STUDY ON QUALITY AND SAFETY ISSUES IN THE HORTICULTURAL MARKETING CHAINS TO PROVIDE NUTRITIOUS FOOD IN BANGLADESH

M.Phil Thesis

Submitted

by

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Institute of Nutrition and Food Science (INFS),

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Begum Jannatul Ferdausi Sumi

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STUDY ON QUALITY AND SAFETY ISSUE IN THE HORTICULTURAL MARKETING CHAINS TO PROVIDE NUTRITIOUS FOOD IN BANGLADESH

Abstract

Fruits and vegetable are an important sub-sector in the agricultural sector because they are valued as protective food. They are very rich sources of mineral vitamins providing more energy. The contribution of horticultural remains extremely important for ensuring food and nutritional security in Bangladesh. A large proportion Bangladeshi population is food insecure due to poor diet quality, not only food nutritional security is also underscored by the present government. The main reasons for the losses are physiological and Biochemical process, Microbial decay, high perish ability and substandard post harvest handling infrastructures. This study was designed to assess quality and safety issue in the horticultural marketing chains to provide nutritious food in Bangladesh and explore the relationship between farmers, middleman, whole sellers and retailers in the horticultural marketing chains and some selected characteristics. It was conducted in combination of desk review of various sources like reports, journals, books documents, and others, and in-depth interview of the identified main stakeholders (supply chain actors like farmers, Middlemen, wholesalers, and retailers).

Findings of the study explain that harvesting is done at any time of the day and knowledge on maturity indices is often inadequate. Packaging is done using gunny bags, used fertilizer sacks, bamboo baskets etc. that provide little protection to perishables. Head loads, rickshaw, van, bicycles, etc. gunny heavy loads of haphazardly packed produce from production sites to market. Trucks and launch boat carrying tightly packed produce in unventilated heavy loads. Untimely harvesting and rough handling is a major cause of nutritional loss followed by inappropriate and or poorly-designed harvesting tools and harvest containers, inadequate field sorting, grading and packing protocols, lack of knowledge about pre-cooling technology, poor infrastructure, lack of appropriate transport systems; shortage of refrigerated transport; poor temperature management, loading and unloading practices also cause of nutritional losses.

The study emphasizes replication of further researches to reduce national losses of nutrient and to make changes in supply chain. To develop a harmonized national plan of action supported with the necessary resources for its effective implementation. Hence, the present study was aimed at conducting extensive survey to collect information on the existing pre and post harvest practices for selected fruits and vegetable assess the postharvest losses (Quantitative and Nutritional) at different stages of supply chain. The result of the present study recommended to the policy makers to develop strategic national plan to minimize

post harvest losses of fruits and vegetables to maintain nutritional quality in the supply chain and carry out nutritional training at all stages of primary and secondary levels in order to create nutritional awareness.

The study was carried out that,61.4% growers, 31.82% whole seller, and 49.99% middle men use bamboo basket to sell their products (Fruits & Vegetables). It is revealed that 61.4% farmer do not wash their products after harvest and only 38.6% farmers wash their products after harvest. The present study also found that grading of FVs (Fruits and Vegetables) is poorly practiced. Some growers and intermediaries were found to practice grading of their products only based on visual judgment. There is no scientific methods of grading of grade standards of fruits and vegetables in my study area. The study found that 59.1% respondent(farmer) use manure and fertilizer and 45.45% respondent apply fertilizer by their own calculation, 90.9% respondent (farmer) do not analyze their soil before growing. The result presented that 56.8%respondent (growers) used pesticides to grow their vegetables and fruits, 59.09% growers use insecticides and fungicides by the selection process from the dealer. During my study it was observed that the79.55% middlemen are packaging together or separately and transport together 29.55% to the distant market for the wholesaler. Sometimes72.72% middlemen thrown away average 5% products before packaging due to damage. The study revealed that 31.82% middlemen said that 2% of their products damaged during transportation. The result has found that middle men and whole sellers were involved with banana ripening either by using conventional or chemical methods. It is observed that 25% middlemen use ripening chemical and 13.64% ripenining the banana by conventional method. The study found that 77% retailers spray water on the vegetables or fruits to keep it fresh and attractive to the consumers. The sources of water is from river, pond, canal and supplied water. It is also found that 77.27% retailers collect water from other sources to spray on their purchased horticultural products to keep it fresh for long time. The result has shown that 40.91% retailer has lost 2% of their commodities (FVs) during transportation and 45.45% retailer discarded their goods due to mechanical damage. About 38.64% wholesalers use ripening chemicals.. The study also revealed that 61.4% growers suffer from health hazards due to use of pesticides.

ACRONYMS & ABBREVIATIONS

APAARI – Asia Pacific Association of Agricultural Research Institutions

BARC-Bangladesh Agricultural Research Council

BARI- Bangladesh Agricultural Research Institute

BBS-Bangladesh Bureau of Statistics

BCIP-Bangladesh Country Investment Plan

BDHS-Bangladesh Demographic and Health Survey

BSTI-Bangladesh Standard and Testing Institute

CA-Controlled Atmosphere

DAE-Department of Agriculture Extension

FAO-Food and Agriculture Organization of the United Nations

FVs- Fruits and Vegetables

ICDDRB-International Centre for Diarrhe-a Diseases Research, Bangladesh

IFPRI-International Food Policy Research Institute

IPHN-Institute of Public Health and Nutrition

MA-Modified Atmosphere

MoA-Ministry of Agriculture

MoH- Ministry of Health

NATP-National Agricultural Technology Project

NFP-National Food Policy

RMA-Rapid Market Appraisal

WHO-World Health Organization

WG- Weight-able Granular

WP- Weight-able Powder

Ha- Hector

MT- Metric Ton

PH-Post harvest

INTRODUCTION

1.1 Introduction: Food safety is presently a global concern. The contribution of horticulture is highly important for ensuring food and nutritional security in Bangladesh. Fruits and vegetables are very important all agricultural production as because these are valued as protective food. It is a great source of minerals & vitamins which provide more energy per unit weight than cereals. A variety of fruits and vegetables are produce in Bangladesh. However, there is a wide gap between availability and the per capita nutritional requirement of fruits. The main reasons of lower availability of quality fruits and vegetables are high post harvest losses, poor transportation, improper storage and low processing capacity of the total production.

The increased production of fruits and vegetables and other agricultural produce will be fully realized only when they reach to the consumer in good condition with reasonable price. The post-harvest losses could be considerably reduced by adopting improved packaging, handling and efficient transport system.

Horticultural crops in Bangladesh cover an area of 873 thousands hectares with a total population of 110 lakh metric tons (BBS,2009). The desired level of development in horticulture has not yet been achieved having a number of constraints. Due to absence of proper post harvest management system, a bulk quantity of the harvested produce is damaged every year. More importantly the lack of proper storage and marketing facilities, and seasonal glut force the farmers to sell their hard-earned produce at throw-away prices. The food and nutrition situation in Bangladesh is fragile due to inadequate and imbalanced diet intake. Consumption of a diversified diet to meet the needs of macro and micro nutrients needs to be promoted (Bhattacherjee *et al.*2007;NFP2008;BDHS 2009).

Fruits and Vegetables are highly valued in human diet mainly for vitamins and minerals. However, the present consumption of fruits and vegetables in Bangladesh is 126/g/day/capita(23 g leafy vegetables, 89 g non-leafy vegetables and 14 g fruits), which is far below from the minimum average requirement of 400/g/day/capita (FAO/WHO 2003). However, according to HIES(2005),the present consumption of fruits and vegetables including potato was 253/g/day/capita,which indicates a poor dietary status in Bangladesh. In this regard, the high levels of low birth weight (33%), underweight (41%),stunting(43%)and wasting (17%) among the children less than five years; anemia among infants, young children adolescent girls and pregnant women; and poor diet diversification are of particular concern (BDHS 2009; BCIP 2010).

The prevalence of overweight (12.5%) among women that has increased by 10% between the 2004 and 2007 also indicate the existence of the double burden of malnutrition in Bangladesh (BDSH 2009). A large proportion of Bangladeshi people is food insecure due to poor diet quality. The usual diet is heavily dependent on rice, and most of the energy in the daily diet is provided by cereals. Rice accounts for 68% of the total calorie consumption in 2005. Therefore, even though rice is not a good sources of protein, it constitutes about half of total protein consumption in the diet. High prevalence of micronutrient deficiency i.e. hidden hunger is common in the society, and the situation could be improved significantly by increasing the consumption of high quality and micronutrient-rice food like fruits and vegetables.

Currently the main aim of the farmer is to increase the production of fruits and vegetables and to ensure the marketing of these items. Relatively little consideration is given to the post harvest quality of these fresh produce items. The loss occurs due to unscientific pre product ire and post harvest management as well as lack of appropriate processing and marketing fair liter that have adverse impacts on farmer income, consumer prices and nutritional quality of produces. Due to tropical and subtropical climates in Bangladesh, a variety of fruits and vegetables are grown in the country. Unfortunately, a considerable proportion of the harvested produce never reaches the consumers mainly because of post harvest losses. The estimated postharvest losses of fruits and vegetables lie in the range of 20-40% (Wills *et al.*2004).

Hence there is general support among scientists for the proposition that increased returns to growers and other stakeholders in the supply chain might come from proper management after harvest rather a further boost to crop production in the field. The principal reasons for postharvest losses are (i) physiological and biochemical processes i.e. increase in respiration, ethylene production and transpiration loss of water, (ii) microbial decay, (iii) high perish ability, and (iv) sub-standard postharvest handling infrastructures. Therefore, it is urgent to formulate national policy to reduce enormous postharvest losses, to maintain quality, and to elevate the rate of per capita consumption of fruits and vegetables of the people of the country. No reliable statistical data are available to indicate the magnitude of postharvest looses of fruits and vegetables in Bangladesh.

However, there are some anecdotal evidences and inadequate reports have been published time to time on postharvest losses of perishables. Hence, a systematic research is needed to correctly estimate the levels of postharvest losses, both quantitative and qualitative (nutritional), of the commercially important fruits and vegetables is also a critical research question. The result of the present study would determine the bottlenecks in the postharvest handling systems to put forward recommendations to the policy makers to develop strategic national plan to minimize postharvest losses of fruits and vegetables and maintain their quality in the supply chain.

1.2 Hypothesis of the study:

The researcher motivated to conduct this research with following hypothesis. Factors provide the damage of Fruits and Vegetables in different marketing chains and problem effecting the fruits and vegetables as well.

1.3 Objectives of the study:

1. To determine the factors affecting quality and safety both at farm level and along the marketing chain
2. To identify the ability of the farmers that is related supply high quality and safe horticultural production and thereby proved high content of nutritious food.
3. To identify the problems experienced by traders
4. To find out the ways of consumers in which quality and safety could be improve and make necessary recommendation

REVIEW OF LITERATURE

Numerous research works have been conducted on different aspects of postharvest management of fruits and vegetables across the glove However, little information is available on the magnitude of postharvest quantitative and qualitative losses of fruits and vegetables at different stages of supply chain, especially in Bangladesh. Some of the available research findings pertinent to the present study have been reviewed in this section

Estimates of post harvest losses of fruits and vegetables vary widely both in the developed and developing countries (pull1993). Postharvest food losses have been quoted as being 15-50% for horticultural products and 10-20% for grains and oil seeds (Okezie1998). However, the levels of postharvest loses of horticultural products have been reported differently by different authors, instances, 20-40 % (Wills *et al.*2004) and 5-100% (NAS 1978). More specifically, the post harvest losses of banana, citrus, grapes, apples, avocado and papaya were reported to be 20-80%, 20-95%, 27%, 14%, 43% and 40-100%, in the developing countries , respectively (NAS 1978). Singh (1960) reported from India that the postharvest loss of fresh mango fruit due to microbial decay varied from 20-33%. Srinivas *et al*. (1996) provided more specific reports on postharvest losses of mango of varieties 'Totapuri' and 'Alphonso', where the losses were 17.9% (3.5% in orchard, 4.9% during transportation ,4.1% in storage, and 5.3% in retail level) and 14.4% (10.9% in orchard, 3.7% during transportation,3.7% in storage, and 5.3% in retail level), respectively. The post harvest handling systems of important vegetables (cabbage, Chinese cabbage, broccoli and bunching onion) in china were assessed. Data were collected on: the time of harvest; types, timing and availability of transport; grading; pre-cooling; packaging; and storage of produce. The main factors responsible for postharvest losses were lack of proper packaging, no pre-cooling, no proper transportation, and lack of good storage techniques. It was estimated that the post harvest loses of Chinese cabbage and oriental bunching onions after storage were 20% and 50%, respectively (Zheng *et al.* 1999).

The total value of vegetables produced in Bangladesh is around Tk. 19400 million, calculated at average retail price. About 70% of the vegetables pass through the marketing channels. If the spoilage is 10%, the loss comes to Tk. 1,462 millions. These losses are due to inadequate knowledge on harvesting, carrying, packaging, transport and storage techniques. In the vegetable marketing channels, traders suffer maximum losses, because they handle and transport more qualities from one place to another than any other intermediaries (Rashid, 1998). The average estimated loss of tomato at farmers' level was 12% (Hossain *et al.* 1997).

The important method of storage of perishable horticultural produce include low temperature storage (Hassan *et al.*1998 Kader 2002) modified atmosphere (MA) storage (Hassan and Shipton 2006; Hassan and Shipton 2006a; Hassan *et al*. 2009a; Hassan *et al*. 2009b), controlled atmosphere (CA) storage (wills *et al*. 2004), use of heat treatments (wills *et al*. 1998; Ledger 2004; Hassan *et al*. 2004) use of ethylene scavenging chemicals (jiang *et al*.2000; Hofman*et al*. 2001; Reid 2002; wills *et al*. 2004) and use of application of recommended fungicides (Ogawa and Manji 1984; Ledger2004)Temperature management is the single most effective tool for maintaining postharvest quality by extending the shelf life of fresh horticultural produce. The optimum storage temperature for okra is 7-10^{o} C. Exposure of okra pods to undesirable

temperatures will result in bleaching, surface burning, shriveling, excessive softening and desiccation (Cantwell and Trevor, 20020) Temperature also influences the effect of ethylene, reduces oxygen, and elevates carbon dioxide level; affect pathogen spore germination and growth rate. Low temperature reduces the adverse effects of pathogens on fresh produce. For instance, cooling commodities below 5^{o}C immediately after harvest reduces the incidence of *Rhizopus* rot (Brackett1993). The symptoms of chilling injury include surface and internal discoloration (browning), pitting, water soaked areas, off-flavor development, and accelerated incidence of surface moulds and decay (Mitchel and Kader1992).

Report published on The Taily Star (16-09-2014) that Bangladesh was not unique in food adulteration, though it was much less common in developed nations. Developed countries have much improved infrastructure in the supply chain, mostly due to the existence of an effective cold chain from harvesting products to sale to the end consumer. The most effective way of preserving and keeping food items fresh after harvest is to store those in suitable temperatures. This will normally mean storing at much cooler temperatures, in some cases down to 0°C or close to 0°C, for example, for fish products. Some fruits and vegetables can be preserved for several months at cool temperatures.

The antioxidant found in fruits help estimate free radical carcinogenic biproduct from metabolic process their by reducing the risk of cancer even while the emphasizing the importance of seasonal fruits in diet the expert point out that it was important to ensure there save for consumption fruits should be thoroughly with fresh/sold water to remove pesticides and other chemicals.

Chemicals used for artificial ripening of fruits causes' cancer. The International agency of research of cancer has listed a number of chemical agent /pesticides that can cause various types of cancer. He says people should be aware the risk of consuming fruits that are artificial ripened. Public health authority should look at more stringent enforcement of rules to prevent the hazardous practices of artificial ripening of mangoes using calcium carbide.

Food inspection caution against certain illegal practices followed by fruits vendors to artificially ripen fruits according to Kuthiravan, designated officer, Tamil Naru Food Safety and Drug Administration Department, Combustion Chemicals like calcium Carbide crystals which react with water to from acetylene gas or acetylene in gas form are used by vendors to artificially ripen fruits.

Ethephone an insecticide is another chemical used for the purpose some vendors also resort to burning kerosene. Stove or incense stiks in closed rooms to quicken the process of ripening Dr.Kathiravanads. According to him artificially ripening mango and sapota were commonly reported in the district all kinds fruits including guava, apple, pineapple.

Papaya and banana are artificially ripe used according to MS Narasinangubride gas as a necrotic agent which can cause to pregnant disorders. It is hazardous to pregnant women and child. Though used in small amount. The chemical used for artificial ripening contain carcinogens, arsenic and phosphorus .Symptoms of poisoning include vomiting diarrhea, burning or tingling sensation numbers, headache and diarrhea.

THE DAILY STAR 9th September 2014 Over 10 thousand samples of more than 50 different food items were tested at the Institute of Public Health in 2012-13. About 60 percent of

the samples were found adulterated or contaminated. Only the samples of sesame (til) oil, black pepper (gol morich) and fenugreek (methi) were reported safe.

Mixing of lower quality ingredients is adulteration and adding toxic chemicals is contamination. Both are widely practised in the country, said Dr Tahmeed Ahmed, director at the Centre for Nutrition & Food Security of ICDDRB . Food adulteration and contamination pose a serious threat to public health, especially in a country like Bangladesh where the level of awareness among the masses is very low due to poor literacy.

The ensuing health hazards include diseases like cancer, kidney or liver failures, memory loss, respiratory problems, infertility, kidney stone and damage of the cardiac system.

There is no database in the country on such crucial factors, but the recent surge in the number of patients suffering from liver/kidney failure indicates a deteriorating situation.

Citing a recent study, Tahmeed warns that the number of cancer patients in Bangladesh could increase to nearly 5 lakh in 2035 from 2,32,868 in 2012.

At present, about 6,00,000 children suffer from acute malnutrition, 41 percent under-five children from stunted growth, while 70 percent of children are anaemic, and one in three is subclinical iodine deficient, he added.

Besides, according to the Centre for Nutrition & Food Security, a total of 16,57,381 cases of acute diarrhoea and resultant 2,064 deaths were reported in 1998 alone. Tahmeed believes impure food is one of the key factors behind all this.

THE DAILY STAR 10th September 2014 Rashid-e-Mahbub, chairman of the National Committee on Health Rights Movement, a non-government platform, said that in fruit and vegetable businesses, wholesalers are mainly responsible for adulteration.

While all of the factors affecting nutritional quality of fruits and vegetables – production method, post-harvest handling, storage, and processing and packaging – apply equally to produce that is produced locally or on farms across the country, relying on local sources for our produce needs has some distinct advantages. First, even when the highest post-harvest handling standards are met, foods grown far away that spend significant time on the road, and therefore have more time to loss nutrients before reaching the marketplace. Second, farmers growing for a local (and especially a direct) market favor taste, nutrition and diversity over shipability when choosing varieties. Greater crop diversity from the farmer means greater nutritional diversity for the eater. Third, in direct and local marketing strategies, produce is usually sold within 24 hours after harvest, at its peak freshness and ripeness, making consuming them a more attractive prospect. Fourth, during this short time and distance, produce is likely handled by fewer people, decreasing potential for damage, and typically not harvested with industrial machinery. Minimizing transportation and processing can ensure maximum freshness and flavor, and nutrient retention. This may seem like an overly simplistic explanation of why local fruits and vegetables are more healthful than those from our

conventional long haul agricultural system. In the Northeast, diets based on foods available locally can be nutritionally adequate year-round. Concerns over nutritional adequacy usually arise because people are unaware of what is available. Fortunately, this guide can provide us with information regarding the delicious seasonal items of the Northeast, and how to prepare and store them.

Canned vegetables tend to lose a lot of nutrients during the preservation process (notable exceptions include tomatoes and pumpkin), frozen vegetables may be even more healthful than some of the fresh produce sold in supermarkets, says Gene Lester, Ph.D., a plant physiologist at the USDA Agricultural Research Center in Weslaco, Texas. Because Fruits and vegetables chosen for freezing tend to be processed at their peak ripeness, a time when—as a general rule—they are most nutrient-packed.

While the first step of freezing vegetables—blanching them in hot water or steam to kill bacteria and arrest the action of food-degrading enzymes—causes some water-soluble nutrients like vitamin C and the B vitamins to break down or leach out, the subsequent flash-freeze locks the vegetables in a relatively nutrient-rich state.

The levels of child stunting, underweight, wasting and childhood anemia, and the level of maternal energy deficiency and anemia are very high in Bangladesh (BDSH2009). The importance of better quality and high-value horticultural commodities like fruits and vegetables in the food consumption basket needs to be increased. The contribution of horticulture remains extremely important for ensuring food and nutritional security in Bangladesh.

It is worth mentioning that low iron intake can lead to anemia, a serious nutrition- related disorder affecting about 2 billion people worldwide (Nandi and Bhattercherjee 2005). The incidence of vitamin C deficiency peaks in children aged 6-12 months who are feed a diet deficient in citrus fruits or vegetables.

Fruits and vegetables are highly valued n the human diet mainly for vitamins and minerals. However, the present consumption rate of fruits and vegetables in Bangladesh is 126 g/ day/ capita, which is far below the minimum average requirement of 400g/day/capita (FAO/WHO 2003) so, higher intake of micronutrient deficiency in Bangladesh. The government of Bangladesh has been promoting food-based strategies through the agriculture and related sectors to enhance production and consumption of micronutrient-rich foods as a sustainable means to address micronutrient malnutrition in the country (Bhattacherjee*et al.*2007.

Efficient trans

METHODOLOGY

Importance of materials and methods in conducting any research can hardly be over emphasized. The researcher took utmost care using appropriate techniques throughout the whole study. The materials and methods used in the study are presented in this chapter.

3.1 Design of the study:

The design of the study was descriptive survey research. This study was designed to assess quality and safety issue in the horticultural marketing chains to provide nutritious food in Bangladesh and explore the relationship between farmers, middleman, whole sellers and retailers in the horticultural marketing chains and some selected characteristics.

3.2 Study Area/Location:

The study was conducted in Dhaka, Narsingdi Gazipur and Savar. It was assume that the large requirement of human, financial and time resources in conducting the conventional surveys and understanding the tasks leased on Rapid Market Appraisal (RMA) in the fast method by which the researcher relatively and systematically collected information for this research. RMA conducted in two folds:

1) Collected reports, documents, journals books, letters etc.
2) Collected information with questionnaires by the interview with different farmers, traders, wholesalers, retailers etc and Key informants from definite area of Dhaka, Gazipur , Narsingdi and Savar.

3.3 Data Collection Period:

1st January to 31st August 2012 and 15th January 2013 to 20th July 2013

3.4 Sampling Technique and Sample Size

Two-stage purposive sampling was applied.

STAGAE-ONE

Selection of Socio-economic Societies

At first, a pilot survey was done among the different locations of Dhaka, Narsingdi Gazipur and Savar and collected the information about quality and safety issues of nutritious food of the respondents. After collecting these information depending on different categories, it was divided into four classes- farmers, middleman, whole sellers and retailers.

Growers: The person those who cultivate their land and grow the agricultural products and sell it to the middle man near the assemble market.

Middle Man: The persons those who purchase the farmers products directly from the field or near the assemble market and sell this products to whole sell market either near or distinct market. Sometimes they called Bepari.

Whole seller: The persons those who purchase the product from the middle man or big farmers and sell it to the retailer and chain shop. They purchase the products in large quantity they are also called Arodar.

Retailer: The persons those who purchase the products from the whole sell market or from the Arodar and sell the product directly to the consumer in the local market. Sometimes the retailers sell their products at the residential area by carrying the products mobile van or head load.

STAGE-TWO

No. of sample for each group

After divided the selected study areas four classes, a number of 44 individual were randomly selected from each classes and the following sample size calculation formula were used.

$n = \frac{1.96^2}{(1-P)\times P \over \epsilon^2}$ Or, $n = \frac{1.96^2 \times 0.5}{0.5 \times 0.30^2}$ Or, n= 44 for Each class **Total Sample size** n= $\frac{K \times 1.96^2 \times P}{(1-P) \times \epsilon^2}$ $= \frac{K \times 1.96^2 \times 0.5}{0.5 \times 0.30^2}$ Or, n = 176	Here, n = Sample size 1.96^2= The value of 95% confidence intervals P = Prevalence for nutritious food = 0.5 (Assumed normally) (1-P) = Prevalence of non nutritious food € = Required Precision K = Design factor = 4

Number of respondents according to study areas:

Location of the Area	No. of growers	No. of middle men	No. of whole seller	No. of retailer
Dhaka	12	10	10	12
Gazipur	12	12	10	10
Narshingdi	10	10	12	12
Savar	10	12	12	10
Total	44	44	44	44

3.5 Development of the instrument:

An interview schedule was prepared for collection of data in accordance with the objectives of the study. Both open and closed for simple and direct questions were included in the schedule.

The interview schedule initially prepared and sent to a panel of experts. According to Open Heim (1966) a panel of expert should be selected of agree on the contents of the schedule. Based on the suggestions of the experts the schedule was modified and then pretested by administering the same to number of 10 respondents. The pre-tested data helped researcher to examine the suitability of the different questions and statements of the schedule. Necessary correction, editions alterations and rearrangements were made in the schedule on the basis of experience of the pretest and final version was prepared and printed.

3.6 Data collection

Data were collected by the researcher herself from 176 (growers, middlemen, whole sellers and retailers) respondents by direct face to face interview, while starting interview with any respondent, the researcher took utmost care to establish rapport with them. So that respondents did not feel hesitant to furnish the desired information. Investigator clearly explained the purpose of the study to the respondents. After data collection from the respondents, one rating scale was filled up from each of the respondent. The researcher sometimes faced a little problem in collecting data. In Some cases the researcher did not face problem in collecting data rather she received excellent co-operation from the respondents.

3.7 Data analysis

Collected data were coded, compiled and analyzed according to the objectives of the study. Space analysis was used to assess the quality and safety issue in the Horticultural marketing chains to provide nutritious food.

The data set were first checked, clean and entered into the computer from the numerical codes on the form. The data were edited if there were any discrepancies and then cleaned it. The frequency distributions of the entire variables were checked by using SPSS. 12.0 windows program.

For tabular, charts and graphical representation Microsoft word Microsoft excel were used.

portation and product handling are needed for the trade of agricultural product and is an important factor is assuring good prices and poverty alleviation in rural areas (Khandaker*et al.* 2009)

According to Ahmed (1992), there were three principal types of marketing channels in the domestic market of vegetables, such as local, regional and inter-regional.

RESULTS

Different types of damages to horticultural produce were observed during the entire marketing channel. The major damages include bruises, cuts and rots for most produce, Latex injury for mango papaya and banana; stem bleeding of jackfruits, mango, and shoot fruit borer of jackfruits, brinjal and okra. The important types of damage occurred to different fruits and vegetables in the entire supply chains. The findings of the study are presented in the following tables and description.

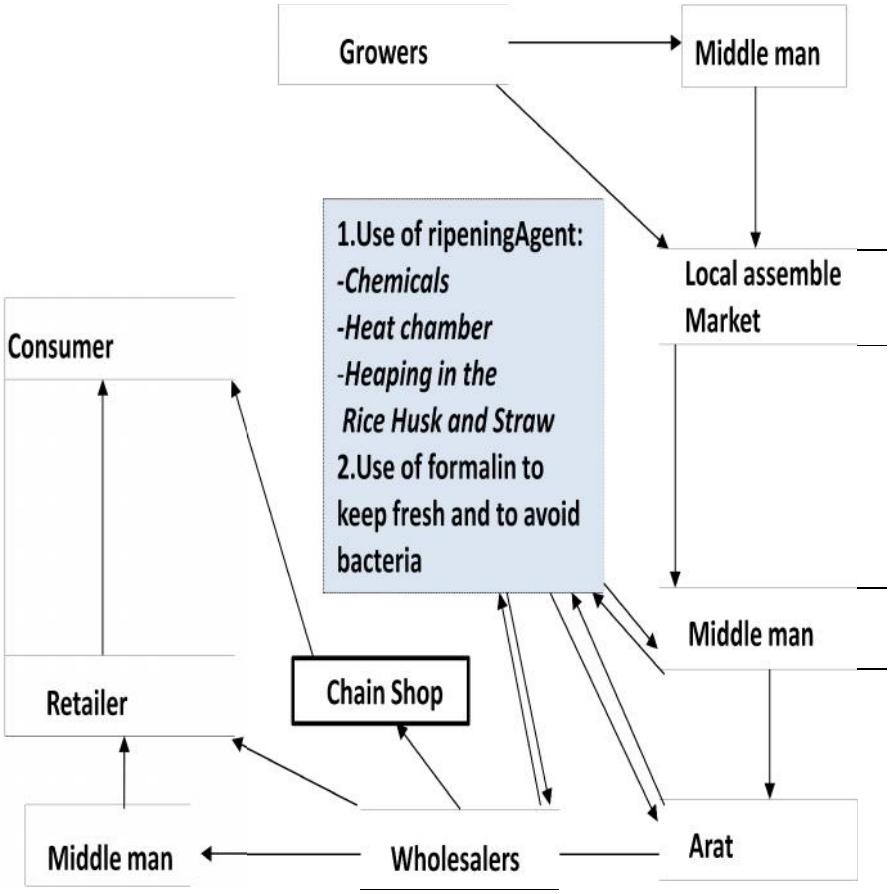

Fig 1: Flow Chart of Supply Chain

Major crop production in Bangladesh (ha)

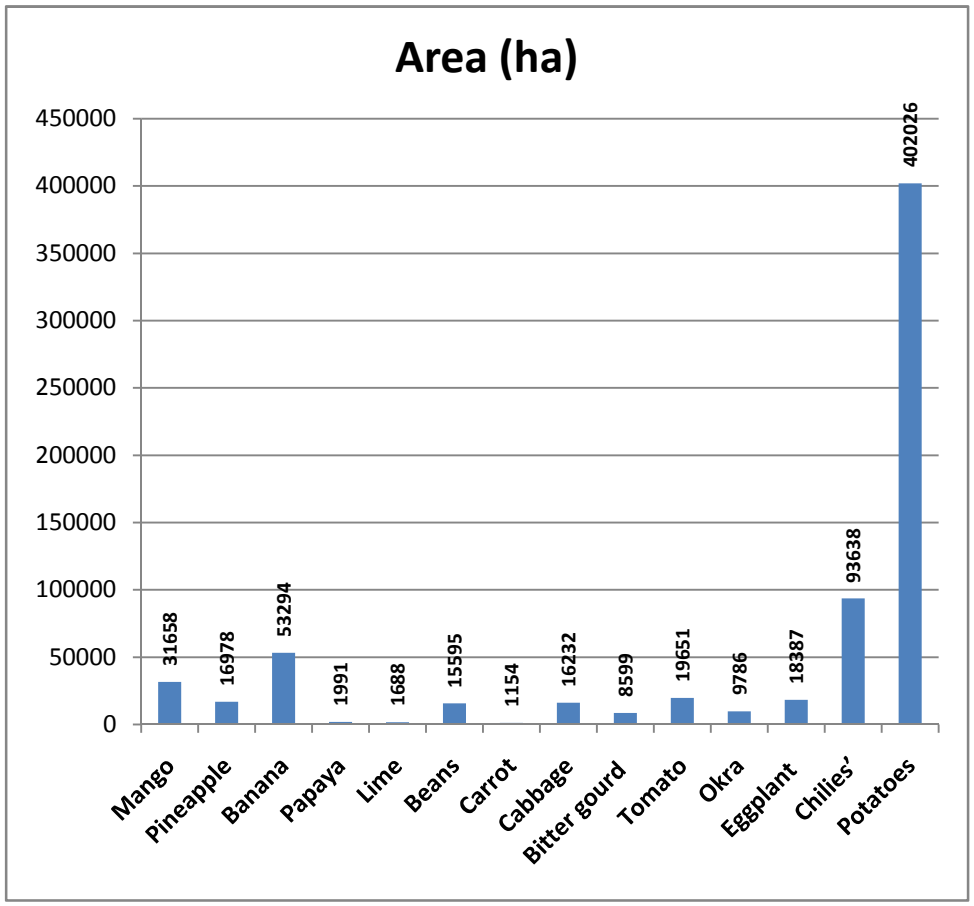

Fig 02: Major crop production in Bangladesh (ha)

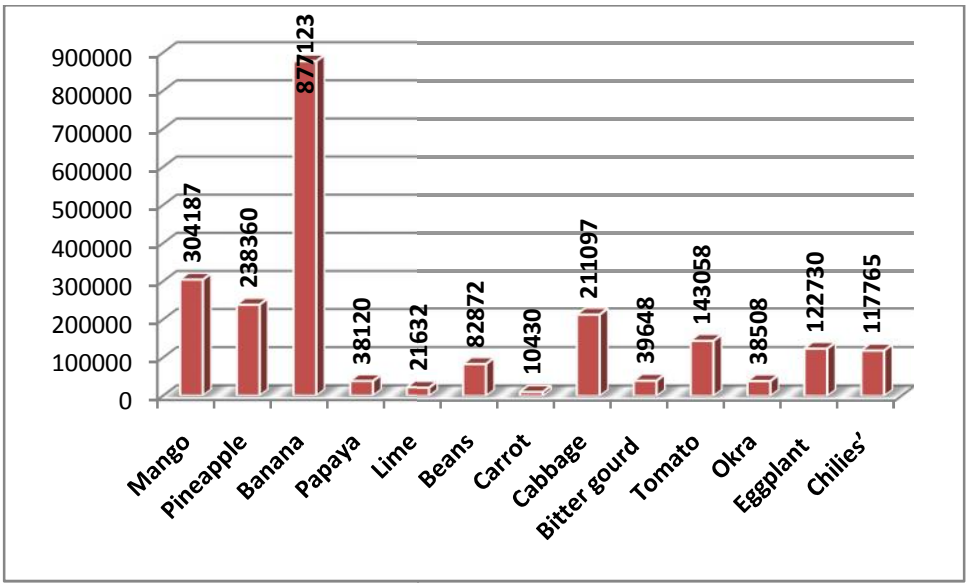

Fig 03: Major crop production tons/ha in Bangladesh (ha)

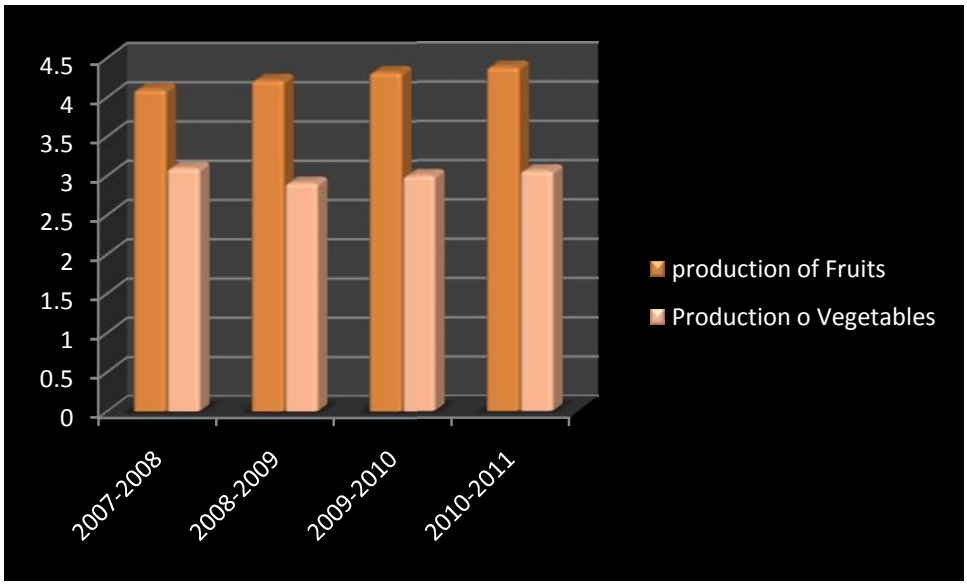

Fig 04: Production trend of Fruits and vegetables(MillionTone)

Source: BBS,2011

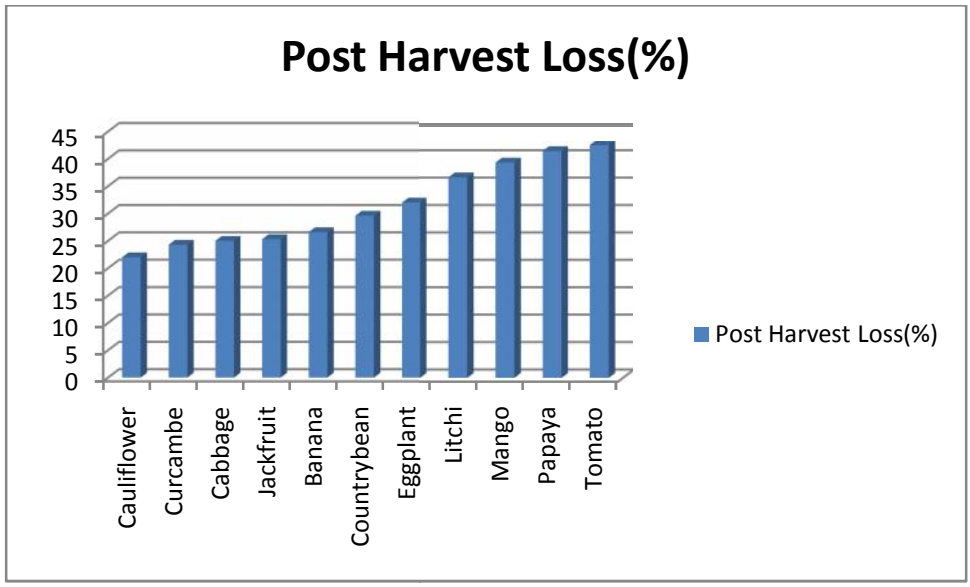

Fig 05: Post harvest loss percent of some major fruits/vegetables in Bangladesh

Sources: BARI Annual Report(2008-2013)

Frequency Table on Commodity

In my study area it is found that 72.70% were vegetable growers and 27.30% were fruits growers (Table 1 shows)

Table 1: Number of Vegetables and fruits growers in the study area.

Goods	No. of Growers	Percent
vegetable	32	72.70
fruits	12	27.30
Total	44	100.0

Time of harvest

The present study found that majority of the farmers (respondent) harvested their product at

Evening 31.8% and 18.2% farmer harvested at midday's. Table 2

Table 2: Harvesting time of Vegetables / fruits in the study area.

Timing	No. of Growers	Percent
Morning	10	22.7
Mid day	8	18.2
Afternoon	12	27.3
Evening	14	31.8
Total	44	100.0

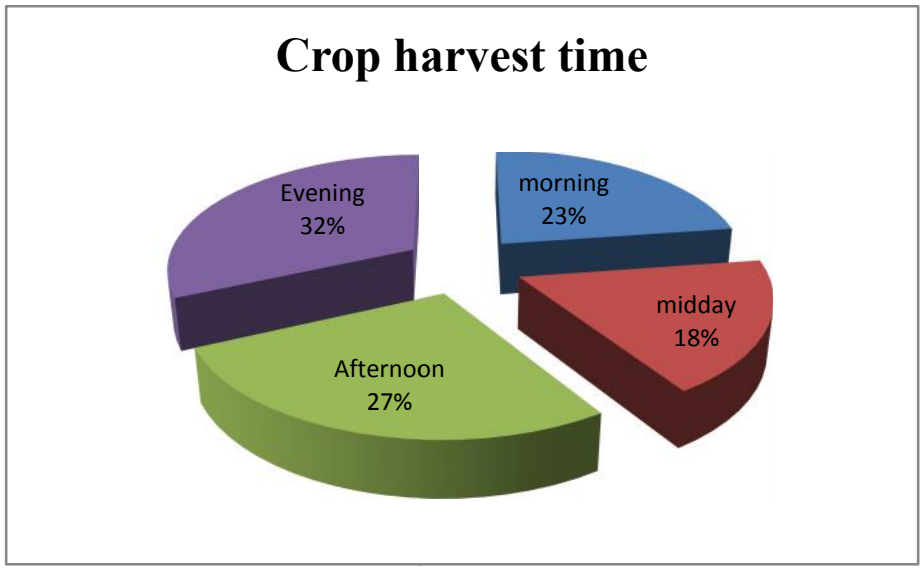

Fig 06: Crop Harvest time

Harvest Method

It is observe that most of the respondents, 61.4%(farmers) used knife for harvest their products (Table 3)

Table 3: Harvesting method of the farmers

Methods	No. of Growers	Percent
Hand harvesting	16	36.4
with knife	27	61.4
using a pole	1	2.3
Total	44	100.0

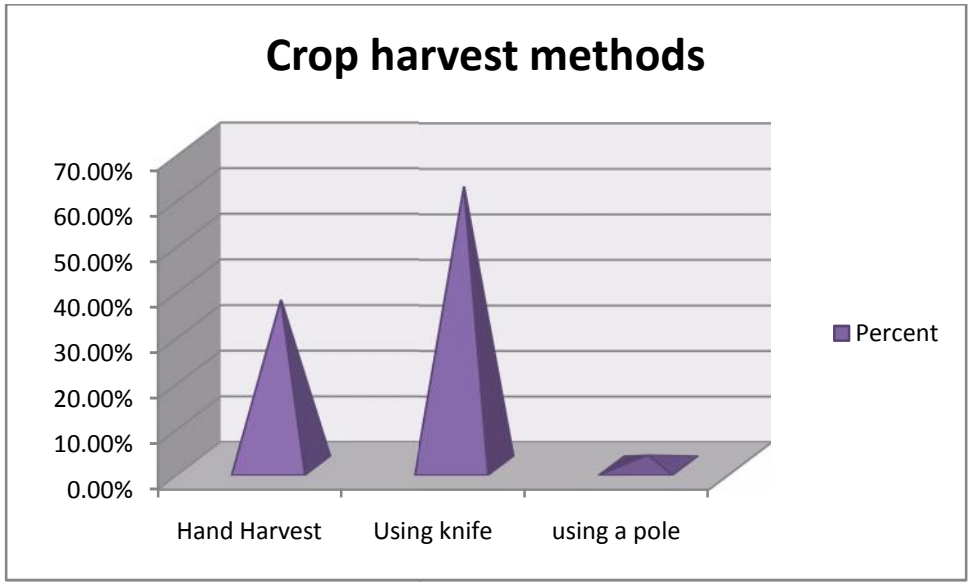

Fig 07: Crop Harvest Method

The present study found that most of the respondents(farmers) used bamboo baskets (61.4%)as container for the vegetables(Table 4) and clean the container 95.50% respondents (Table 4)

Table 4: The farmers used Containers for theVegetables / fruits

Used Container	No. of Growers	Percent
Sack	6	13.6
Basket(Bambo)	27	61.4
Poly bag	4	9.1
Others	7	15.9
Total	44	100.0

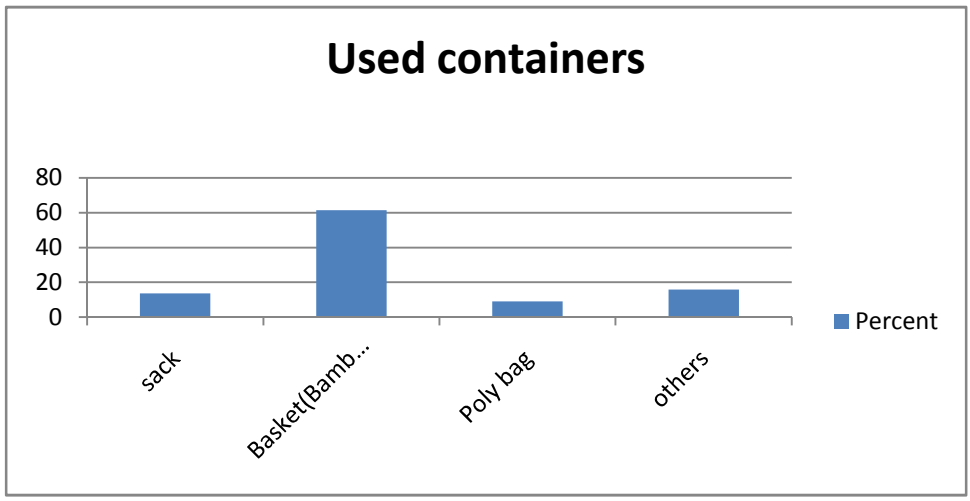

Fig 08: Containers used by the farmers

Clean container

Table 5: Number of farmers whether cleans the containers before used.

Clean	No. of Growers	Percent
Yes	42	95.5
No	2	4.5
Total	44	100.0

Wash product

It is revealed that 61.4% respondents (farmer) do not wash their products after harvest.

Only 38.6% respondent (farmers) washes their products after their harvest, so their products are free from contamination.

Table 6: Numbers of farmers whether wash the product after harvest.

Wash	No. of Growers	Percent
Yes	17	38.6
No	27	61.4
Total	44	100.0

Table 7: Numbers of farmers whether they harvest their product in immature condition.

	No. of Growers	**Percent**
Yes	8	18.18
No	36	81.81
Total	44	100.0

Different types of damages to horticultural produce were observed during the entire marketing channel. The major damages include immature harvest (18.18) (Table 7) over ripe, insect damages, natural disaster, cuts, latex injury, stamp bleeding etc. The important types of damages occur to different types of fruits and vegetables in the entire supply chain are presented in the following Table 8.

Table 8: Quantity % of product damage during harvest

Damage	No. of Growers	Percent
1-5%	41	93.2
6-10%	3	6.81
Total	44	100.0

Table 9: Quantity % of products waste due to other reason.

Waste	No.of Growers	Percent
1-5%	30	68.18
6-10%	10	22.72
11-20%	4	9.09
Total	44	100.00

Table 10: Reasons of waste

Reasons	No.of Growers	Percent
Immature	8	18.18
Over ripe	4	9.09
Insect damage	16	36.36
Natural disaster	16	36.36
Total	44	100

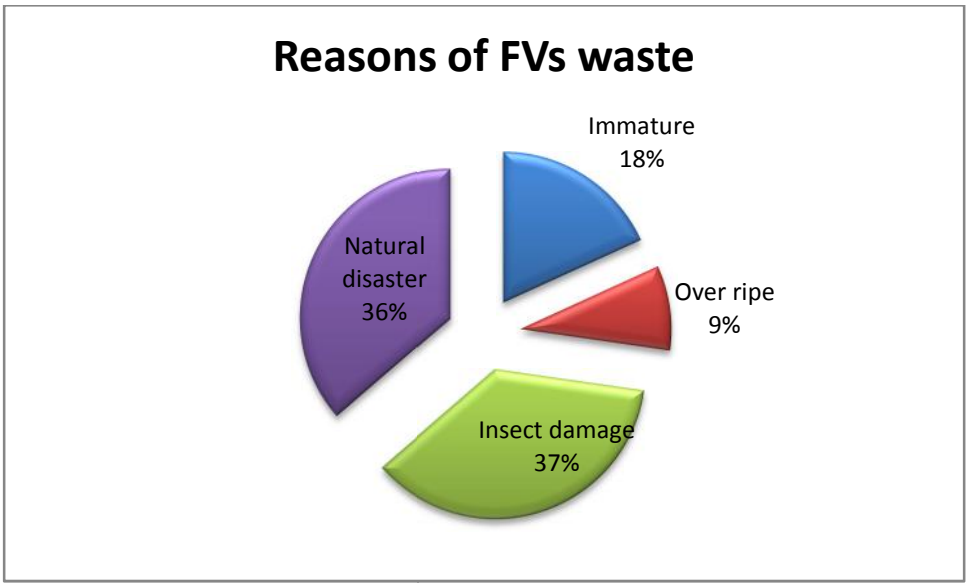

Fig 09: Reasons of FVs waste

The present study found that grading of fruits and vegetables is poorly practiced in Bangladesh. Some growers and intermediaries were found to practice grading of their produce only based on visual judgment.

Table 11**:** Number of farmers whether they packing their products.

Packing	No. of Growers	Percent
yes	13	29.5
No	31	70.5
Total	44	100.0

There are no scientific methods of grading of grade standards of fruits and vegetables in Bangladesh. Different types packaging materials were used during transport of horticultural products especially bamboo baskets, sack and others. 75.00% and 20.5% respondents (farmers) are used bamboo baskets and others during transportation. Table 11& Table 12

Table 12: The farmers used different packing materials for marketing

Packing materials	No. of Growers	Percent
Sac	02	4.5
Bamboo Basket	09	20.5
Others	33	75.0
Total	44	100

Transportation

Fruits and vegetables are transported from the growers field to the local assemble markets by van, rickshaw, and by others. Majority of the farmers are transported their products by van 65.9% and about 2.3% by pickup van.

Table 13: Growers transported their products to assemble market by different means.

Transport	No. of Growers	Percent
Van	29	65.9
Pickup van	1	2.3
Rickshaw	5	11.4
Others	9	20.5
Total	44	100.0

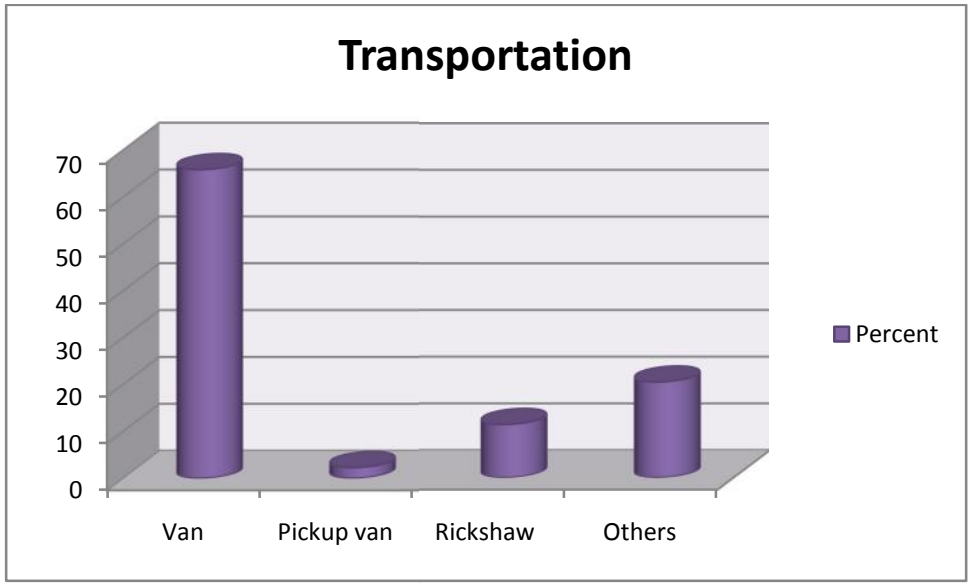

Fig10: The growers used different transportation to sell their products

It is revealed that 48.18% farmers sold their vegetables @7-25Tk./Kg. 2.3% farmers sold their fruits @30-50 Tk./piece (Table 14). It is observed that the farmers sold his product 9.09% to the direct market, 81.8% to the middle man and 9.09% sold to the whole sale market. Table 15 follows.

Table 14: Price of Vegetables and fruits (Tk. /Kg/ Piece)

Vegetable/Fruits (Tk./Kg/Piece)	No. of Growers	Percent
7	2	4.54
10	2	4.54
15	13	29.54
20	19	48.18
25	5	11.37
Fruits		
30	1	2.3.
40	1	2.3
50	1	2.3
Total	44	100

Selling Place

Table 15: The farmers sold their products in different area.

Place	No. of Growers	Percent
1.Market	4	9.09
2.Middle man	36	81.8
3.Whole seller	4	9.1
Total	44	100.0

The present study showed that 59.1% respondents (farmers) are used manure and fertilizer.45.45% respondents (farmers) are applied fertilizer by their own calculation, and 90.9% respondents (farmers) do not analyze soil before growing.63.7% respondents (farmers) used their sources of irrigation water by other means. Table16,17 &18.

Table 16: The farmer used pattern of fertilizer

Fertilizer	No. of Growers	Percent
Manure	13	29.5
Fertilizer	3	6.8
Manure+ fertilizer	26	59.1
no fertilizer	2	4.5
Total	44	100.0

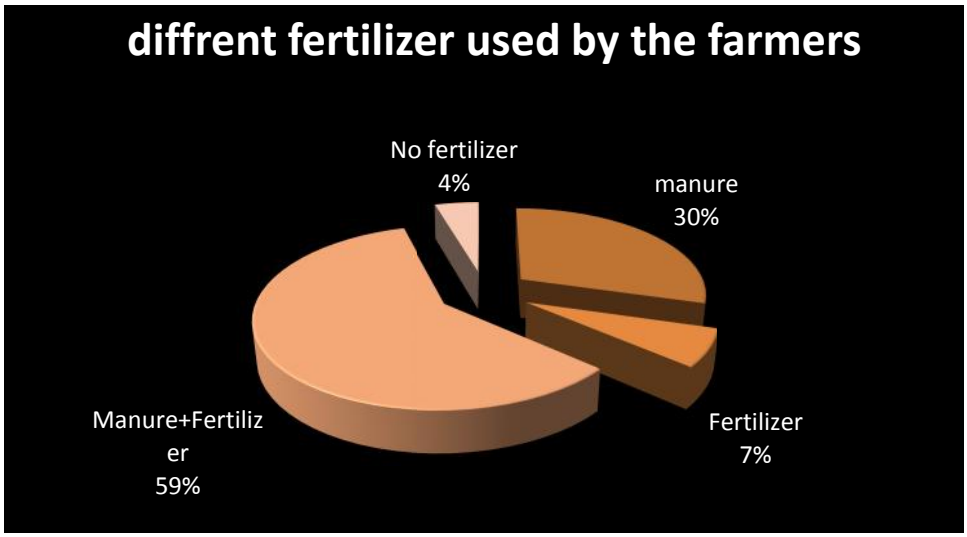

Fig11: Different dose of fertilizer used by farmers

Table 17: The growers used the rate of fertilizer.

Dose	No. of Growers	Percent
recommended dose	7	15.90.
on calculated dose	20	45.45
Others	17	38.63
Total	44	100

We found through our study that 90.9% farmers do not analyze their soils before growing the products (Table 18). It is revealed that 63.70% farmers used water from other sources (Table 19).

Analyzing soil before growing

Table 18: whether the growers analyze their soil before growing the products

Soil analysis	No. of Growers	Percent
Yes	4	9.1
No	40	90.9
Total	44	100.0

Source of irrigation

Table 19: The sources of water used by the growers

Source	No. of Growers	Percent
Pond	16	36.4
Cannal& H.tubewel	28	63.70
Total	44	100.0

Result showed that 56.8% respondent (growers) used pesticides to grow vegetables and fruits (Table 20) among the pesticides, fungicides, and sumithion were mostly used by the farmers (Table 20A) . The growers used insecticides and fungicides by the selection process of Dealer 59.09 % (Table 21). The doze and selection method used by the farmers from the information of Dealer 56.32% (Table 22) on the other hand the instruction of pesticides use received from Dealer 61.36% (Table 23 & 25).

Use of Pesticides

Table 20: whether the growers used pesticides for production.

Observation	No. of Growers	**Percent**
Yes	25	56.8
No	19	43.20
Total	44	100

Pesticides Name

Table 20A: Pesticides used by the growers.

Pesticides	No. of Growers	**Percent**
Agrovet, Thiovit 80 WG, Agrovet DF, Hivit 80 WDG, Sulphin 80 WG, Bavistin DF, Aimcozim 50 WP, Regard 50 WP	7	15.90
Ribcord, Rovral 50 WP	4	9.1
Fungicides		
Sumithion	14	31.81
Nogos	14	31.81
Total	5	11.36
Dithane M 45, Champion 77 WP	44	99.98

Pesticide selection process

Table 21: Selection process of pesticides used by the growers

Selection	No. of Growers	Percent
DAE	14	31.82
Diller	26	59.09
By won	4	9.09
Total	44	100

Application method

Table 22: Application method of information

Organization	No. of Growers	Percent
DAE	19	43.18
Dealer	25	56.82
Total	44	100

Selection of dose

Instruction of pesticide

Table 23: Information collected for selection of dose.

Organization	No. of Growers	Percent
DAE	17	38.64
Dealer	27	61.36
Total	44	100

The optimum dose of pesticides should be used in the crop field but majority of the growers do not use the recommended dose. They used overdoses of pesticides in the field. As majority of the growers received information from the and sometimes by own knowledge (Table 24).So the growers suffer from health hazards by applying pesticides. On the other hand the products become poisonous which is harmful for the consumer health and diorite the nutrient value also.

Table 24: List of common pesticides and fungicides with optimum dose

Name of Pesticide	Optimum Dose (Rate/ ha)	Applying Dose by Farmers
Thiovit 80 WG	3.30 kg	4-5 kg
Agrovet DF	2.25 kg	3-4 kg
Hivit 80 WDG	2 gm / Litre of Water	4-5 gm/Litre
Sulphin 80 WG	2 gm/Litre of water	4-5 gm
Bavistin DF	1 gm/Litre of water	3-4 gm
Aimcozim 50 WP	500 gm	700-800
Regard 50 WP	1 gm/Litre of water	3-4 gm
Rovral 50 WP	1.00 Kg	2-3 kg
Dithane M 45	2.20 Kg	3-4 kg
Champion 77 WP	2 gm/Litre of water	3-4 gm
Admire 20 SL	1.00 Litre	2-3 Litre
Actara 25 WG	5 gm/100 litre of water	7-8 gm
Belt 24 WG	0.4 gm/Litre of water	0.5-6.0 gm

It is revealed that 61.4% (Table 25) growers suffer from health hazards by applying pesticides

Table 25: Health Hazards by the Growers

Health Hazards	No. of Growers	Percent
Suffer from health hazards	27	61.4
Not Suffer from health hazards	17	38.6
Total	44	100

Flood water contamination

We found that 86.36% farmer's do not faced the problem of flood water contamination (Table 26).

Table 26: Whether the growing field faced in flood water contamination.

Organization	No. of Growers	Percent
Yes	6	13.63
No	38	86.36
Total	44	100

MIDDLE MEN

During my study it was observed that the middlemen collected the vegetables or fruits from the assembled market or from growers field about 51 to 100 kg (52.26%) and sold it to whole seller (Table 27). After purchased the commodity the middle man also grading it 90% (Table 28)

Table 27: Quantity of fruits/ vegetables collected from the assembled market by the middlemen

Quantity	No. of middle men	Percent
Below 50kg	13	29.56
51kg-100kg	23	52.26
Above 100kg	8	18.18
Total	44	100

Table 28: Quantity of fruits/ vegetables purchased by the middlemen

Purchased	No. of middle men	Percent
Yes	38	86.35
No	6	13.65
Total	44	100.0

About 79.55% middlemen packing the commodity (Table 29) The usual means of packaging the horticultural produce by bamboo basket 49.99% and recently introduced poly sheet (Table 30) for long distance transport. It also helps to reduce transport damage.

Packing the commodity

Table 29: the middlemen either packing the collected products or not.

Purchased	No. of middle men	Percent
Yes	35	79.55
No	9	20.45
Total	44	100.0

Mode of packing materials

Table 30: Mode of packaging of the products by the middlemen for transportation

Packing Type	No. of middle men	Percent
Bamboo Basket	22	49.99
Straw	5	11.37
Poly sheet	4	9.09
Sac	8	18.18
Others	5	11.37
Total	44	100

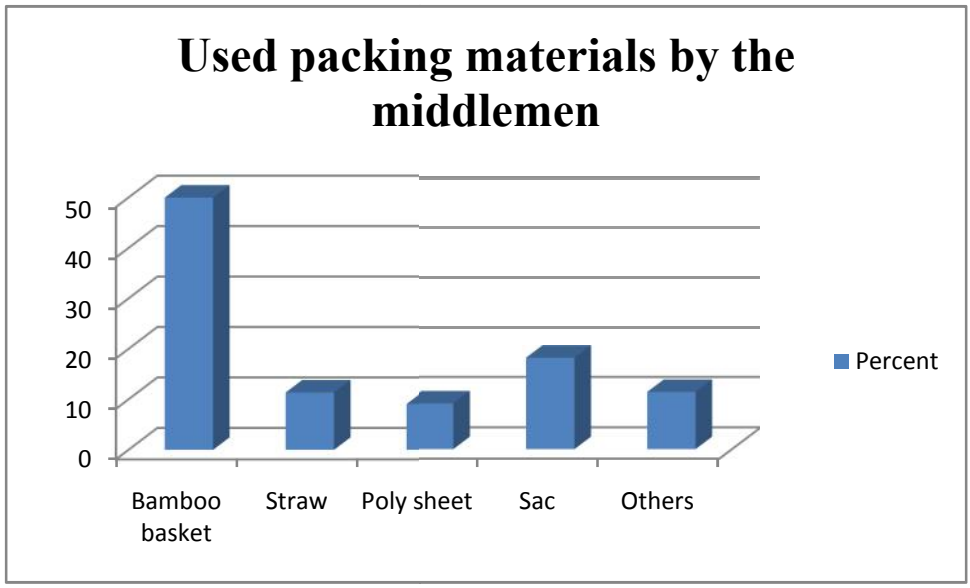

Fig12: Mode of packing materials

Sometimes packaging together or separately 79.55% and transport together 29.55% to be distant market for the wholesaler (Table 31 & 32 respectively) Sometimes the middlemen 72.72% thrown away average 5% products before packaging due to damage (Table 33)

Table 31: Whether the middlemen packing together/ separately

	No. of middle men	Percent
Yes	35	79.55
No	9	20.45
Total	44	100.0

Table 32: The middlemen transported the products together or not.

	No. of middle men	Percent
Yes	13	29.55
No	31	70.45
Total	44	100.0

72.72% Middle men said 5% thrown due to damage (Table 33)

Table 33: Percentage of amount thrown by the middlemen before packing due to damage/ spoilage.

Amount of throwing away before packing due to damage /spoilage

Thrown %	No. of middle men	Percent
5%	32	72.72
10%	7	15.92
15%	5	11.36
Total	44	100.0

The vegetables and fruits are transported from growers field/assemble market to whole sell market by van 49.98% and the distant market by pickup van 27.26% shown in Table 34. Maximum Middlemen came from big cities especially from Dhaka.

Table 34: The middlemen used different transport to carry their products for whole sale market

Used Transport	No. of Middle men	Percent
Van	22	49.98
Pickup	12	27.26
Others	10	22.76
Total	44	100.0

We found that 13.63% middlemen said fruits ripen during transportation and 31.85% said sometimes ripened while 54.52% reported that fruits do not ripen during transportation (Table 35)

Table 35: Sometimes fruits undergo ripen during transportation.

Ripening	No. of Middlemen	Percent
Yes	6	13.63
Sometimes	14	31.85
No	24	54.52
Total	44	100.0

The study revealed that 31.82% middlemen said that 2% of their products damaged during transportation (Table 36)

Table 36: Amount of fruits/vegetables wasted during transport

damage	No. of Middlemen	Percent
1%	14	31.82
2%	14	31.82
3%	16	36.35
Total	44	100

79.5% Middlemen sold their commodity mainly to the whole seller and sometimes 9.09% sold in chain shop and 11.4% to the Customer (Table 37)

Table Where sale the fruits/vegetables

Table 37: The middlemen sold their fruits/vegetables in different areas

Place of sale	No. of Middlemen	Percent
Wholesaler	35	79.5
chain shop	4	9.09
Customer	5	11.4
Total	44	100

Percent of profit: 52.27% Middlemen said that they made below 10% profit by selling their products (Table 38).

Table 38: The middlemen earned profit by selling fruits/vegetables their that collected from growers/ assemble market

Earned profit	No. of Middlemen	Percent
below 10%	23	52.27
10%	16	36.36
15%	5	11.36
Total	44	100.0

Climacteric fruits like Banana are subject to chemical treatment for uniform ripening. Usually calcium carbonate is used for fruit ripening 79.55% (Table 39)

Table 39: Use of various chemicals during transport

Used chemicals	No. of Middlemen	Percent
Carbonate	35	79.55
Carbide	3	6.82
Formalin	6	13.64
Total	44	100.0

Methods of fruits ripening: Both conventional and chemical ripening methods are used in Bangladesh. Synthetic chemicals are especially used for large scale and commercial fruit ripening. Immature and premature fruits are the main targets for enhanced ripening to obtain early price. In this method of ripening a certain percentage of nutrition losses. Polyethylene covering and application of heat by lighting candles (banana), fruit piercing through enlarged fleshy peduncle (Jack fruit). The middle men and whole sellers in the banana supply chain are mostly involved in artificial fruit ripening.

Table 40: Toxic chemicals used in different fruits and their adverse effects

Serial No	**Name of fruits/vegetables**	**Toxic chemicals used**	**Adverse effect**
01	Banana	Aldrin	Convulsions, loss of consciousness
02	Apple	Alpha chlordane	Blood cancers like leukaemia and lymphoma
03	Tomato	Eyhion	Respiratory problems
04	Pineapple	Eyhion	Respiratory problems
05	Been	Beta BHC	Respiratory damage
06	Lettuce	Gamma BHC	Cancer, respiratory failure
07	Carrot	DDT	Cancer, birth defects
08	Capsicum	Gamma chlordane	Liver, digestive and nervous system damage

Source: The Daily Star, 9th September, 2014

All middle men and whole sellers were involved with banana ripening either by using conventional or chemical methods. It is observed that 25.00% middlemen are used ripening chemical and 13.64% ripenining the Banana by conventional method. (Table 41)

Table 41: The middlemen used different chemicals/ hormones

Name of ripening chemicals	No. of Middlemen	Percent
Conventional method	6	13.64
Carbonate	6	13.64
Ethapone	3	6.82
ripening	11	25.00
Calcium carbide	5	11.36
No chemical	13	29.55
Total	44	100

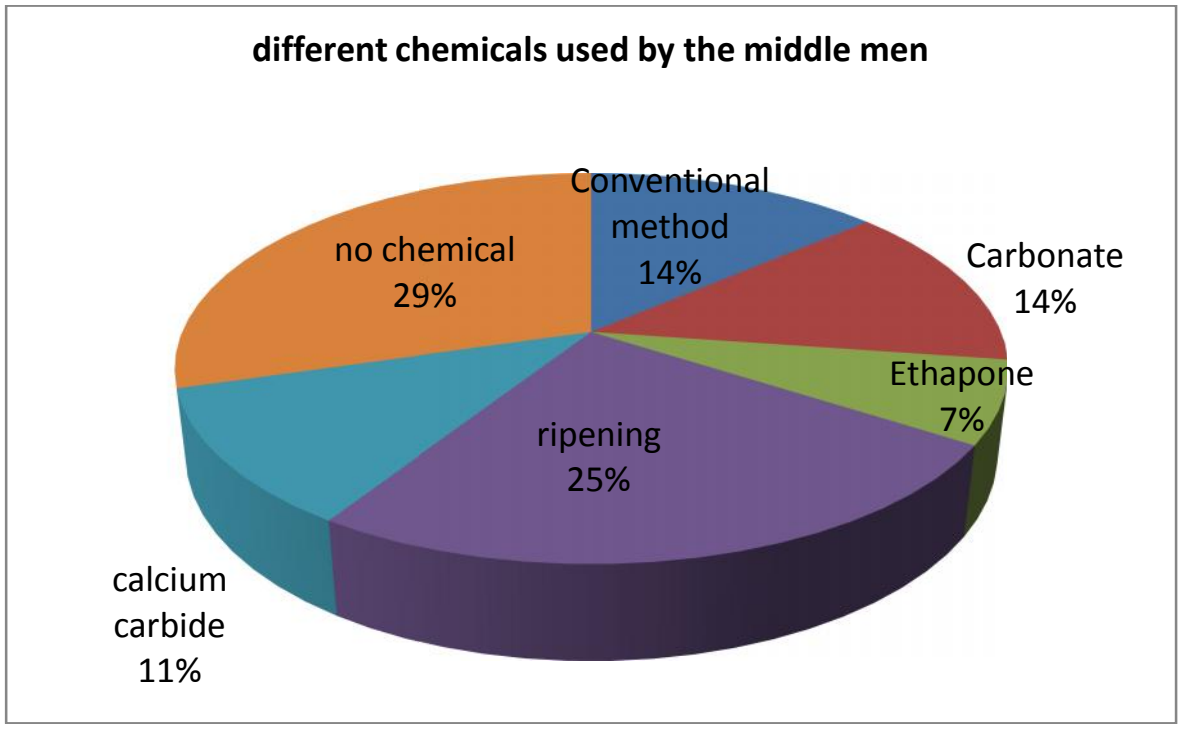

Fig 13: Different chemicals used by the middlemen

WHOLE SELLER

It was found that 77.27% whole sellers collected above 100kg per item of horticultural produce daily in their shop.

Table 42: Quantity of fruits and vegetables collected by the whole sellers

Quantity	No. of whole seller	Percent
51-100 kg	10	22.73
Above 100kg	34	77.27
Total	44	100.0

Packaging fresh fruits and vegetables is one of the most important steps in the long and complicated journey from grower to consumer. Due to the lack of proper packaging system in Bangladesh, large volumes of the inedible portions of vegetables are transported to wholesale markets from the field. Results revealed that 31.82% whole seller used bamboo baskets for packaging and the rests are used sack, poly sheet, straw and others for packaging purpose (Table 43).

Table 43: The whole sellers used different types of packing for vegetables/ fruits

Packing types	No. of whole sellers	Percent
Bamboo basket	14	31.82
Sack	4	9.09
Poly sheet	6	13.64
Straw	9	20.45
Others	11	25
Total	44	100.0

54.55% wholesalers said that they pack their fruits / vegetables before selling (Table 44).

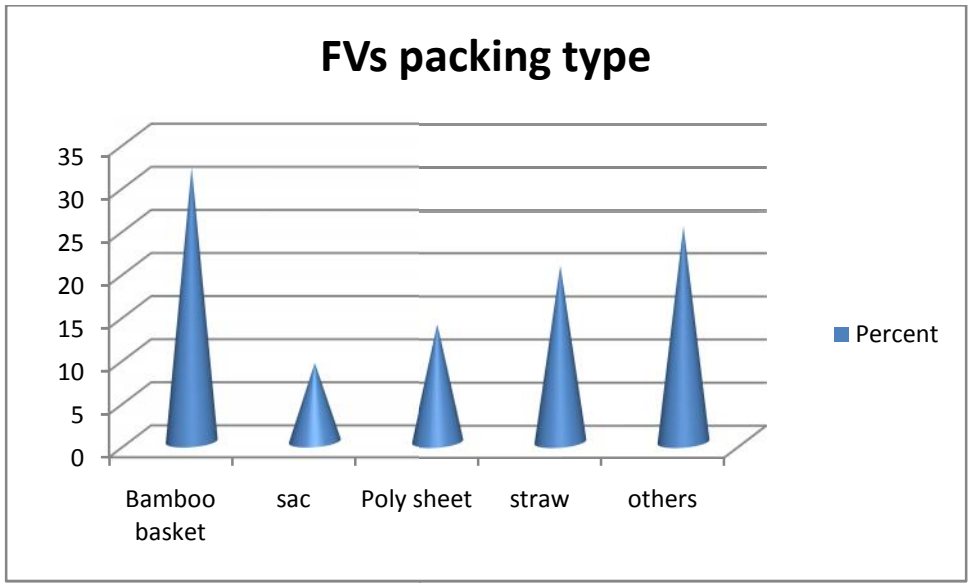

Fig 14: Whole Sellers Packing Type

Table 44: Whether packing before sell the fruits / vegetables

Observation	No. of Growers	Percent
Yes	24	54.55
No	20	45.45
Total	44	100.0

86.36% whole sellers shorted out the vegetables or fruits before collection (Table 45). 31.82% whole sellers shorted out the produce for 7 days and the rests are in different duration (Table 46). It is also found that 29.55% whole sellers thrown away 2% damage produce and the Rests are in different percentage (Table 47).

Table 45: Whether sorted out before collection

Observation	No. of whole sellers	Percent
yes	38	86.36
no	6	13.64
Total	44	100.0

Sort how long (day) already pack before sell

Table 46: the whole sellers sorted out the fruits / vegetables in different days

Days	No. of whole sellers	**Percent**
1st	6	13.64
2nd	7	15.91
3rd	9	20.45
5th	4	9.09
7th	14	31.82
100	4	9.09
Total	44	100.0

Throw of vegetables/fruits due to damage/spoilage

Table 47: Damage percent of the fruits / vegetables in different days

Damage%	No. of whole sellers	Percent
1%	12	27.27
2%	13	29.55
3%	10	22.73
4%	2	4.55
5%	7	15.91
Total	44	100.0

Transportation is one of the most important post harvest handling operations for perishables transportation is used at different stages of supply chain. The whole sellers 61.36% mainly used pick up van to supply the produce at chain shop, supermarket and others destination, (Table 48).

Table 48: The whole sellers used different transports for supply the fruits / vegetables .

Transports Type	No. of whole sellers	Percent
Van	8	18.18
pickup van	27	61.36
Others	9	20.45
Total	44	100.0

Use of ripening chemicals/ conventional method

It is a recommended practice of using ripening agent to tomato worldwide for uniform ripening especially for commercial purposes. But tomatoes are generally harvested at immature conditions and sprayed the ripening chemicals. Same practices were done in case of banana also. The fruits ripen with beautiful color. The ripe fruits remain hard for quite a long period of time and damage is minimized. Unfortunately these benefits are at the cost of consumer's satisfaction but the nutrition status diorite. The study found that 38.64% whole sellers used ripening chemicals on different fruits especially banana, mango and tomato Table 49.

Table 49: The whole sellers whether used ripening chemicals/ conventional methods

Used	No. of whole sellers	Percent
Yes	17	38.64
No	10	22.73
Sometimes	17	38.64
Total	44	100.0

A wide variety of transport systems were found available in horticultural produce transportation from the growers fields to whole sale market. The mode of transportation includes head load, shoulder load, rickshaw, van, pickup van, pushcart and many more. Again open trucks were found to be the only vehicle for long distance transportation of horticultural produce as used by the middle men (Bepari) to assembled market. Sometimes the road condition is not good. Due to this reason some fruits and vegetables wasted by bumping the vehicles. It is found 40.91% respondents (whole seller) 2% goods waste during transport (Table 50). 20.45% respondents expressed 5% wasted at the time of transport, (Table 51) .

Table 50: Percentage of fruits / vegetables waste during transport

Waste amount	No.of Whole sellers	Percent
1%	5	11.36
2%	18	40.91
3%	5	11.36
4%	7	15.91
5%	9	20.45
Total	44	100.0

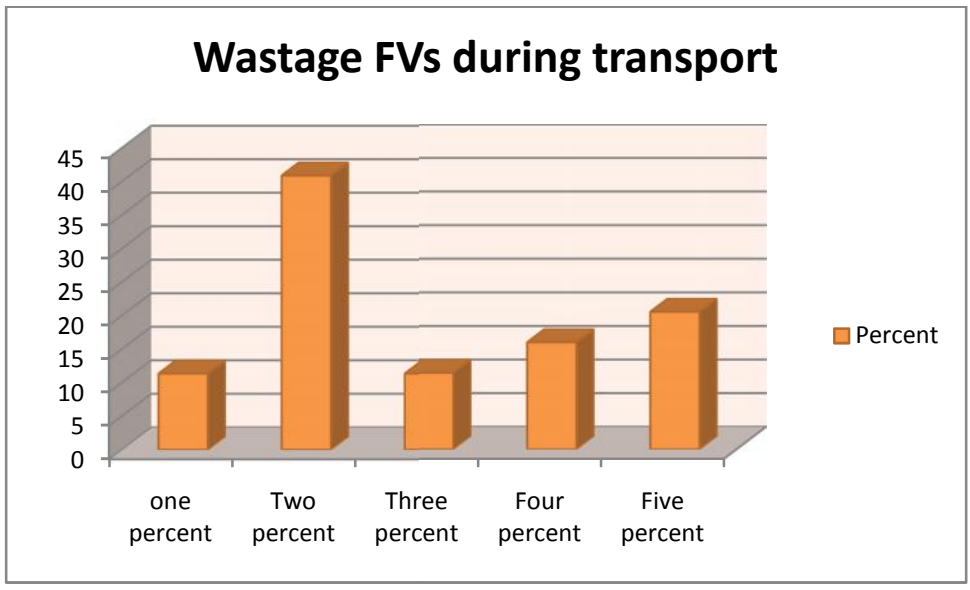

Fig 15: Percentage of fruits / vegetables waste during transport

It is revealed that 84.09% respondents sold their to the fruits / vegetables retailers and 15.91% sold to the super market or chain shop and 68.18% respondent said their profit percentage is 5%, (Table 52)

Table 51: The whole sellers sold their vegetables/ fruits in different areas

Selling Area	**No. of whole sellers**	**Percent**
Retailer	**37**	**84.09**
Supermarket/chain shop	**7**	**15.91**
Total	**44**	**100.0**

Table 52: The whole seller's percentage of profits earn from selling the fruits / vegetables

Profit(%)	No. of whole sellers	Percent
5%	30	68.18
10%	9	20.45
15%	5	11.36
Total	44	100.0

RETAILER

All Retailers

Table 53: Age of the respondents and percent retailers

Age	No. of Retailers	Percent retailer
22	1	2.27
25	2	4.55
26	2	4.55
27	2	4.55
28	4	9.09
30	2	4.55
32	2	4.55
35	2	4.55
36	2	4.55
38	6	13.64
40	5	11.36
42	3	6.82
45	2	4.55
50	5	11.36
55	4	9.09
Total	44	100.0

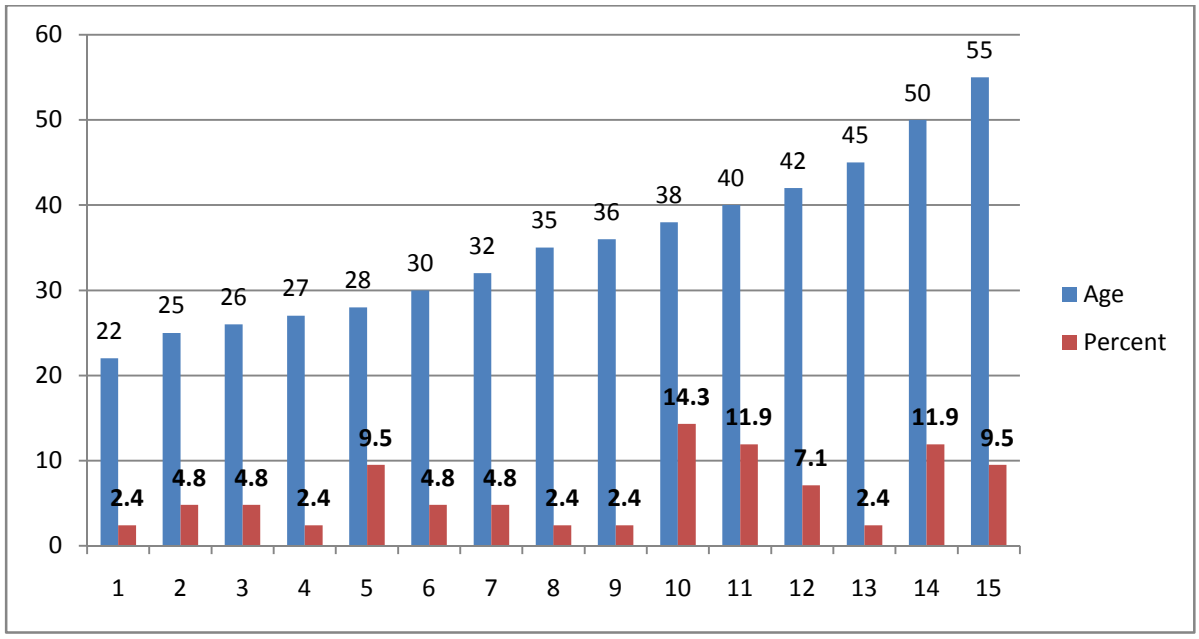

Fig 16: Age and number of retailers

Education of the respondent

59.09% are passed primary , S.S.C passed , 2.27% are no education 38.64%(Table-54) .

54: Education of the respondent

Education	No. of Retailers	Percent
Primary	26	59.09
Secondary(s.s.c)	1	2.27
No education	17	38.64
Total	44	100.0

It is observed that the retailers sold their goods (Vegetables or fruits) to the consumers in small or big market. Sometimes hawkers type retailers sold their goods at the residential area and carry their goods by van. 57.1% respondents (Retailer) sold their goods in medium scale, 59.09% sold in large scale and 25.00% sold in small scale15.91% to the consumers, (Table 55)

Table 55: Retailers sell their fruits / vegetables to the consumers at different categories

Category	No. of Retailers	Percent
Small Scale	7	15.91
Medium Scale	26	59.09
Large Scale	11	25.00
Total	44	100.0

The retailers collected their goods (vegetables/fruits) from whole sell markets. Results showed that 52.27% retailers collected their fruits / vegetables from whole sale market daily for the consumers, (Table 56). If not sold the all fruits / vegetables the retailers 34.09% kept their fruits / vegetables in the bamboo basket or gunny bags and 31% retailers stored their fruits / vegetables in his own shop on the Polly sheet bag if not complete to sell, Table 57.

Table 56: The retailers purchase their vegetables/ fruits in different times

Purchase	No. of Retailers	Percent
Daily	23	52.27
every 2 day	10	22.73
every 3 days	8	18.18
every week	3	6.82
Total	44	100.0

Table 57: Unsold vegetables/ fruits stored in different system

Storage system	No. of Retailers	Percent
in own shop on the Polly sheet	14	31.82
own shop in straw	10	22.73
floor of own shop	5	11.36
in own shop in the bamboo basket	15	34.09
Total	44	100.0

Percent of FVs discard in 1st Day

1% of discard

The 52.27% retailers discard their 1% goods 1st day, 22.73 discard 5% goods in the Second days, and 15.91% discards 10th % in the 3rd days9.09%, (Table 58).

Table 58: Percent of FVs discard in Day 1

Discard (%)	No. of Retailers	Percent
1%	23	52.27
2%	10	22.73
3%	7	15.91
5%	4	9.09
Total	44	100.0

Table 59: Percent of FVs discard in Day 2

Discard	No. of Retailers	Percent
2%	8	18.18
3%	17	38.64
4%	5	11.36
5%	11	25
7%	3	6.82
Total	44	100.0

Table 60: Percent of FVs discard in Day 3

Discard	No. of Retailers	Percent
5%	15	34.09
6%	7	15.91
7%	3	6.82
8%	3	6.82
10%	16	36.36
Total	44	100.0

It was found that 45.45% retailer discarded their goods due to mechanical damage, (Table 61).

Reasons of discard

Table 61: Different reasons of discard the vegetables/fruits

Reasons	No. of Retailers	Percent
Disease/Spoilage	6	13.64
Mechanical damage	20	45.45
Low quality	13	29.55
Unable to sell	5	11.36
	44	100.00

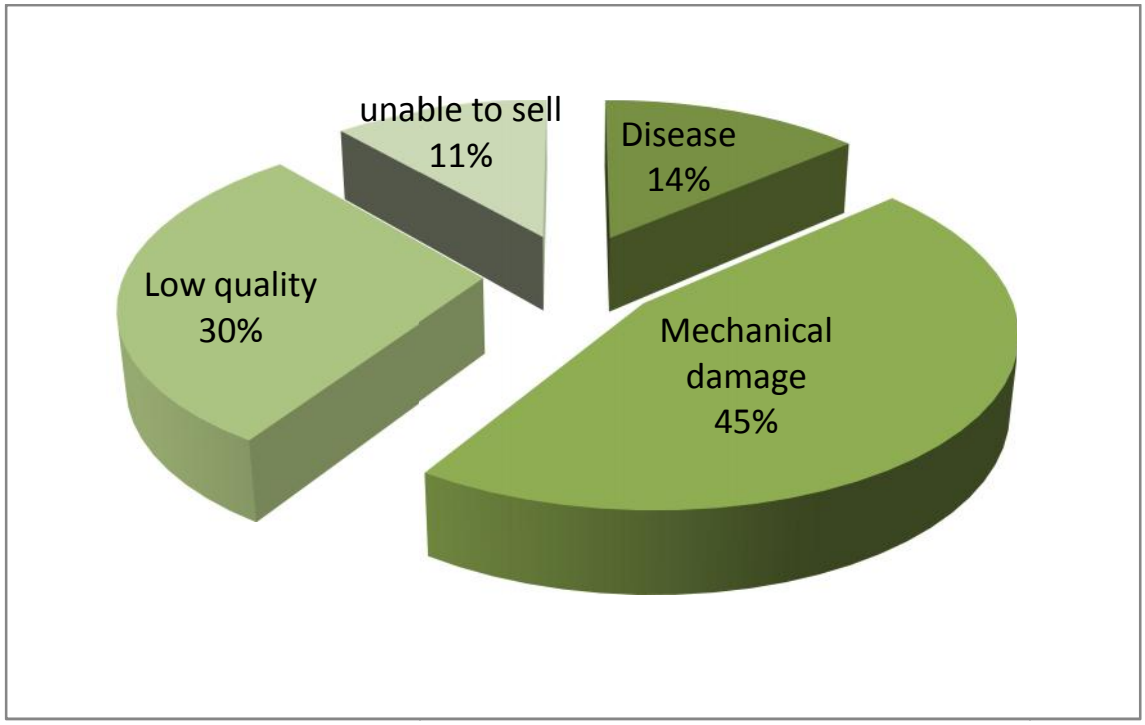

Fig17: Different reasons of discard the vegetables/fruits

It is observed that 36.36%, 34.09% and 11.36% retailers sold vegetables Tk.15 to 30 Tk per kg.9.09%, 6.82% and 2.27 % retailers sold fruits Tk 45 to 70 Tk per dozen, kg and per piece (jackfruit), It was also found 65.91% retailers sold their goods by 10% profit and 27.27% retailer 15% profit and 6.81% retailer 20% profit (Table 62)

Prices of sell item

Table 62: Selling price of different vegetables/ fruits in different rate

Price (TK/Kg/Piece)	No. of Retailers	Percent
15	15	34.09
20	16	36.36
30	5	11.36
45	1	2.27
50	3	6.82
70	4	9.09
Total	44	100.0

Profit margin (%)

Table 63: Profit earn by the retailers from the consumers

Profit(%)	No. of Retailers	Percent
10%	29	65.91
15%	12	27.27
20%	3	6.81
Total	**44**	**100.0**

The present study found that the retailers 75% spray water on the vegetables or fruits to keep it fresh and attractive to the consumers, (Table 64), the sources of water is different areas .i.e. River, pond, supply water and cannals.. It was also found that 77.27% retailers collected water from ponds to spray on their purchase horticultural produce to keep it fresh for long time(Table 65).

Table 64: Whether use of water on fruit /vegetable by the retailers

Water use	No. of Retailers	Percent
Yes	33	75
No	11	25
Total	44	100

Sources of water

Table 65: Sources of water for the retailers

Sources	No. of Retailers	Percent
River		9.09
Cannals	4	9.09
Supply Water	2	4.55
Pond	34	77.27
Total	44	100.0

Status of post harvest handling and value addition.

Post harvest losses of fresh horticultural produce occur at different points in the entire supply chains. These losses are quantitative, qualitative and economic. Post-harvest losses of some important horticultural crops are presented in Table 66 (BARI, 2006). Post harvest losses varied from crop to crop and within different stages. Among the selected crops, the highest loss was recorded in tomato (37%) followed by okra (34%) and lowest loss was found in chilies (14%).

Post harvest spoilage of fruits and vegetables are enormous and vary from 18- Post harvest losses Post harvest losses 44% that causes a loss of TK.339.2 million. About 2.2 million tons of produce is lost due to Post harvest spoilage in focused crops that provides enormous negative impact on the economy of the country (Hossain, 2010).

The loss occurs due to unscientific pre-production and post-harvest management as well as lack of appropriate processing and marketing facilities that have adverse impacts on farmer income, consumer prices and nutritional quality of the produce.

Table 66: Post harvest losses of some important fruits and vegetables

Crop	**Area(ha)**	**Production(MT)**	**PH Loss %**	**Total (MT)**
Mango	31658	304187	33.0	1181
Pineapple	16978	238360	18.0	42905
Banana	53294	877123	20.0	175424
Papaya	1991	38120	35.0	13342
Lime	1688	21632	28	6057
Beans	15595	82872	28	23204
Carrot	1154	10430	25	2608
Cabbage	16232	211097	25	52774
Bitter gourd	8599	39648	27.0	10705
Tomato	19651	143058	37.0	52931
Okra	9786	38508	34	13093
Eggplant	18387	122730	20	24546
Chilies'	93638	117765	14.0	16487
Potato	402026	6647778	25.0	1661945
Total	**-**	**8893308**	**-**	**2196403**

Source (*BARI 2006)*

Table: 67 Production trand of fruits and vegetables in our Banglasesh

Year	Fruits (Million-Ton)	Vegetables(million-Ton)
2007-08	4.1	3.1
2008-09	4.22	2.91
2009-10	4.32	3
2010-11	4.38	3.06

Source:BBS,2011

Table 68 Post harvest Lossess of selected fruits and vegetables.

Fruits & Vegetables	**Post harvest loss (%)**
Cauliflower	22
Cucumber	24.3
Cabbage	25
Jackfruit	25.3
Country bean	29.6
Eggplant	32
Litchi	36.6
Mango	39.3
Papaya	41.4
Tomato	42.5

Source:BARI Annual Report 2008-2013

Table 69: Leafy portions rejected and flesh portions consumed as a result valuable nutrients are discarded

	Calcium Mg/100g	**Iron mg/100g**	**Carotene μg/100g**	**Vitamin-C mg/100g**
Colocasia	40	0.42	24	0
Colocasia leaves	227	10.0	10,278	12
Drumstick	40	0.18	110	120
Drumstick leaves	440	7.0	6,780	220
Knol khol	20	1.54	21	85
Knol-khol leaves	740	13.5	4,146	157
Radish	35	0.4	3	15
Radish leaves	265	3.6	5,295	81
Turnip	30	0.4	0	43
Turnip leaves	710	28.4	9,396	180

Source: Roy,S.K. Paper presented in the knowledge mapping workshop on international network on preserving safety and nutrition of indigenous fruits and vegetables .held at BRAC inn, Dhaka during 19-21 September,2011.

Discussion

Harvesting is done at any time of the day and knowledge on maturity indices is often inadequate. Sometimes immature and over mature produce are harvested. Removal of field heat is seldom practiced. Products are prepared for market without or minimum sorting and grading. Products are washed with dirty/polluted water. Packaging is done using gunny bags, used fertilizer sacks, bamboo baskets etc. that provide little protection to perishables. Head loads, rickshaw, van, bicycles, etc. gunny heavy loads of haphazardly packed produce from production sites to market. Trucks and launch boat carrying tightly packed produce in unventilated heavy loads.

Traders use full sacks and basket of produce as seats while transporting the produce to distant markets. In the wholesale markets of city/town, unloading, reloading and handling are made roughly that cause substantial post-harvest loss. Retail markets are unpaved, open to dust, rain and sun. Sometimes, produce are sprinkled with dirty water while on display.

Inadequate storage facilities at the farm level, poor temperature conditions, including sanitation of the storage room facilities, lack knowledge on temperature requirements, ethylene sensitivities of different commodities for mixed loading are also major cause of nutritional loss.

Lack of national standards of fresh horticultural produce, poor enforcement of standards, lack of collection centers, packing houses, grading facilities, inadequate packing technology, lack of skill, and awareness of appropriate use of financial resources, lack of suitable labeling and inadequate knowledge of protection of the produce from microbial contamination also cause of nutritional losses.

Limited availability of suitable varieties for processing, insufficient processing technologies, inadequate commercialization of new technologies, minimum development of novel products are also cause of nutritional loss and lack of processed product promotion also cause of nutritional losses.

Fruits like, mango, papaya, tomato and banana are forced ripened treating the immature ones with calcium chloride, ethrel for attractive color. No storage facilities are available in the production areas or rural and urban markets, Commodities are kept in open space for sale.

Superstores in the city markets, however, sell their produce keeping in cool environment to minimize nutritional losses and sometimes packed nicely to attract the customers.

Untimely harvesting and rough handling is a major cause of nutritional loss followed by inappropriate and or poorly-designed harvesting tools and harvest containers, inadequate field sorting, grading and packing protocols, lack of knowledge about pre-cooling technology, poor infrastructure, lack of appropriate transport systems; shortage of refrigerated transport; poor temperature management, loading and unloading practices also cause of nutritional losses.

Traders Problem:

The changing demand in domestic and international markets for high value product creates challenges as well as opportunities for existing supply chain. It is estimated that 70% of the jobs related to agro processing in Bangladesh are generated in rural areas. Majority of the horticultural produces like fruits and vegetables are produced by small and marginal holders, but due to weak and fragmented value chain, only small percentage of the produce reaches the growing urban market. Greater attention is required for certification and quality enforcement to ensure premium quality and safety standards of fruits and vegetables in the value chain. Initiatives are needed to improve controls over pesticide use, increase food safety standards, and reduce contamination of heavy metals for both international and domestic trades (Mintin *et al.*2010) Kapse and Katrodia (1997) carried out an investigation on long distance road transshipment of mango. They reported that the fruits packed in corrugated fiver board boxes were the best.

The salient points of existing post-harvest handling practices which deteriorate nutritional status are summarized below:

Growers often grow the same commodity, same variety and plant at almost same time inviting glut at production due to which prices fall sharply and loss stands high after harvest;

a) Produce are prepared for market without or minimum sorting and grading.

b) Produce are washed with dirty/polluted water;

c) Packaging is done using gunny bags, used fertilizer sacks, bamboo baskets etc. that provide little protection to perishables;

d) Head loads, rickshaw, van, bicycles, etc. gunny heavy loads of haphazardly packed produce from production sites to market. Trucks and launch boat carrying tightly packed produce in unventilated heavy loads. Traders/ workers use full sacks and basket of produce as seats while transporting the produce to distant markets;

e) In the wholesale markets of city/town, unloading, reloading and handling are made roughly that cause substantial post-harvest loss;

f) Retail markets are unpaved, open to dust, rain and sun. Sometimes, produce are sprinkled with dirty water while on display.

g) Fruits like, mango, papaya, tomato and banana are forced ripened treating the immature ones with calcium chloride for attractive color;

h) No storage facilities are available in the production areas or rural and urban markets, Commodities are kept in open space for sale;

i) Superstores in the city markets, however, sell their produce keeping in cool environment to minimize nutritional losses and sometimes packed nicely to attract the customers.

j) ***Problems in harvesting, preparation for marketing, storage and transportation***

1. Untimely harvesting and rough handling.
2. Inappropriate and / or poorly-designed harvesting tools/ equipments and harvest containers.
3. Inadequate field sorting, grading and packing protocols.
4. Lack of knowledge about pre-cooling technology.
5. Poor infrastructure (roads, bridges) and lack of appropriate transport systems; shortage of refrigerated transport; poor temperature management, loading and unloading practices.
6. Inadequate storage facilities at the farm level and refrigerated storage at the markets and ports.
7. Poor temperature conditions, including sanitation of the storage room and facilities.

8. Lack of knowledge on temperature requirements and ethylene sensitivities of different commodities for mixed loading.

Problems in grading and packaging

1. Lack of national standards of fresh horticultural produce and poor enforcement of standards
2. Lack of collection centers/ packing houses/ grading facilities.
3. Inadequate packing technology/ suitable packaging (for transportation, storage and consumers)
4. Lack of skill, and awareness of appropriate use of packaging / financial resources.
5. Lack of suitable labeling
6. Inadequate knowledge of protection of the produce from microbial contamination.

Problems in processing of fruits and vegetables

Scores of problems were brought to our notice by the growers and other intermediaries in fruits and vegetables marketing. The particular problems of the particular crops at the different levels of supply chain were investigated.

1. Limited availability of suitable varieties for processing and insufficient processing technologies.
2. Inadequate commercialization of new technologies and lack of basic infrastructure.
3. Inadequate suitable facilities/ infrastructures
4. Lack of processed product promotion.

It is also our national problems that,

- Food safety has never been a priority policy agenda of our decision-makers, although it affects the whole population, especially our children.
- The government did take action from time to time but it was mostly cosmetic and one Off. Till today, there is no effective and functional regulatory mechanism to ensure safe food, and people feel helpless.

CONCLUSION

Nutritional status of the fruits and vegetables mainly depends on the minimization of postharvest losses in all stage of handling procedures and supply chain. Lack of knowledge and poor practices are major contributors to post-harvest losses in the marketing chain of vegetables. Extension services are required to strengthen the capacity of growers, middlemen (collectors), transporters, wholesalers and retailers, to change their attitude and to improve the knowledge base on post-harvest losses to maintain nutrient value.

Consumers are the end users of the fruits and vegetables carried through a number of handling steps. The perception of the consumers is important in considering the introduction of improvement interventions in the present marketing systems.

The present section describes the results of an extensive consumers' survey in relation to their awareness regarding produce quality and safety. The study also investigates the degree of willingness of the consumers to pay more if they want high quality and safe produce.

It was noticed that considerable proportion of the consumers knew the names of some chemicals used to fruits and vegetables for long-term preservation and forced ripening.

Food safety are mainly depends on post-harvest losses which is related to good packaging and good transportation. Therefore, considering the long-term needs of eco-systems and to achieve on overall economy, other alternatives available like plastic crates/trays, corrugated fiber board boxes, corrugated polypropylene board boxes, woven sacks, molded pulp trays/ thermoformed plastic trays and stretched film and shrink wrapping would have to be looked into Micronutrients including vitamins and minerals are included for good health.

Fruits and vegetables are rich sources of micronutrients including Calcium, Iron, Vitamin A, Vitamin C and antioxidants. Therefore, dietary diversification through fruits and vegetables consumption and nutrition education would be a sustainable approach to fight micronutrient malnutrition in Bangladesh.

FAO in collaboration with DAE implemented a project on integrated horticulture and nutrition development which resulted in improving both the production and productivity of rural farmers and also improved their consumption of fruits and vegetables for better nutrition.

Nutrition education is of paramount importance to ensure nutritional security in the country. The degradation and patterns of changes of nutrients in fruits and vegetables consumption, fruits and vegetables require proper handling, preparation and storage to maintain nutritional quality. We know that Vitamin C is unstable and it degrades sharply due to oxidation with the progress of time after harvest.

So a short time period between harvest and consumption would ensure Vitamin C security to the people. Soaking fruits and vegetables should also be avoided since water can dissolve a number of key nutrient elements including Vitamin C.

RECOMMENDATIONS

Current post-harvest handling practices and value addition of horticultural produce, however, presents a dismal picture. Huge quantities of fresh fruits and vegetables go to waste owing to spoilage at various steps of the supply chains.

Traditional techniques which result in considerable deterioration of physical and nutritional quality are generally practiced by growers, traders and processors. Improvement of these age-old practices and adaptation of modern technologies have now become essential in order to reduce the high levels of post harvest losses and value addition in produce so as to increase the supply for food for the growing population from a limited natural resource base and thereby strengthen the economy of the country.

Market opportunities exist for processed foods such as dehydrated fruits, canned fruits and vegetables, frozen vegetables, pickled fruits and vegetables, mango pulp, pineapple concentrate, tomato ketchup and paste, fruit juices(such as mango, orange and pineapple), potato chips and other potato products, both in domestic and export markets. Ensuring the availability and access to food for growing populations poses a challenge in environments of dwindling land and water resources.

Reducing pre and post-harvest losses has been recognized by policy makers and planners as a major strategy to address food security in the country, given the significant contribution it can offer to increase the availability of food for human consumption. The management of the supply chain starting from cultivation through to the final sale to consumers is one of the major options available for minimizing this waste.

This however, requires the concerted action of a large number of stakeholders, including farmers, farmer associations, processors, service providers, transporters, exporters and retailers, along the entire value chain. Post-harvest management and value addition of horticultural produce requires participation of different stake holders that includes farmers, traders, packers, transporters, consumers, public and private agencies. This sub sector faces lot of problem to meet the growing demand of good quality produce in the domestic as well as export markets.

From this research it can be inferred that important issues like updated nutrient composition of indigenous and exotic fruits and vegetables. Post harvest nutrient loss and appropriate methods of food preparations cooking need to be included into the existing course curricula, research and practiced in the real life in order to reduce to severe micronutrient malnutrition in Bangladesh. Some recommendations/ interventions are suggested to overcome the problems related to postharvest management and value addition of horticultural produce for maintaining nutritional status. These are as follows;

1. Develop protocols of produce grading, create awareness and disseminate the findings through training and demonstrations, etc.
2. Encourage subsidy from government and investment from the private sector to establish packinghouse, grading and pre-cooling facilities.
3. Encourage financial support from government and investment from the private sector and conduct cost-benefit analysis on different storage systems and conduct training of storage operators and other handlers.
4. Develop suitable packaging technology fit for sites/ commercialization and create awareness and provide government financial support for appropriate use of packaging technologies and materials
5. Develop appropriate regulatory policies/systems for labeling.
6. Collect and introduce germless for breeding program to develop processing variety.
7. Organize training for the stakeholders to disseminate modern technologies of post-harvest management and value addition of horticultural produce, and
8. Support for product promotion encouraging participation in exhibition/ fair, mass media campaign.
9. Development of need based technologies for quality and safety issues. All these recommendations are related with nutrient value. So nutrition education should be made compulsory at all stages of primary and secondary levels in order to create nutritional awareness and faster food habits right from school age.

10. Bangladesh needs to set up laboratory to frequently test the quality of foods at the farm levels.
11. We appeal to growers, marketers, retailers and everybody involved in the food supply chain to pledge in public to do everything in their power to limit, within scientifically proven permissible levels, the use of chemicals in the food items they produce, market and retail. We also appeal to the government to act.

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Chapter VIII

Appendix

Fig:18 Assemble market of at Shibpur,Narshingdi.

Fig:19 Assemble market of at sripur,Gazipur

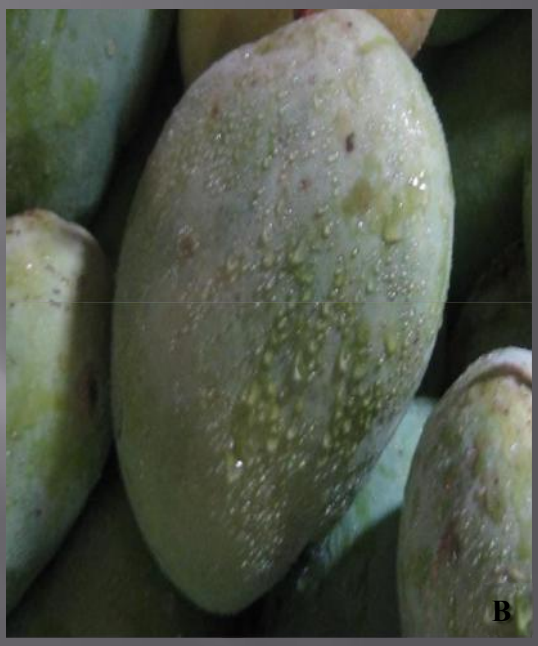

Fig 20. Mango fruits spread on the floor and ready to receive chemical spray for accelerated ripening (A) and mango fruits were subjected to chemical spray for accelerated ripening (B) (mango assemble market of Kansat, Shibgobj, Chapai Nowabgonj)

Source : Post Harvest Loss Assessment book

Fig 21.Traders and growers spray chemicals on mangoes to increase their shelf life before they are shipped out to the market. If they do not taint the fruits with toxic chemicals, the fruits would stay good a few days less that's all. The photo was taken in Meherpur. Photo: BSS

Source: The Daily Star, 10.09.14

Fig 22.Chemicals being sprayed in a pineapple orchard in Jangalia of Madhupur in Tangail

Source: Post Harvest Loss Assessment book

Fig 23. Spraying of plant growth regulator to the flowers of summer tomato

Source: Post Harvest Loss Assessment book

Fig 24. A man spraying chemicals on litchis to increase their shelf life before they are shipped out to the market.If they do not taint the fruits with toxic chemicals, the fruits would stay gooda few days less that's all. The photo was taken in Dinajpur

Source: 10-09-14 The Daily Star

Fig. 25 Chemically treated bananas are being heated up in an earthen pot in Bogra so that they ripe faster

Source: The Daily Star, 10.09.14

Fig 26. Decaying of Tomatoes as a post harvest loss

Source: post harvest loss assessment book

Fig 27. Highly nutritious and anti oxidant rich tomato fruits are lost afte harvest(A&B: Sayedabad wholesale market, Dhaka; and C: Nimshar Bazar, Comilla)

Source: The Daily Star, 13.09.14

Fig 28. Green tomatoes are seen in the photo, taken in a March morning and a farmer is seen spraying chemicals on his harvest at Char Kishoreganj in Munshig

Source: The Daily Star,13.09.14

Fig 29. Damages to pineapple fruits due to sun burn
Source: Post Harvest Loss Assessment book

Fig 30. Mode of transportation of cauliflower as followed by the growers to bring to the assemble markets
Source: Post Harvest Loss Assessment book