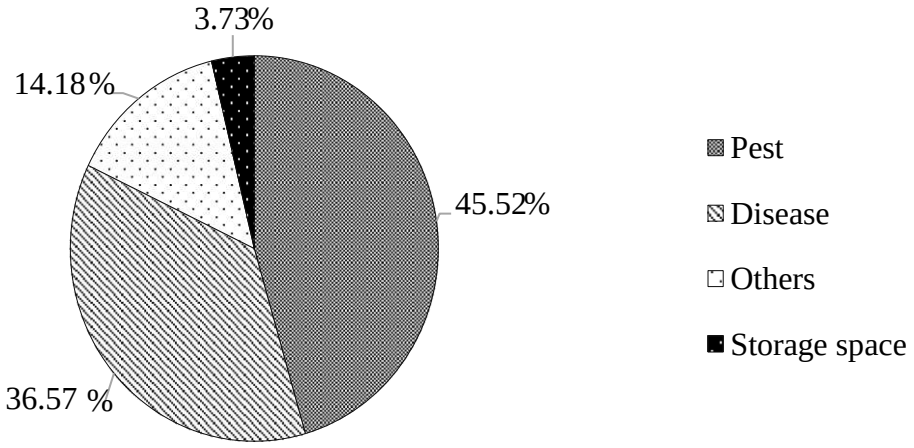

Figure 4.3 : Causes of post-harvest losses.

4.5.3 Strategies to reduce loss

Therefore, in order to reduce the post-harvest and pre-harvest losses respondents uses different ways to reduce PHL such as most of the respondents (30) practiced care during handling, 7 of them

separate the rotten ones, 6 of them uses cow dung, 5 of them sprinkle ashes, and 4 of them uses pesticides during harvesting to reduce pest attack as shown in Figure 4.4.

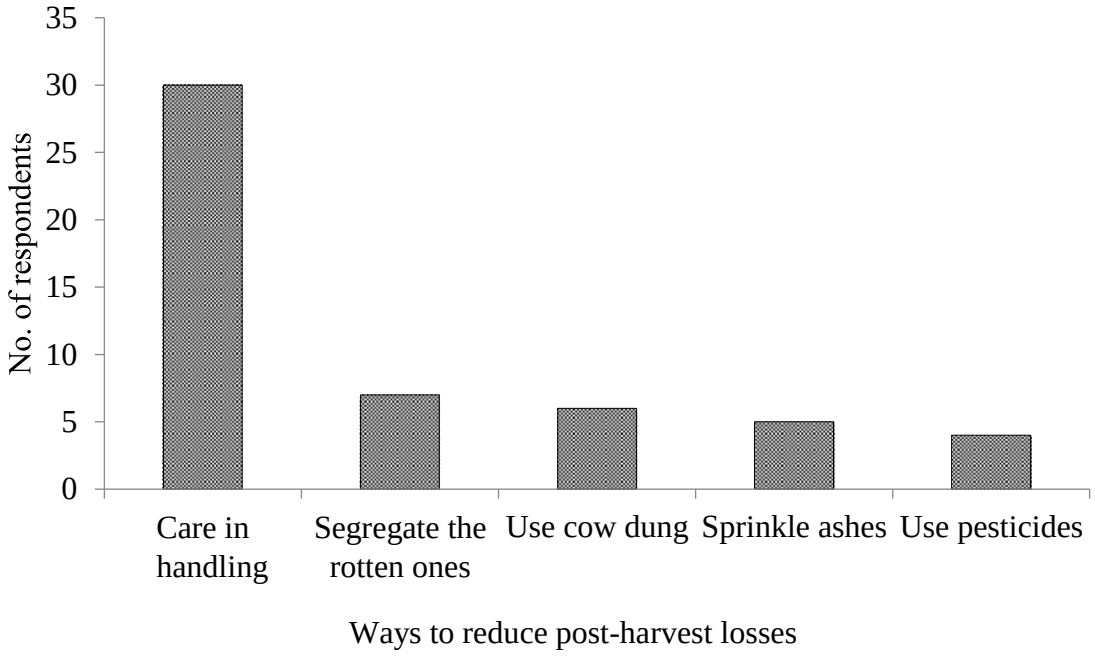

Figure 4.4 Ways to reduce post-harvest losses.

4.6 Mode of transportation

Figure 4.5 shows that out of the 134 respondents (55.22%) of the respondents uses motor vehicles to transport their produce to the nearest market, however, (41%) still carry on their vegetables to the nearest market themselves and (2.99%) transport their vegetables by horses and (0.75%) uses other means.

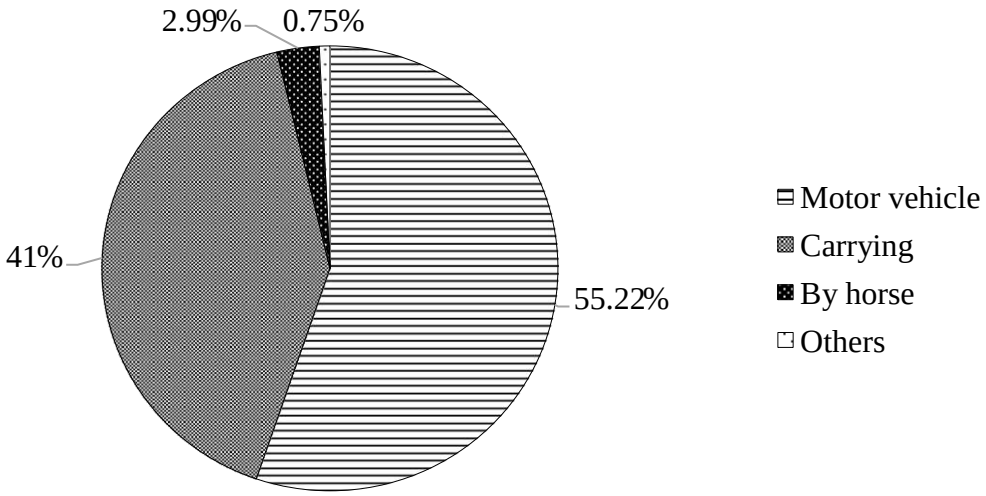

Figure 4.5 : Mode of transportation.

In the four eastern districts, about 61% of the respondents stated that they lose their vegetable during transportation. In Lhuntse Dzongkhag, most of the farmers (41.8%) have lost their vegetables less than 5kg, in Mongar Dzongkhag, most of the farmers (28%) have lost vegetables between 6-10kg, in Trashigang Dzongkhag, most of the farmers (73.6%) have lost their vegetables less than 5kg, and in Trashiyangtse Dzongkhag, of the farmers (25%) have lost their less than 5kg, and another (25%) have lost their vegetables more than 15kg as shown in Table 4.4. However, Lhuntse Dzongkhag has the highest number (47.2%) who responded they didn't face any losses because most of the vegetables are being directly taken from their field after harvesting.

Table 4.4: Dzongkhag wise post-harvest vegetables lost in kilograms (yearly), (n=134).

Dzongkhags (Districts)	Quantity in kilograms	Respondents (%)
Lhuntse	No loss	47.2
	Less than 5	41.8
	Between 6 to 10kg	5.4
	More than 15 kg	5.4
Mongar	No loss	36.0
	Less than 5	12.0
	Between 6 to 10	28.0
	More than 15 kg	24.0
Trashigang	No loss	10.5
	Less than 5	73.6
	Between 6 to 10	10.5
	More than 15 kg	5.2
Trashiyangtse	No loss	37.5
	Less than 5	25.0
	Between 6 to 10	12.5
	More than 15 kg	25.0

However, whenever the vegetables are damaged, most of the farmers (41) throws them, (35) of them feed to animals, (5) of them consume them after cutting the damaged ones, and (1) uses it as a manure (Figure 4.6).

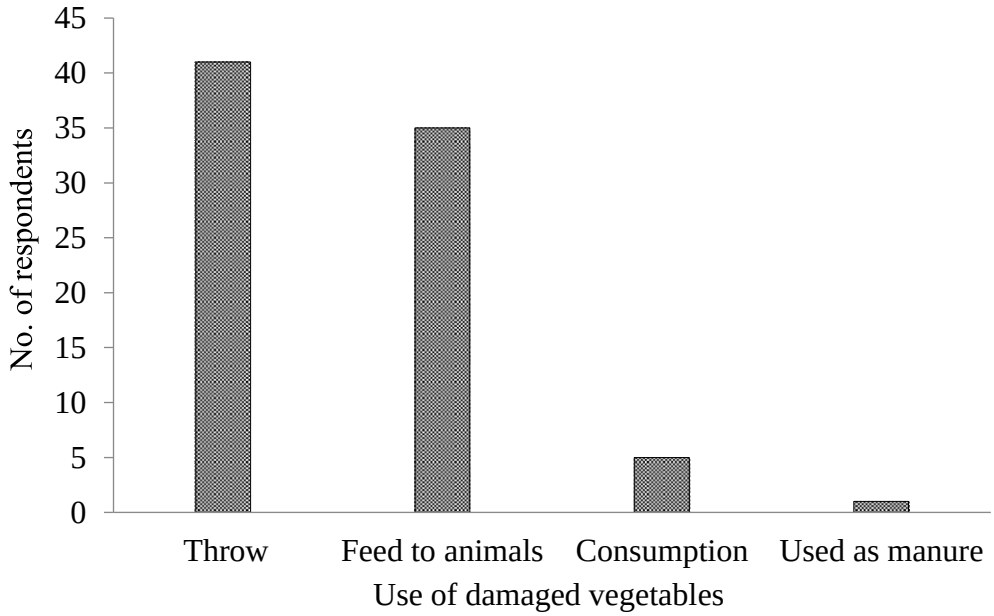

Figure 4.6: Use of damaged vegetables.

4.7 Impact on income

All the farmers (134) who attended training said that the training has had a positive impact on the income earned. The mean income before training was Nu. 12,349.25, and the mean income after training was Nu. 25,595.90 per household (Table 4.5). However, after attending training there was a significant difference in effect of training on postharvest on income earned before (*M*=12349.25, *SD*=28009.44) and after (*M*=25595.90, *SD*=35232.988), *t* (-133)=-7.775, *p*=.000) because after training farmers gained more knowledge and skills and through this skills and knowledge they shifted from traditional practice of agriculture to using advanced technologies and ideas where their time is saved and can do more economic activity such as planting different vegetables rather than focusing on one particular vegetables.

Table 4.5: Mean income earned before and after training, (*n*=134).

	Mean (Nu.)	**SD**	**Std. Mean**
Income before training	12,349.25	28,009.44	2,419.65
Income after training	25,595.90	35,232.99	3,043.67

4.8 Income earned from sale of post-harvest products

The mean income earned from sale of the post-harvest products before attending training was Nu. 17,745.52, and after training is Nu. 30,988.81 and after attending training they could do other productive activity such as selling post-harvest products such as chips, cookies and donuts, pickles and sweets where they were earning more. Therefore, the training on post-harvest has had impact on income earned by farmers after attending training (Table 4.6).

Table 4.6: Income earned from sale of post-harvest products, (*n*=134).

Income earned from post-harvest products	Mean (Nu.)	SD
Before training	17,745.52	30,901.17
After training	30,988.81	67,105.56

4.9 Knowledge Attitude Skills Aspirations Practice

Most of the farmers responded that they were using and will be able to use their skills after attending training. Most of the farmers (97%) responded that they apply what they learnt in harvesting, about (99%) of the responded they uses skills learnt in cooling, and about (96%) responded they uses what they learnt in cleaning, (100%) of the responded they sort vegetables based upon how they were taught, (97%) of them pack vegetables as per knowledge learnt in training, and about (83%) of them develop different products after attending training. However, there were also farmers who responded that they will not be able to use their skills and knowledge and few respondents who were not sure if they will be able to use their knowledge and skills learnt from training. It could be possible that they were not confident enough to use the skills or do not aspire to use the skills (Table 4.7).

Table 4.7: Usage of skills after training, (*n*=134).

Usage of skills	Yes (%)	No (%)	Don't know (%)
Harvesting	97.0	0.7	2.2
Cooling	99.2	0.0	0.7
Cleaning	96.2	1.4	2.2
Sorting	100.0	0.0	0.0
Packaging	97.0	2.2	0.7
Product development	83.5	10.4	5.9

Most of the respondents (96.99%, *n*=129) responded that there was decrease in Post-Harvest Losses of vegetables after attending training, however (2.26%, *n*=4) was not sure and (0.75%, *n*=1) responded it will not reduce post-harvest losses of vegetables because even after attending training, even if we practice those things that we learn in training other factors such as new pest and disease destroys produce (Figure 4.7).

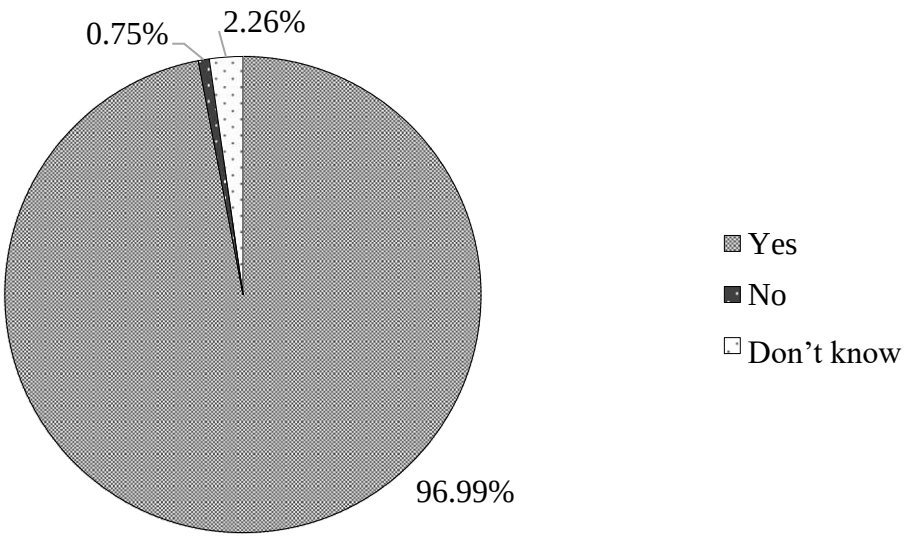

Figure 4.7: Percentage of reduce post-harvest losses after attending training.

4.10 Harvesting

Majority (70.1%) responded that the best time for harvesting is either morning or evening, 27.6% responded that the best time for harvesting it's in afternoon, 0.7% of respondent that it is after rain or watering, while 1.5% (2) of respondents they are not sure of the best time for harvesting (Figure 4.8). Harvesting should be done during the coolest part of the day either early morning when there is no dew drops or late afternoon (FAO, 1989). Therefore, the training on harvesting have impact on farmer's knowledge.

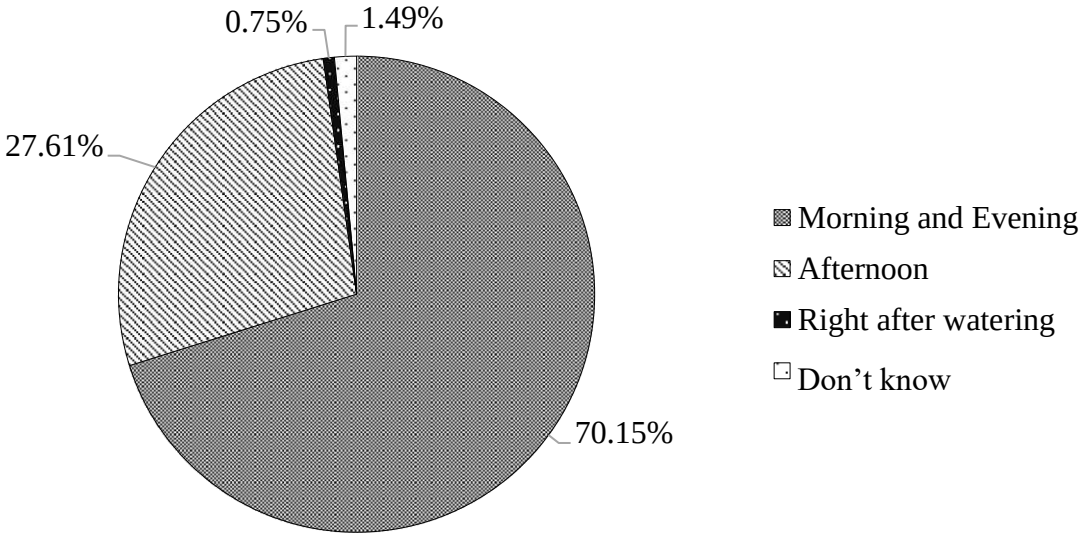

Figure 4.8: Knowledge on best harvesting time.

Most of the farmers (64.9%) prefer bamboo basket for keeping their vegetables and 20.9% prefer sacks for storing their vegetables because it's easily available and they can weave bamboo baskets themselves rather than buying plastics, crates and other containers for storing vegetables (Table 4.8). These shows that the farmers have KASA and are practicing. The farmers uses different container for keeping their vegetables such as 35.1% responded that they take it to the house after harvesting, 32.8% of farmers responded that after harvesting they directly pack after harvesting, 16.4% of farmers responded that after harvesting they move under shade, 13.4% of farmers responded that after harvesting they keep in the ground, and 2.2% of farmers responded others such as consume directly (Table 4.9).

Table 4.8: Container used for keeping vegetables after harvesting, (n=134).

Harvesting container used	**Respondents (%)**
Plastics	4.5
Bamboo baskets	64.9
Sacks	20.9
Crate	8.2
Others	1.5

Table 4.9: Post-harvest activity, (*n*=134).

Post-harvest activity	Respondents (%)
Keep in the ground	13.4
Move under shaded area	16.4
Take it to the house	35.1
Pack directly	32.8
Others	2.2
Total	100.0

4.11 Cooling

Farmers are aware of cooling techniques. Most of the farmers (88.8%) prefer room cooling and 11.2% prefer hydro cooling (Table 4.10). They are choosing either of the cooling techniques because most of the farmers (30.6%) responded that it minimizes decaying and loss. Therefore, in four Districts most of the farmers cool their vegetables in their own house after harvesting as there is more open spaces and more often it is safe and easy to check the vegetables.

Table 4.10: Methods for cooling vegetables after harvest, (*n*=134).

Methods for cooling	Respondents (%)
Room cooling	88.8
Hydro cooling	11.2
Reasons for choosing cooling technique	
Minimize decaying and loss	30.6
Easy and maintains freshness	18.7
Efficient and fast	11.9
Recommended by EA	7.5
Customers preference for vegetables	2.2
Protect from animals and pests	12.7
Protect from heat	9.0
I don’t know	7.5
Total	**100.0**

4.12 Cleaning

Most of the farmers (50%) preferred washing as the best cleaning method for leafy vegetables, 38.8% preferred wiping for cleaning, 8.2% preferred others such as cutting of the leaves and roots, 2.2% preferred brushing for cleaning and 0.7% preferred sanitizing for cleaning as shown in Figure 4.9. They chose washing as the most appropriate cleaning technique because 34.3% of them responded it was cleaner and faster, and 30.6 % of them responded that it was easy and cleaning with water maintains freshness and 30.6% of them responded it minimizes decay and damage, and 4.5% of them responded it was because of customer preference (Table 4.11).

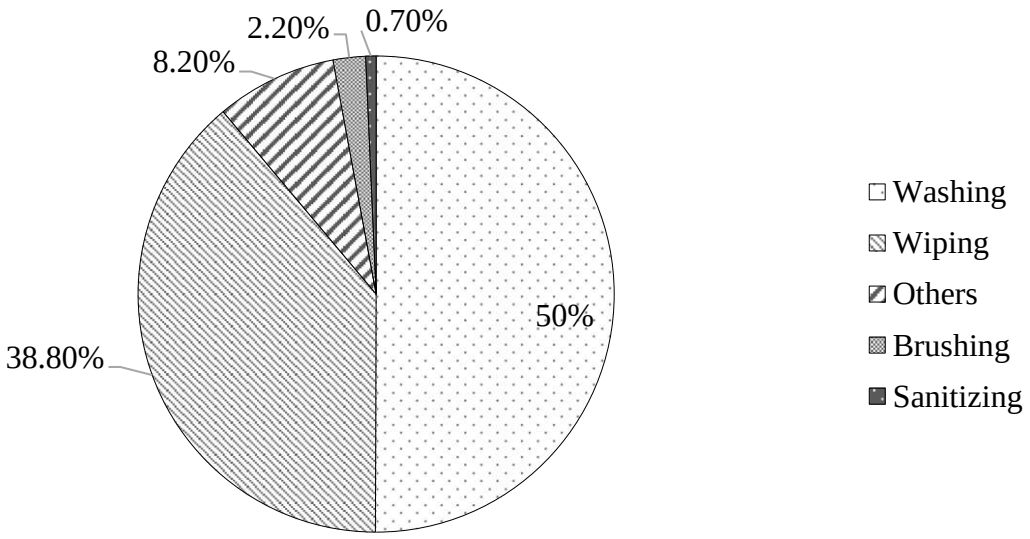

Figure 4.9 : Best methods of cleaning.

Table 4.11: Reasons for choosing the cleaning technique**.**

Reasons for choosing the cleaning technique	**Respondents (%)**
Easy and maintains freshness	30.6
Cleaner and faster	34.3
Customer preference	4.5
Minimize decay and damage	30.6
Total	100.0

4.13 Sorting

Farmers have ideas about sorting technique. Among 134 respondents, most of the farmers (70.9%) sorted based on size for vegetables such as potatoes, 22.4% sorted base on color for vegetables such as spinach, cabbages and leafy vegetables, 5.2% sorted base on shape for vegetables such as radish and potatoes, and the remaining 1.5% do not sort (Figure 4.10).

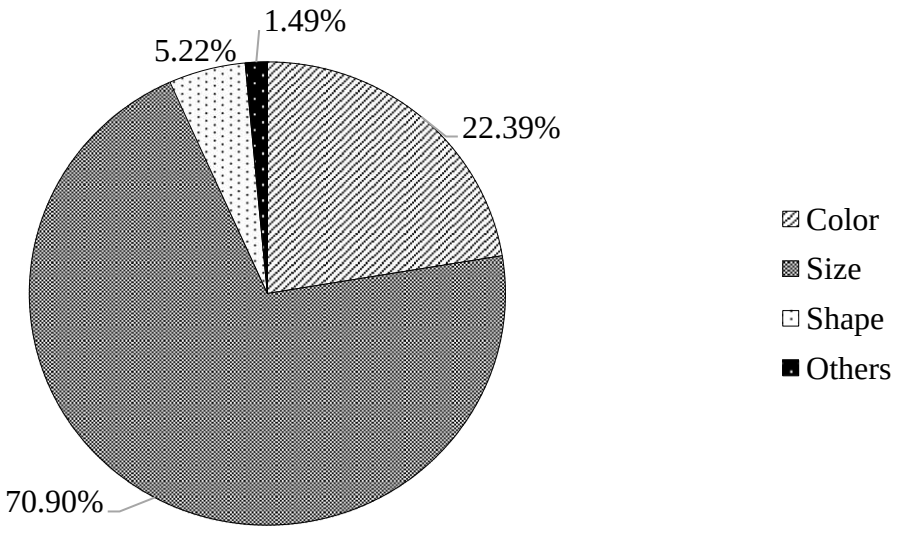

Figure 4.10: Different ways of sorting.

Most of the farmers sort their vegetables based on different sorting techniques such as color, size, and shape. About (70%) of the farmers sorted based on size, smaller ones were kept as seedlings, medium ones were consumed and bigger ones were sold in the market. Farmers sorted vegetables because 35.8% responded that it was mostly preferred by customers, 28.4% responded as it was easy, 24.6% responded as it was sold fast in the market, and 11.2% responded as it minimizes damage and losses (Table 4.12).

Table 4.12: Reasons for choosing the sorting technique.

Reasons for choosing sorting technique	Respondents (%)
It's easy	28.4
Customer preference	35.8
Minimize damage and loss	11.2
Sell fast	24.6
Total	100.0

4.14 Packaging

Most of the farmers (67.9%) preferred others for packing vegetables such as sacks were used for large quantity for vegetables such as potatoes, cabbages, cauliflowers, broccolis, chilies, and radishes. Majority of the farmers (17.2 %) responded that packaging materials should be biodegradable after use and (14.9%) of the farmers responded that container should be food graded materials (Table 4.13). For example, in Bhutan, crops such as cardamom is packed with use of recycled plastic or bags made out of jute and stored in corners of home which lack adequate aeration and preservation (United Nation Development Programme [UNDP], 2016).

Table 4.13: Packaging technique preference.

Packaging technique	**Respondents (%)**
Container should be food graded quality	14.9
Biodegradable after use	17.2
Others	67.9
Total	100.0

Farmers use various materials for packing their vegetables. Most of the farmers (67.9%) use others because 32.8% of the farmers responded it's easier and cleaner, 29.9% of the farmers responded that it was easily available and comfortable for materials such as sacks, 12.7% of the farmers responded as it reduces damages, 20.8% of the farmers responded as it was environment friendly and because of customer preference. However, 3.7% of the farmers do not know about the packaging materials (Table 4.14).

Table 4.14: Reasons for choosing packaging materials.

Reasons for choosing packaging materials	**Respondents (%)**
Environment friendly	10.4
Easier and cleaner	32.8
Customer preference	10.4
Reduce damages	12.7
Available and comfortable	29.9
I don't know	3.7
Total	100.0

4.15 Product development

Most of the respondents started making pickle (59), cookies and donuts (40), and chips (*n*=31) after attending training and this were also those products which were sold in market and fetched them additional money (Figure 4.11).

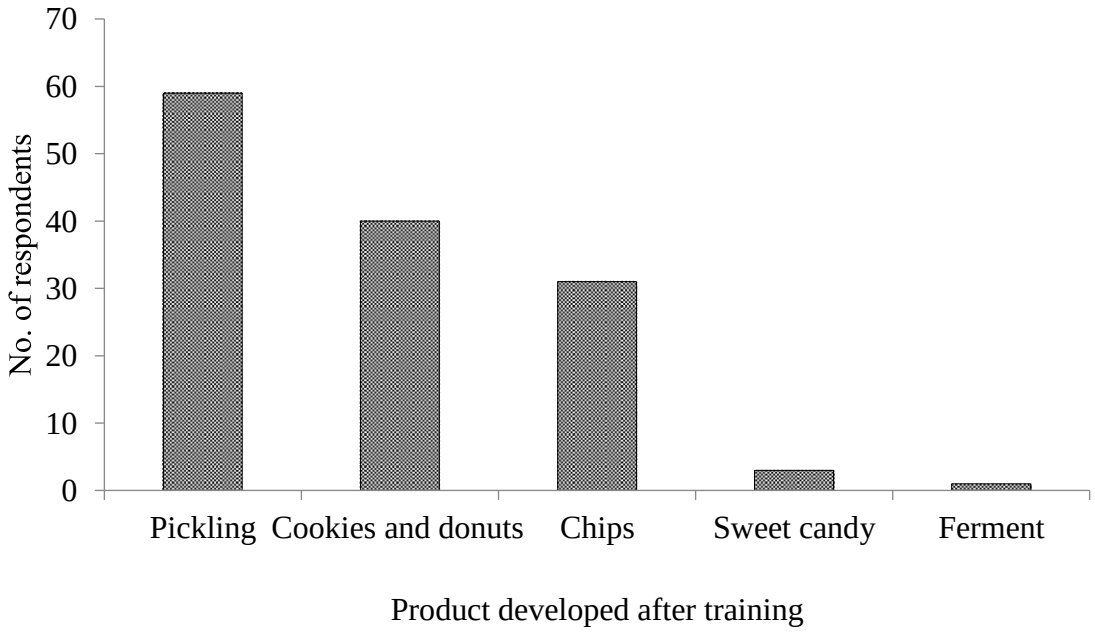

Figure 4.11: Product developed after attending training.

4.16 Source of information about training

Most of the farmers (46.3%) heard about post-harvest training from neighbors (Figure 4.12). In Bhutan, the Department of Agriculture Marketing and Cooperatives (DAMC), in collaboration with the Food Corporation of Bhutan (FCB), provides the market information related to price and demand supply situation, largely through television, radio and website (Gyeltshen et al., 2015).

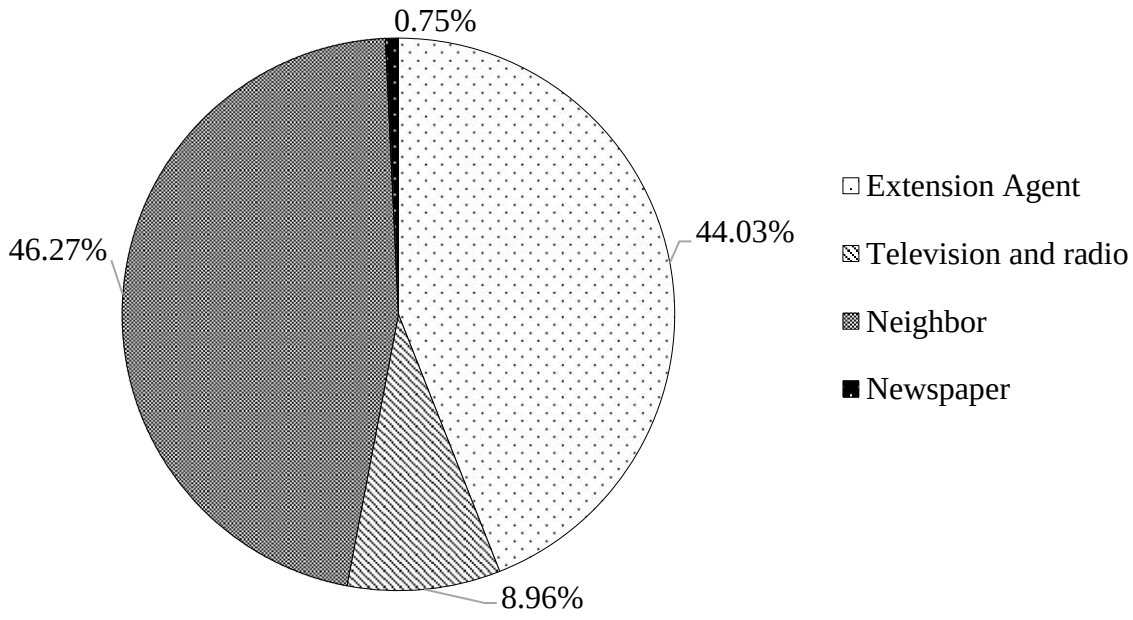

Figure 4.12: Sources of information on types of training.

4.17 Trainers of farmers in post-harvest training

Majority of the respondents (97) were trained by extension agents in their respective gewogs, 33 of them came to Agriculture Research Development Centre in Mongar for training and 4 of them was trained by dzongkhag officials (Figure 4.13).

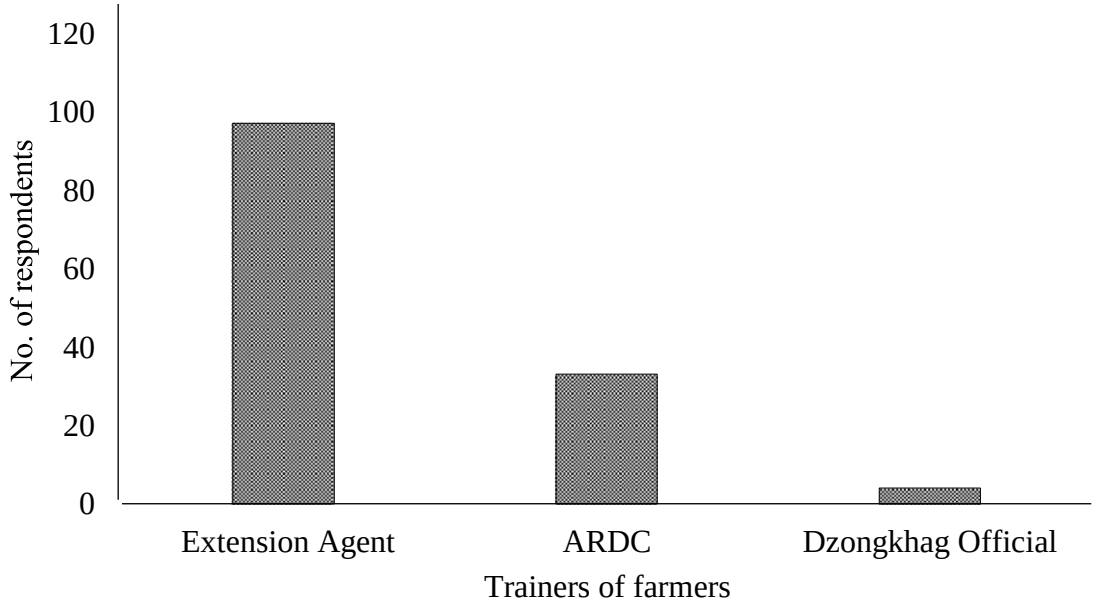

Figure 4.13: Trainers of farmers in post-harvest training.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Post-harvest training have important role to boost up household income and capacity building of the farming community. Currently, CARLEP has conducted training on post-harvest for 46 times and trained around 650 males and 1,091 females. Post-harvest training has an impact on building capacity of farmers and consequently increasing their income.

It was found that most of the farmers in Lhuntse (54.47%), Mongar (21.95%), Trashigang (12.19%), and Trashiyangtse (11.38%) were engaged in farming activities especially production of vegetables such as potatoes, chilies and broccoli. More than 80% of the farmers across four Dzongkhags have benefited from the trainings. They have gained knowledge, skills and have also practiced which helped them to reduce post- harvest losses of vegetables. Moreover, their average income before training was Nu. 12,349.25, which increased to Nu. 25,595.90, after attending training.

This study will provide information on impact of post-harvest training particularly on the average yield from the four Dzongkhags, income earned after attending training and ways to reduce post-harvest losses to the Ministry of Agriculture and Forests and agriculture extension officers to make appropriate agriculture development plans in their Dzongkhag. Followings are the recommendations that can be adopted by the stakeholders.

5.2 Recommendations

1. The government should introduce postharvest trainings on packaging because most of the respondents pack their vegetables in sacks and plastics which are not up to the standard of respondents.
2. More trainings on product development and value addition for vegetables such as cabbage, asparagus and radish which are produced in large quantity and are susceptible to decay. Therefore, trainings on these vegetables should also be made available to the farmers, so that farmers can earn additional income.
3. This present study was carried out in only four Dzongkhags namely Lhuntse, Mongar, Trashigang and Trashiyangtse. The future researchers who aims to study on similar topics

can include Pemagatshel and Samdrup Jongkhar Dzongkhags so that the results will be able to represent the scenario of impact of post-harvest training in the six eastern Dzongkhags.

References

Adejo , P. E. (2017). Post-Harvest Management Practices of Yam and Farmers Information Needs in the North-Central of Nigeria. *Journal of Nutraceuticals and Food Science*, 3-9.

Adhikari, S. (2006). *Country report of Nepal: Management of fruits and vegetables in the Asia pacific region. Asian productivity organization and FAO.*

Ahmad, M., Jadoon, M. A., Ahmad, I., & Khan, H. (2007). Impact of Trainings Imparted to Enhance Agricultural Production in District Mansehra. *Sarhad Journal of Agriculture*, 1211-1216.

Aliber, M., & Hart, T. G. (2009). Should subsistence agriculture be supported as a strategy to address rural food insecurity. *Agrekon*, 434-458.

Alwin, D. F., Stafford, F. P., & Belli, R. F. (2009). *Calendar and Time Diary Methods in Life Course Research.* Sage Publications.

Babalola, D. A., Makinde , Y. O., Omonona , B. T., & Oyekanmi, M. O. (2010). Determinants of post-harvest losses in tomato production: a case study of Imeko – Afon local government area of Ogun state. *Journal of Life and Physical Sciences*, 14 - 18.

Bamberger, M. (2010). *Reconstructing Baseline Data for Impact Evaluation and Results Measurement.* PREM notes.

Beesley, A. D., & Shebby, S. (2010). *Evaluating capacity building in education: The North Central Comprehensive Centre.* Colorado.

Bellon, M. R. (2004). Conceptualizing interventions to support on farm genetic resource conservation. *World Development*, 159-172.

BLSS. (2017). *Bhutan Living Standard Survey Report 2017.* Thimphu: National Statistics Bureau of Bhutan.

Bosa, S. O., & Bolarin, F. M. (2015). Post-Harvest Losses: A Dilemma in Ensuring Food Security in Nigeria. *Journal of Natural Sciences Research,* 151-154.

Choda, S., Tenzin, K., & Wangchuk, D. (2018). *Annual Outcome Survey Report for Commercial Agriculture and Resilient Livelihoods Enhancement Programm.* Wengkhar, Mongar: Office of Programme Management.

Dhruba, R. B. (2018). Postharvest horticulture in Nepal. *Horticulture International Journal*, 458–460.

Elemasho, M. K., Alfred, S. D., Aneke, C. C., Chugali, A. J., & Ajiboye, O. (2017). FARMERS' PERCEPTION OF ADOPTION OF POST-HARVEST TECHNOLOGIES OF SELECTED FOOD CROPS IN RIVERS STATE, NIGERIA. *International Journal of Agricultural Research, Innovation and Technology*, 22-26.

El-Ramady , H. R., Szabolcsy, É. D., Abdalla, N. A., Taha, H. S., & Fári, M. (2015). Postharvest Management of Fruits and Vegetables Storage. *Sustainable Agriculture Reviews*, 65-152.

Emmanuel, A. O., Abu, Y., YUsuf, S. K., & Nansoh, S. (2016). Use of Agricultural Information Sources and Services by Farmers for Improve Productivity in Kwara State. *Library Philosophy and Practice (e-journal)*, 1456.

FAO. (2011). *Appropriate food packaging solutions for developing countries.* Rome.

FAO. (2013). *Report on the High-Level Multi-Stakeholder Consultation on Food Losses and Food Waste in Asia and the Pacific Region.* Bangkok: FAO.

FRMD. (2017). *Land Use and Land Cover of Bhutan 2016, Maps and Statistics.* Thimphu: Department of Forests & Park Services, Ministry of Agriculture and Forests.

Genova, C., Weinberger, K., HOANG, B. A., DANG, D. D., NGUYEN, T. T., Le, N., & Nguyen, T. T. (2006, 1 4). *Postharvest loss in the supply chain for vegetables - the case of chili and tomato in Vietnam*. Retrieved from http://www.avrdc.org/pdf

GNHC. (2012). *Data Collection Survey Report on Food Self-Sufficiency and Food Security in the Kingdom of Bhutan.* Nomura Research Institute.

Gyeltshen, S., Griffith, G., Dorji, L., & Lakey. (2015). Assessment of the Citrus Value Chain in Bhutan: A Review. *Australasian Agribusiness Perspectives*, 1-14.

Kader, A. (2005). Increasing Food Availability by Reducing Postharvest Losses of Fresh Produce. *Postharvest Symposium*, 2169-2176.

Kader, A. A. (2002). *Postharvest technology of horticultural crops.* Oakland.

Kereth, G. A., Lyimo, M., Mbwana, H. A., Mongi, R. J., & Ruhembe, C. C. (2013). Assessment of post-harvest handling practices: knowledge and losses of fruits in Bagamoyo district of Tanzania. *Food Science and Quality Management*.

Kiaya, V. (2014). Post-Harvest Losses and Strategies to Reduce them. *ACF International*, 2-25.

Kitinoja, L. (2013). *Returnable Plastic Crate (RPC) systems can reduce postharvest losses and improve earnings for fresh produce operations.* Oregon: The Postharvest Education Foundation.

Latif, S. F. (2001). *Impact of female livestock extension workers (FELEWs) on household economy contributed by backyard chicken production in Mardan division.* Peshawar.

Mada, D. A., Hussaini, D. I., Medugu, A. I., & Adams, I. G. (2014). Study on Impact of Post-Harvest Losses and Post-Harvest Technology in Ganye Southern Adamawa StateNigeria. *Global Journal of Science Frontier Research: D Agriculture and Veterinary*, 2732.

Mathison, S. (2005). *Knowledge, Attitudes, Skills, Aspirations (KASA).* SAGE Publications.

Miyinyawa, Y. (2002). *Farm structures.* Ibadan Press.

NBC. (2014). *Draft National Strategic Plan for Cereals.* Thimphu.

NSB. (2013). *Statistical Yearbook of Bhutan.* Thimphu.

NSB. (2016). *Statistical Yearbook of Bhutan.* Thimphu.

NSB. (2018). *2017 Population & Housing Census of Bhutan: National Report.* Thimphu.

NSSC. (2010). *Land Cover Assessment Report.* Thimphu.

Obiakor, S. I., & Oni, K. C. (2002). Post-harvest food loss prevention: The role of the National Centre for Agricultural Mechanization (NCAM) Ilorin under the FGN/UNDP first country Cooperation (ccf-1) framework. *Proceedings of National Seminar for Cooperating Agencies under the CCF-I Framework on Post-Harvest Food Loss Prevention*, (pp. 1-10). Ibadan.

Olayemi, F. F., Adegbola, J. A., Bamishaiye, E. I., & Awagu, E. F. (2012). Assessment of Post-harvest losses of some selected crops in eight local government areas of Rivers State, Nigeria. *Asian Journal of Rural Development*, 13-23.

Opara, U. N. (2008). Agricultural Information Sources Used by Farmers in Imo State, Nigeria. *Information Development*, 289-295.

PAR. (2017). *Bhutan Poverty Analysis Report.* Thimphu.

Paudel, K. B. (2006). *Country report of Nepal: Management of fruits and vegetables in the Asia pacific region. Asian productivity organization and FAO.*

PHMD. (2012). *Annual Report 2010/11.* Lalitpur.

Tibagonzeka, J. E., Akumu, G., Kiyimba, F., Atukwase, A., Wambete, J., Bbemba, J., & Muyonga, J. H. (2018). Post-Harvest Handling Practices and Losses for Legumes and Starchy Staples in Uganda. *Agricultural Sciences*, 141-156.

Tobgay, S. (2005). *Agriculture Diversification in Bhutan.* Gold Coast.

UNDP. (2016). *Enhancing Sustainability and Climate Resilience of Forest and Agriculture Landscape and Community Livelihoods in Bhutan.*

UNDP. (2017). Enhancing Climate Resilient Agriculture and Food Security in Bhutan.

USAID. (2016). *Reaping the benefits: Technical Guidance on Reducing Post-harvest Losses in Smallholder Farming Systems.* Washington.

Wangchen, C., & Srzedruckr, G. (n.d.). *Grain postharvest status in Bhutan.*

Appendix

Table: Support to farmer's training under CARLEP (2017-2018).

Training	Units/ Gender	Lhuntse	Mongar	P/Gatshel	S/Jongkhar	T/yangtse	T/gang	Total
1.Farmer-to-famer training (Lead Farmer Model)	No. of training	6	0	2	0	2	2	**12**
	Male	84	0	60	0	58	36	**238**
	Female	206	0	91	0	19	34	**350**
2. Supports to lead farmers-others		0	0	0	0	230		**230**
3. Farmer Exchange Visit	No. of training	5	3	6	1	5	2	**22**
	Male	11	13	168	14	77	31	**314**
	Female	22	43	64	13	63	17	**222**
4. Farmers festivals	No. of training	7	2	1	1	0	1	**12**
	Male	64	80	19	116	0	27	**306**
	Female	137	120	41	64	0	37	**399**
5. Training related to FGs and Coops	No. of training	0	3	6	0	3	1	**13**
	No. of group trained	2	3	6	0	3	0	**14**
	Male	10	10	94	0	37	20	**171**
	Female	36	57	64	0	34	4	**195**
6. Training on Postharvest Management	No. of training	9	14	2	10	4	7	**46**
	Male	204	151	2	79	14	200	**650**
	Female	289	364	40	108	106	184	**1,091**

Total	493	449	42	187	120	384	**1,675**