Assessment of Fruits and Vegetables Supply Channel to Ensure Safe Food Provision

Pervin, Shahida

Waseda University

September 2014

SOCIAL SCIENCE RESEARCH COUNCIL, BLOCK # 18, SHER-E-BANGLA NAGAR, DHAKA,
PLANNING DIVISION, MINISTRY OF PLANNING, GOVERNMENT OF PEOPLES REPUBLIC OF BANGLADESH

Assessment of Fruits and Vegetables Supply Channel to Ensure Safe Food Provision

SHAHIDA PERVIN

9/9/2014

ACKNOWLEDGEMENT

This research report is made possible by the grace of Almighty who created me and enlightened me with knowledge.

At the beginning I would like to express my gratitude to the Planning Commission, Bangladesh, for extending valuable cooperation by providing financial support to undertake this research on an issue that has become a great cause of concern to the people at all levels in the country.

To complete the research I got help from many people, including: family, my teacher, teachers of agricultural universities, government official in agriculture related departments, agriculture and marketing specialists, and friends.

First and foremost, I would like to express sincere gratitude to my supervisor Prof. Dr. Habibur Rahman for his most support and encouragement. His enlightened and encouraging support was with me from the very begin to the end of the research. His continuous supervisory support was in every stages of the research including conceptualization, questionnaire preparation, data collection, data organization and presentation, and finally reading the report thoroughly to comment on coherence, language and grammar.

I highly appreciate Saiduzzaman Pulak for his effective assistance in collecting data and preparing report. I would also like to thank Md. Ibrahim Khalil, Md. Sabug Howlader and Md. Rakibul Alam for their cooperation in data collection.

Finally, I sincerely acknowledge those anonymously who helped me in providing with information and suggestions.

Executive Summary

Availability of safe food has been a growing concern at all levels in Bangladesh that people are denied access to safe food. Limited access to safe food is barrier to safe and healthy living, and people have to pay heavy toll through food borne illness. Fruits and vegetables should be reached at consumers with efficiency based on minimum loss, shorn of harmful elements, more benefit to producers, lower monetary and time costs, and right share of mark up to provide with safer food.

The current study examines the safety issue throughout the supply chain of fruits and vegetables in Bangladesh. Two most popular fruits - banana and pineapple, and two most popular vegetables - eggplant and bitter gourd are taken as sample items for the study based on their volume of production and consumption. The study was conducted in three districts Tangail, Narsingdi and Dhaka following basically purposive sampling technique.

The study tends to: identify the existing market channel, most efficient channel and key players in the channel; identify the issues relating to safe fruits and vegetables; identify any other challenges for supplying safe fruits and vegetables; identify the possible alternatives to deal with the challenges; and suggest most efficient channel of fruits and vegetables based on some indicators.

The study findings suggest that fruits are vulnerable at both production and marketing stages of the supply chain due to careless use of unsafe chemicals and fraud practices. The vegetables are mostly vulnerable at the production level due to both careless and unconscious use of some chemicals that are considered harmful for human body. The unsafety practices begin at the production field of the fruits and vegetables.

Three behavioral practices- production practices, fraud practices and food handling practices generally make the food items unsafe. Behavior of consumer, producer, marketer and regulatory authority, and governance of the supply chain are the key determinants of safe food provision. Due diligence exercise is a crucial issue apropos of the safe food supply.

Information gap between the supplier and demander is one of the main causes of market failure of safe fruits and vegetables. Other reasons include market participants` carelessness, unawareness, unhealthy competition, rapacious demand for benefit, lack of monitoring, supervision and quality development support, lack of education, and lack of professional training.

Special attention is immediately required to address these critical issues and come up with safe practices.

- Training, awareness building campaign, smooth and quality transportation services, and monitoring and regulatory rules are critical for ensuring supply of safe fruits and vegetables.
- Existing market channels are posing challenges to supplying safe fruits and vegetables. There should be clarified responsibility of the entire safe food supply chain and the participants of the chain should share the responsibilities. When producers become strong market participants, activities of some of the commission takers like faria, local arotdar, broker (dalal) will be abolished. Training, financial support to the producers, local cooperatives can provide necessary support in this regard.
- The source of knowledge about risky materials needs to be addressed. There is hardly any institutional or formal source of knowledge in the existing fruits and vegetables market chain.
- Steps should be taken to make the important product information available to the controllers and the users of the channel. Providing information and technical assistance are important to the producers and the marketers.
- Three broad things might be supportive to make sure an acceptable level of food safety: determining a minimum level of food safety for all, disclosing all information concerning the pattern of safety and justifying the consumers` willingness to pay for safe food non-linearly.
- Producer organizations can empower the producers and make sure their benefits are properly reaped. Producers should be much communicative and organized. When producers will be assured of their benefits, it will motivate them to behave in a society-friendly way. Again message to producer will be easily reached at producer when they are organized and connected.

- Safety branding is the demand of the present time. Policy should be taken for providing the incentives for organic and safety branding so that the talented young brains will come forward with sustainable safety concept to handle the agricultural food market chain in Bangladesh.
- Hence inclusive agro business needs to be facilitated. Inclusive agro business-compliance involves quality and safety assurance, brand development, product niche definition and shifts in the chain coordination.
- Messages should be targeted toward changing behavior and the rules should be stricter and if needed new rules should be imposed with regard to pesticide use.
- Illegal practice of collecting tolls by the musclemen and traffic police has to be strictly dealt with to provide smooth and tension free environment of supplying fruits and vegetables. In case of transportation, two types of problems are observed - unfair practices of policeman, smuggling and the like, and poor infrastructure facilities e.g., roads, and market condition.
- Continuous monitoring and supervision must be strengthened to stop unconscious and fraudulence practice. Enactment of rules and regulations bring all the practices and authoritative rules into a formal framework.
- Availability of safe technology and facility to keep produces fresh and safe is a challenge which deserves special importance.
- Finally, appropriate measures need to be taken by the government to ensure prevention of unethical use of hazardous materials, awareness of the key players involved at all levels of the supply chain. Continued pressure from the active and legit civil society groups can be quite instrumental in dealing with the situation which becomes a serious concern for the current and the future generations to come.

Contents

1. Introduction

Availability of safe food is one of the prime essentials for secured living. In the recent years it has been a growing concern at all levels in Bangladesh that people are denied access to safe food – especially the food items that comprise their everyday food consumption basket. Limited access to safe food acts as a barrier to safe and healthy living. Several studies (e.g., FAO 2010, Mahoney 2010) indicate that millions of people pay heavy toll through food borne illness in Bangladesh every year.

Access to safe food is a critical element in the food security definition given by the FAO. And Bangladesh, like many other countries in the world, expressed commitment to work on this particular issue. In Bangladesh the share of agriculture in GDP is 13 % while crops and horticulture together accounts for 72% of this agricultural GDP. The average daily per capita caloric intake is estimated 2318.3 K.cal. The contributions of vegetables and fruits, that contain valuable components of balanced diet, are estimated at 89.1 K.cal and 31.1 K.cal respectively (BBS 2011). It is widely recognized that increasing consumption of fruits and vegetables is preventive measure for chronic dieses. Intake of fruits and vegetables is 211 grams/capita/day in 2010 while desirable amount is 400grams/capita/day (NFPCSP 2012). Lower intake and unsafe intake jointly contribute to health hazards caused directly by lower nutrition, and indirectly by food borne illness and related cost.

Agricultural fruits and vegetables markets channel is a new concern among the economists and policy makers. Efficient distribution is a must to meet the increasing demand for food with safety assurance for increasing population. To ensure efficient distribution, reduce wastage and provide safe vegetables and fruits, supply chain plays the key role. A supply chain is a system involved in moving a product or service from supplier to demander. The scope of supply chain begins with sources of supply and ends at consumption point (Stevens 1989). Supply chains bring the supplier and demander in connection with each other who are separated by time and space. Agricultural supply chains are also economic systems to distribute benefits and apportion risks among participants (van Roekel et. al. 2001).

Varieties of fruits and vegetables are produced year round all over the country. If produced fruits and vegetables reach the consumers efficiently, based on the minimum loss, shorn of harmful elements, more benefit to producers, lower monetary and time costs, and right share of mark up, safer food could be provided. Due diligence exercise is a crucial issue apropos of the safe food supply. The current study is an attempt to examine the existing food supply chain whether there has been any use of health damaging chemicals and hand-picks the issues and identify the challenges in supply chain that impede supply of safe fruits and vegetables.

2. Food Safety as an Issue

Food safety itself is a complex criterion and there is no single indicator to measure food safety (Valeeva 2004). Wholesome of food that does not exceed an acceptable level of risk associated with chemical, physical hazards or pathogenic organisms (Anon. 1998) is considered as safe food. Three behavioral practices- production practices, fraud practices and food handling practices generally make the food items unsafe (Robson 2014). Unsafe practices contribute to insecurity as food safety is an integral part of contribution of food security**.**

Unsafe food has multi facet costs that create threat to life, threat to community, threat to economy, and overall threat to world population. Consumption of unsafe food results in several food borne illness and leading to medical expenses and productivity loss (Medeiros et. al. 2001). Three main costs- real resource compliance costs, social welfare losses, and transitional social costs have to bear to provide with safe food. (Unnevehr & Jensen 2001). Coupled with the aforesaid cost, there are also supervisory or monitoring and transaction costs. When unsafety practice exists in the supply chain, the regulatory authority has to put additional supervisory or monitory effort (e.g., deploy more force) to safeguard supply of safe food. This increases the time and monetary costs to the authority.

Behavior of consumer, producer, marketer and regulatory authority, and governance of the supply chain are the key determinants of safe food provision. The degree to which demand for safe food can lead the market to enhance food safety is determined by the consumer ignorance concerning the safety of their food purchases (Crutchfield and Allshouse 1998). However, free

market without good governance and regulatory force cares little for consumer ignorance and priority. Lack of symmetric information prevents consumer demanding safe food. Intrinsic characteristics of safe produces and invisibility to the naked eye prevent the safe supplier to be competitive with the unsafe suppliers (Oger, Woods & Jean-Albert, Allan 2001). Where there is constraint in branding safety and reaping reward, producer and marketer have little vested interest to minimize the asymmetry of safety information (Crutchfield and Allshouse 1998). As a result, consumer does not have rational demand and the supplier does not care for consumer well-being. Additionally, vast population provides incentive to concentrate more on quantity supply in preference to quality supply.

3. Fruits and Vegetables in Bangladesh

3.1.Fruits and Vegetables

Fruits: Total volume of fruits production is 4385 metric ton in 2010-11. More than 70 types of fruits are grown in Bangladesh. Fruits are mainly divided into two categories: periodical and seasonal. Periodical fruits may be classified into two other groups on the basis of the amount of time the trees take to bear them after plantation: short term fruits and long term fruits. Short term fruits grow on trees in two or less than two years after plantation, like banana, pineapple, papaya, etc. Long term fruits grow on trees in more than two years after plantation, like mangoes, jackfruits, wood apple, etc. Seasonal fruits may be classified on the basis of the seasons in which they grow, for example summer, winter and all seasoned fruits. Summer fruits are available in Bangladesh from mid-April to mid-October (Baishakh to Ashwin). Mango, berry, litchi, jackfruit, guava, hog plum, pineapple, sapota, chalta, lemon, palmyra, etc. are the most available summer fruits. However, lemon, pineapple and guava are found almost round the year. The main winter fruits are orange, olive and wood apple. Some fruits are available in our country throughout the year, for example: banana, pineapple, papaya and coconut (Hortex Foundation, NCTB 2007).

Vegetables: Total volume of fruits production is 4385 metric ton in 2010-11. More than 100 types of vegetables are grown in Bangladesh of both indigenous and exotic varieties. Based on seasonality in production these vegetables are categorized as summer seasoned, winter seasoned, and all-seasoned, according to the seasonal variation in production. Of the summer vegetables, various cucurbits, vegetable cowpea, stem amaranth, several aroids, Indian spinach are predominant. Winter vegetables are mainly tomato, cabbage, Chinese cabbage, cauliflower, eggplant, carrot, spinach, bottle gourd, bush bean, cucumber, small cucumber, yard long bean, hyacinth bean, French bean, pea seed, broccoli and radish. All year round vegetables are like ash/wax gourd, snake gourd, bitter gourd, okra, heat-tolerant tomato, eggplant, carrot, spinach, many leafy vegetables and small onion are grown. Summer vegetables are cultivated during the monsoon season from mid-April to October. On the other hand, winter vegetables are grown from November to mid-April. The production of vegetables is higher during winter (60 to 70%) and most districts produce marketable surplus during that season (Hortex Foundation, Weinberger and Genova II 2005).

Table 1: Fruits and Vegetables Production

Indiators	2008-09	2009-10	2010-11
Fruits area (000 acre)	361	360	347
Fruits production (000 m.ton)	4224	4525	4385
Fruits yield (kg/tree)	11.7	12.64	12.63
Vegetables area (000 acre)	881	885	908
Vegetable production (000 m.ton)	2909	2993	3068
Vegetable yield (kg/acre)	3283	3416	3378

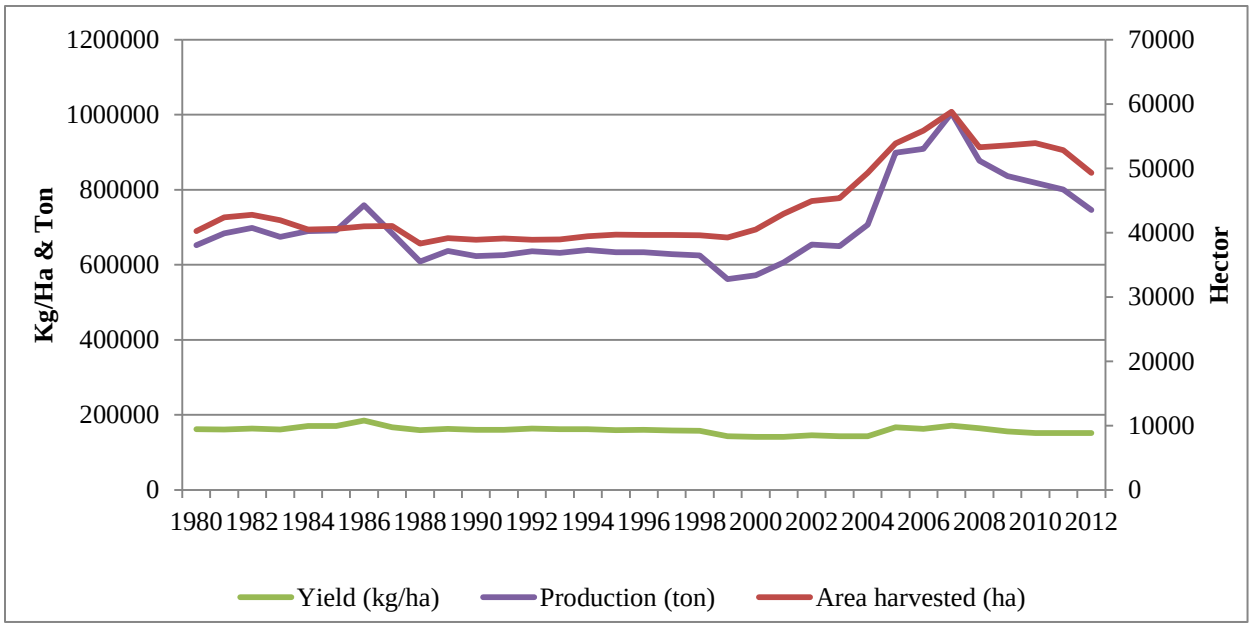
Sources: Agricultural yearbook, Statistical year book

This is the study only for two fruits- banana and pineapple, and two vegetables- brinjal and bitter gourd. A brief description of these items is presented in the following.

Banana: Banana is the year round fruit of Bangladesh. It`s cultivation is distributed through the warmer countries. The banana occupies first position in terms of acreage production and second position in terms of amount of production among fruits in Bangladesh. Banana is recognized as

the most popular among all the fruit consumed in Bangladesh. There are several ways of consumption of both ripe and unripe bananas. Ripe banana is eaten as desert fruit. Unripe fruits are cooked and provide a starch food. This study only considers ripe banana.

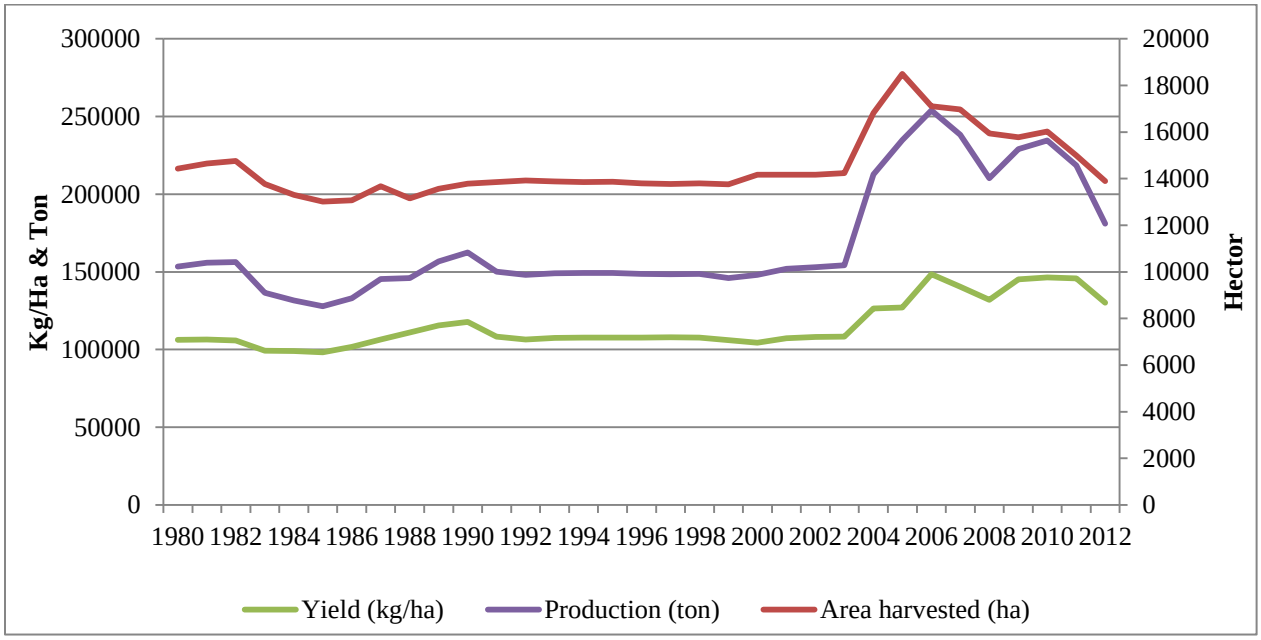
Figure 1: Production and Land Cultivation of Banana in Bangladesh



Source: FAO stat database

Pineapple: Pineapple is a perennial crop grown for its fruits and used as both fresh and processed. The pineapple, a native of Brazil is known as 'Pina' in Spanish and Ananas in French. Presently the pineapple growing region is extended over a wide range of countries in the world. The pineapple occupies third position in terms of acreage production and fifth position in terms of quantity production among the fruits grown in Bangladesh. Pineapples are consumed as fresh fruits or used for manufacturing juice, jam and squash. Pineapple is an excellent source of vitamin C, A and B. This study only considers the fresh pineapple fruit.

Figure 2: Production and Land Cultivation of Pineapple in Bangladesh



Source: FAO stat database

Vegetables: Brinjal (Eggplant) and Bitter Gourd: Brinjal is one of the very popular and common vegetables in Bangladesh. Different varieties of brinjal are produced in Bangladesh. The most familiar varieties are Uttara, Tarapur, Suktara, Kazla, Nayantara, Islampuri. Bitter gourd is mainly an Asian vegetable and highly grown in Bangladesh. Bitter gourd contains a large proportion of iron and vitamin-C.

3.2. Production Cycle

Agricultural items that are selected for this study are basically available throughout the year. But still there is some intensive production period, plantation time, harvesting time, maturity time. The production cycle affects the price and behavioral market practices. Seasonal variation highly influences the market price so there remains a little inconsistency in the price in different stages of the channel. Items taken as sample in the study are all short term specially the fruits items. All vegetables are normally short term. High times for plantation of banana are mid-January to mid-March and mid-September to mid-November and harvesting time is December to February.

Banana takes 10-12 months for natural maturity and grows once a year. Pineapple takes 18 to 24 months to be matured. The planting time of pineapple is mainly mid-March to mid-May and mid-September to mid-November, and harvesting time is May to July. High time for planting and harvesting brinjal is October to mid-November and late November to mid-April respectively. Once the brinjal plnat is planted, it produces the fruit all the year round. Bitter gourd is planted in mid-April to mid-June and is harvested in mid-June to mid-August. Brinjal and bitter gourd take 1.5-3 months to be matured and give output all the year round once the plants are matured. These two vegetables in different variety are available around the year in Bangladesh.

Table 2: Cropping Calendar of Fruits and Vegetables

Items	Planting time	Harvesting time	Maturity time (month)	Yearly cycle	Available
Banana	Mid-January to Mid-March and Mid-September to Mid-November	December to February December to February	10-12	1	Throughout the year
Pineapple	Mid-March to Mid-May Mid-September to Mid-November	May to July May to July	18-24	0.5	Throughout the year
Brinjal	October to Mid-November	Late November to Mid-April	1.5-3	1	Throughout the year
Bitter gourd	Mid-April to Mid-June	Mid-June to Mid-August	1.5-3	1	Throughout the year

Source: BBS, Hortex foundation, Survey

4. Review of Food Safety and Agricultural Market Channel Literature

Market channel gained recent research focus. As food security is a growing concern, a large number of research on the food supply chain has been done in the recent years - both at the national and at the international level. Some of the relevant domestic literature has been reviewed to understand the pattern of food safety research in Bangladesh and to develop the conceptual and methodological framework for the study, if there is availability of any agricultural food safety research.

Matin et. al. (2008) retrieved the market channels of tomato and mango, and explored the level of efficiency of these channels in two different primary research articles. Taking from different districts, they measured efficiency based on some indicators as producer`s share, marketing cost, middle men`s margin, price deviation, peak period seasonal price variability, lean period price variability for tomato market, and percent of product run through the channel, producer`s share, marketing cost, middle mens` margin, price deviation for mango market. They found Farmer- Aratdar (local) - Bepari - Aratdar (Dhaka) - Retailer (Dhaka) - Consumer and Farmer - Retailer (Local) - Consumer chain as most efficient for tomato and mango marketing respectively. But as mango producers do not have enough storage facility, Farmer - Bairal – Bepari - Aratdar (Local) - Aratdar (Dhaka) - Retailer (Dhaka) - Consumer is more beneficial for them as the famer can sell larger amount through this channel.

Sabur, Hossain, and Palash. (2006) represent the onion market with three channels to disclose costs, margin and seasonal variation. Using stationary and cointegration test on the data of 1975-2004, they found that onion market is cointegrated in the long run excluding some exception. That is, it was observed that within a month, change in price of one market fully reflects the change in price of other markets.

Rahman et al. (2006), in a study at four villages Demazani, Poranbari, Jhalopara, and Kundoish in Amrool Union of Bogra district found six marketing channels for potato. The existing channels in the primary and secondary markets were: (i) Farmers - consumers, (ii) Farmers – retailers -consumers, (iii) Farmers - middlemen/ traders – retailers - consumers, (iv) Farmers – wholesalers - retailers - consumers; and the channels up to the terminal market were: (v) Farmers –wholesalers – retailers - consumers, (vi) Farmers - middlemen/traders – wholesalers – retailers -consumers. The study indicates that prices and costs increased with distance of the markets from the production area. The study also shows that larger farmers receive higher margin because of timely selling in the markets according to demand and their ability to use distant markets. Five channels were identified for cucumber market where four channels were used by all sorts of producers and the fifth channel by only the large producers.

Huq, Alam, and Akter. (2004) find the market efficiency for potato marketing in three different areas of Bangladesh based on 6 indicators i.e. percent of product which flows out through the

channel, producers` share to consumers price, relative marketing costs, level of middle-mens` margin, peak period price variability, lean period price variability. The study found 25 market channels of which six were more efficient and accounts for 66% of the total potato flow out from producer to consumer.

Available literature emphasizes on the cost, benefit, and loss over the market channel and mostly ignored the food safety issue especially from the perspective of Bangladesh. This paper tends to address the gap in the market channel research with special focus on such a critical issue that has gained significant amount of attention at all levels in Bangladesh in the recent years. The study reveals the existing market channels of fruits and vegetables, and specifies the issues with regard to safe fruits and vegetables in the channel. An effort has also been made to propose a good market channel and moderate the existing structure, if there is any room.

5. Objectives of the Research

The key objective of the research are to understand and critically examine the existing structure of the market channel for dealing with the food safety issues that has drawn lot of attention due to its serious implication for human health especially in the context of Bangladesh.. However, the specific objectives of the current research are to:

- Identify the existing market channel, most efficient channel and key players in the channel
- Identify the issues relating to safe fruits and vegetables
- Identify any other challenges for supplying safe fruits and vegetables
- Identify the possible alternatives to deal with the challenges
- Suggest most efficient channel of fruits and vegetables based on indicators like food loss in different stages, harmful preservative use, safe transportation, cost, markup
- Suggest policy based on research result

Based on the above set of specific objectives this research aims at finding answers to the following research questions:

- How the agricultural vegetables and fruits reach the final consumer from the producer, i.e., the structure of supply chain?
- Who are at the helm of supply chain?
- What are the key issues (e.g., agricultural practices, adulteration, market forces) related to safe fruits and vegetables supply?
- What are the challenges in safe fruits and vegetables supply chain?
- How can the challenges be overcome?
- How much is the loss of fruits and vegetables in terms of marketing?
- What are the sources of unsafe food provision and why those occur?
- How the danger of safe food can be minimized through fruits and vegetables market channel?

6. Supply and Demand Economics of Safe Fruits and Vegetables

One of the major requirements of a perfectly competitive market is availability of perfect information about the price and quality of the goods. The current practice in the fruits and vegetables market does not comply with the requirement of providing perfect or symmetric information. Consumers have very little information about the quality of the produce. Quality does not only mean the visible characteristics – it also includes the intrinsic features of the produce. Safety features are not visible at open eye. This is concomitant with the intrinsic characteristics of fruits and vegetables. The invisible characteristics provide asymmetric information and cause market failure. Once the neoclassical assumption of symmetric assumption is dropped, the obtained equilibrium may fail to be efficient (Weiss 1995).

Due to prevalence of unsafe practices in the fruits and vegetables supply chain, suppliers of safe produce have to bear additional costs. The additional costs accrued from asymmetric information that prevents safe fruits and vegetables supplier to compete with unsafe suppliers resulting in driving out of the safer food by the less or entirely unsafe food from the market (Weiss 1995).

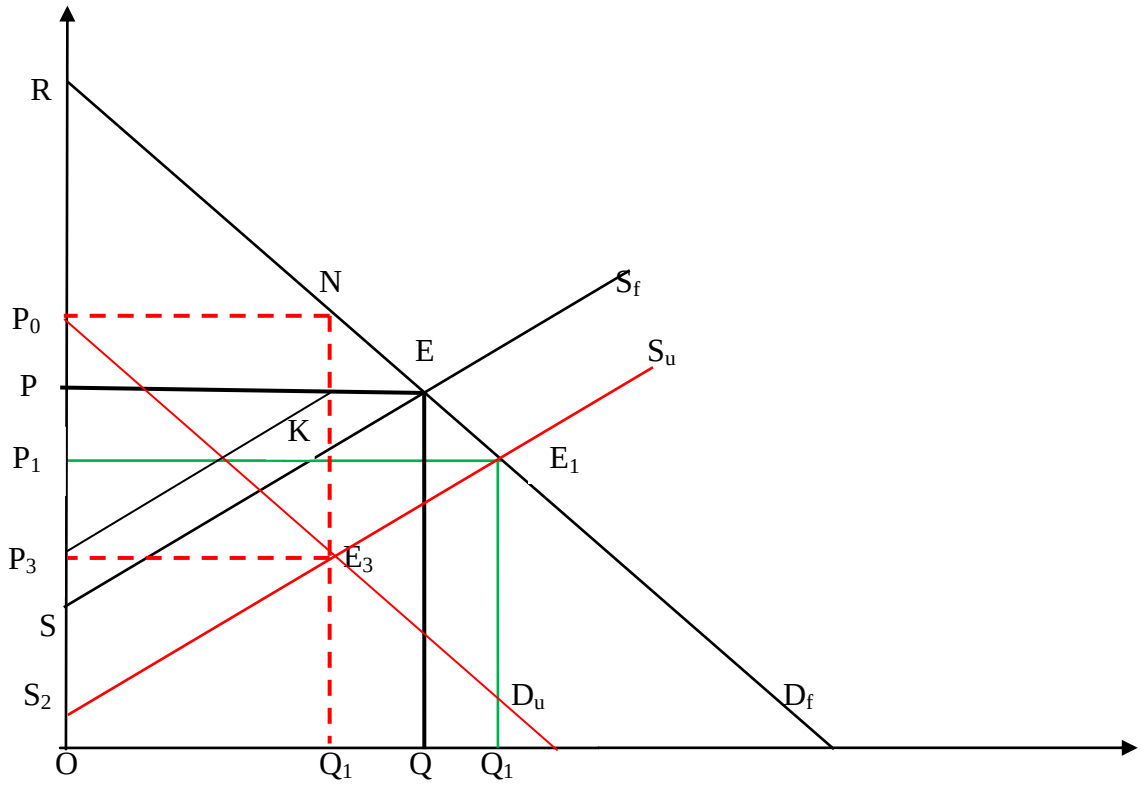
Beyond the competitive cost of lower price, cost exists to provide both safe (wastage loss, low production) and unsafe food (cost of preservation, pesticide, insecticide, and other chemicals).

When fresh produce is supplied, the wastage cost caused by spoilage, insect and the like is included with the output. If someone goes further back, s/he may find that there is lower production due to not using unsafe materials. The demand and supply is balanced by price. When unsafe output is supplied, the cost of preservative, insecticide etc. is included with the unsafe output cost. Therefore, it does matter which impose more cost to supplier in the ongoing market structure where suppliers are the channel regulators. From the supplier side, it is expected that the later bear lower cost of supply as there is opportunity of hiding information.

What should be the strategy? Higher production and lucrative produce with highest risk? Higher production and lower spoilage? Maximum production with acceptable level of spoilage and tolerable level of risk? Or Lower production and higher spoilage? Apparently, from supplier side, it seems higher production with attractive look and lower spoilage is beneficial. From society side, goods should be supplied considering the health cost and ensuring minimum amount of fruits and vegetables consumption for the larger population. Rather, price of the product, factors like convenience, appearance, texture, smell and perceived quality - all influence the choices made at the marketplace (Oger, Woods & Jean-Albert, Allan 2001).

We assume, hybrid produce with tolerable level of harmful material is safe, although, any chemical or/and even hybrid output is questionable. This analysis accepts the tolerable level as safe and the level should be determined by the standard setting authority. Based on the information published and media broadcast, this study assumes that there is unethical practices of using harmful chemicals especially in the fruits and vegetable produces beyond the acceptable level.

Figure 3: Demand and Supply of Safe Fruits and Vegetables



In a perfectly competitive fruits and vegetables market, the demand D represents the marginal benefit of consumers having the produce and supply curve S represents the marginal cost of suppliers at all stages say, producers and different market intermediary.

Lets assume that the market supply curve for fresh produce S_f and demand curve D_f, achieve equilibrium at point E with price P and quantity Q. Total value is PEQO. In this example the consumers' surplus is PER and suppliers' surplus is PES.

When the unsafe produce is supplied, the supply curve shifts rightward to Su for lower spoilage cost and higher production and equilibrium takes place at E_1. Consumer surplus has been increased by PEE_1P_1. Producer`s surplus also increased by SKE_1S_2-$PEKP_1$. The share of surplus depends on the elasticity of the supply and the demand curve with regard to price. The higher the elasticity of the supply curve the lower the surplus accrued to the supplier and vice versa, and the

higher the elasticity of demand curve the lower the surplus accrued to the consumers and vice versa. But this is not the actual scenario.

There has been some intrinsic outcome of increased supply through provisioning unsafe produces. The equilibrium does not take place at E_1 but at E_3 with actual price OP_0. P_3P_0 is the cost for medical and lost income due to food borne illness. This happens due to reduction of consumer`s marginal benefit from unsafe produce arrested by health cost and productivity loss. Now the consumer surplus is $P_3E_3P_0$ lower than PER by PENPo. And producer benefit is $P_3E_3S_2$ lower than PES by P_3KES. But this depends on the loss of benefits due to unsafe produce. This point deserves the cost benefit analysis of increasing benefit of supplying more or lucrative good using harmful elements and the cost of those harmful elements from consumer side. From supplier side if the cost for unsafe material is used to improve the supply quality, it will bring more benefit. But this is an aggregate initiative and no single stakeholder can do this fruitfully. The central authority has certain roles to play for dealing with this crucial issue.

From normative side of economics, this is a general expectation that the right to access safe food is ensured and it is the duty of state to ensure an acceptable level of safe food provision regardless of the costs and the financial benefits from it. The duty of the state is justified by the reality that the general level of consciousness among mass population is substantially low due to low or no level of education and the absence of effective mechanism to ensure supply of proper product information to the consumers. Positive analysis also should take place to justify and rigor the economic efficiency.

7. Methodology

Food safety has been highly topical recently in the public debate, food policy, industry and research. In research, there have been three main streams dealing with consumer demand for provision of, and consumer perception of quality and safety of food (Grunert 2005). The concentration of this study is on the provision of safe fruits and vegetables. The study is based on the field level data of the supply chain and considers only the raw fruits and vegetables - not the processed ones.

7.1.Study Locations

Two fruits and two vegetables from two districts, two items from each district have been selected. Forward looking strategy was used to interview the respondent. That means interview was started from the producers and ended at the ultimate marketer i.e., retailer. The location of study was selected based on the intensity, quantity, area of production, distribution, and contribution of the product in market. The primary selection of the location was based on secondary information and the selection was finalised after the pre survey field visit and discussion with local representatives, and knowledgeable persons. Following the above criteria two districts - Tangail for frutis and Narsingdi for vegetables - were selected. Tangail and Narsingdi were selected for production area and local markets of the selected fruits and vegetables. Dhaka was selected for destination and clearance market. All the items normally come to Dhaka. Therefore, we selected three broad locations: Tangail, Narsingdi and Dhaka. These three locations cover all the stakeholders of different stages of market channel-producer, faria, bepary, wholesaler, arotdar and retailer who are the major players in the supply chain.

7.2.Study Population

Two most popular, and famous, delicious and nutritious fruits - banana and pineapple - respectively the second and third largest quantity production of fruits in Bangladesh were selected for this study. Jackfruit, basically a summer season fruit of Bangladesh, is produced in highest quantity. To avoid the seasonality issue, the second and the third largest produced fruits, banana and pineapple, that are grown almost all the year round, are considered for the study. For both these items Tangail district has been selected as the sample area because of its importance in terms of production volume and acreage. Total area of fruits production in Taingail District is 19,325 acres comprising 58% for pineapple and 38% for banana. Selection of Tangail district as a representative area for the research has been based on these critical information.

In Narsingdi district the total operated land area is 209853 of which 25846 acres (12%) is used for vegetable cultivation. Almost 50 percent vegetables from Narsingdi are transported to Dhaka and other outer markets. Recently government undertook initiatives to ensure safe vegetables

production with *vermi compost* fertilizer under department of agricultural extension (DAE), which was piloted in Narsingdi district. Some pilot research of IPM`s (Integrated Pest Management) effectiveness also have been carried out in Narsingdi. These initiatives demonstrate the role of Narsingdi as a vegetables producer district. Considering the market contribution and production intensity, Narsingdi district was selected as sample vegetables producer district for this study. Two vegetables brinjal (eggplant) and bitter gourd, which are mostly produced in the same season and highly produced in Narsingdi district were selected.

7.3.*Sampling*

Union is the smallest administrative area that we considered for data collection at the production level. The nearby large market that helps in channeling the fruits and vegetables was taken for market channel data. Three steps were followed to select the production study area and two steps for the study market. The steps are the selection of district, *upazilla* (sub district) and union for production level data and selection of nearby market of production region and then terminal market at Dhaka. In case of market, firstly largest local market and then the largest distribution market of Dhaka, and then the local market of Dhaka were selected.

Both banana and pineapple are extensively cultivated across the Madhupur Upazila of Tangail District. So Madhupur Upazila of Tangail District was purposively selected. Two Unions, Aushnara and Arunkhola of Madhupur Upazila are the two most cultivated areas for both pineapple and banana contributing to about 70% of total banana and pineapple production in Madhupur Upazila. 30 producer respondents for each item were randomly selected from these two unions - 15 each from Aushnara union Arunkhola union. For both banana and pineapple, a total of 60 producers were interviewed from these two unions. Jalchatra Bazaar is the largest pineapple market in the country. The Total volume of fruits production is Madhupur bazaar is also a large market for banana. 15 marketers of different category were randomly selected for each item from these two bazaars. So from these two markets, total 30 marketers were interviewed for banana and pineapple.

Narsingdi is considered as one of the pocket areas of brinjal production (Haider et.al 2012). Two unions of Belabo thana- Narayanpur and Amlabo were selected as study unions where brinjal is grown intensively. Seasonally brinal is produced at about 115 hactor at Narayanpur union and 105 hactor at Amlabo union. 15 respondents were selected randomly from two unions as brinal producer. These two unions are the highest intensive area of brinjal production in Narsingdi district and one of the unions in Bangladesh. Two neighbouring bazaars namely Narayanpur and Baroicha, where the largest portion of the produced are gathered were selected to find the market intermediary. For brinjal 15 marketers were selected from these two market locations. Shibpur Upazila of Narsingdi district is one of the fastest growing bitter gourd supply location in the country. Therefore, Shibpur Upazila was purposively selected for the study. Bitter gourd is mostly cultivated in two Unions of Shibpur Upazila - Joynagor and Chacrodha. From each union 15 farmers were selected randomly for the interview. Following the producers` opinion about where they mainly gather the produces, Shibpur Bazaar and Joshor Bazaar were selected for marketer data. Marketers have been identified according to their role in the market. Based on the size of the two bazars, 10 respondents were selected from the Joshor Bazar and 5 from the Shibpur Bazar.

From Dhaka top three markets, in terms of the size of operation, were selected where fruits and vegetables are assembled from all over the country. The selected markets are Kawranbazar, Jatrabari and Badamtoli. Kawran bazar is the largest both for fruits and vegetables. Jatrabari was selected for vegetables only and Badamtoli fruits only. These markets were covered for arotdar, wholesaler, faria and retailer. For retail marketer Mirpur, Hatirpul and floating van were covered.

From different steps of the channel marketers were selected purposively up to terminal market. A total of 314 persons were interviewed encompassing the producers and marketers in all stages. 119 questionnaires were filled up by producers, 30 for each item except for bitter gourd. Number of questionnaires for marketers from all stages of the channel was 195. The survey was conducted during April-June 2014.

Table 3: Sample Distribution

Items	Producer	Faria	Bepari	Arotdar	Wholesaler	Retailer	Total
Banana	30	5	10	6	11	16	78
Pineapple	30	5	10	9	10	15	79
Brinjal	30	1	15	5	10	18	79
Bitter gourd	29	3	10	5	11	20	78
Total	119	14	45	25	42	69	314

7.4.Data Collection (including questionnaire preparation)

At the preliminary stage of the research, every sample area was visited by the researcher to gain knowledge on the survey locations. Each sample area was visited along with a local inhabitant so that the characteristics of the field were easily grasped. The survey questionnaires were developed based on the knowledge gained through the field visits and desk study. Pre testing of questionnaire was conducted by the researcher and surveyors to understand the mode of response by respondents and check the compatibility of the surveyor with questionnaire. The questionnaires were finalized through several discussion sessions with the study supervisor. In addition, there were a number of informal and formal discussions with professionals, specialists, marketers, producers and local people for knowledge development. Before starting the actual survey there was a discussion session with one Upazila (sub district) Agricultural Officer.

After completing the pre testing, final survey was started with modified questionnaires based on the feedback from the pre testing phase of the survey. At this stage, all the players of the market chain were interviewed in phases. The data was collected from the entire market channel through face to face interview with using structured questionnaire under the supervision of the Principal Researcher. There were informal FGDs, purposive unplanned discussions with different groups of people. Training was given to the enumerators on data collection procedure and overview of the research project to prepare and motivate them for good quality data collection. After gaining good knowledge about the market, open discussions were conducted with a few marketing specialists before and after field survey.

The questionnaire for the producers covered the areas like basic household information, learning, production cycle, market participation, cost in different stages, unsafety issue, preservation, market information, and perception with regard to food safety. Similar issues are covered in the questionnaire for the marketers.

7.5.*Data Processing and Analysis*

After collecting the data, it was processed using the formal procedure. Data was classified and processed according to their types. Coding was to handle the data easily and was revised in time of data cleaning and processing. Data was analyzed with the application of some fundamental descriptive statistical tools as mean, standard deviation, percentage. The processed data has been presented in tabular and diagrammatic forms. Besides the quantitative analysis, strenuous effort was made also on qualitative analysis to make the research more effective as some aspects of the study are qualitative in nature. Statistical software package Stata was used to facilitate quantitative analysis.

8. Data Analysis

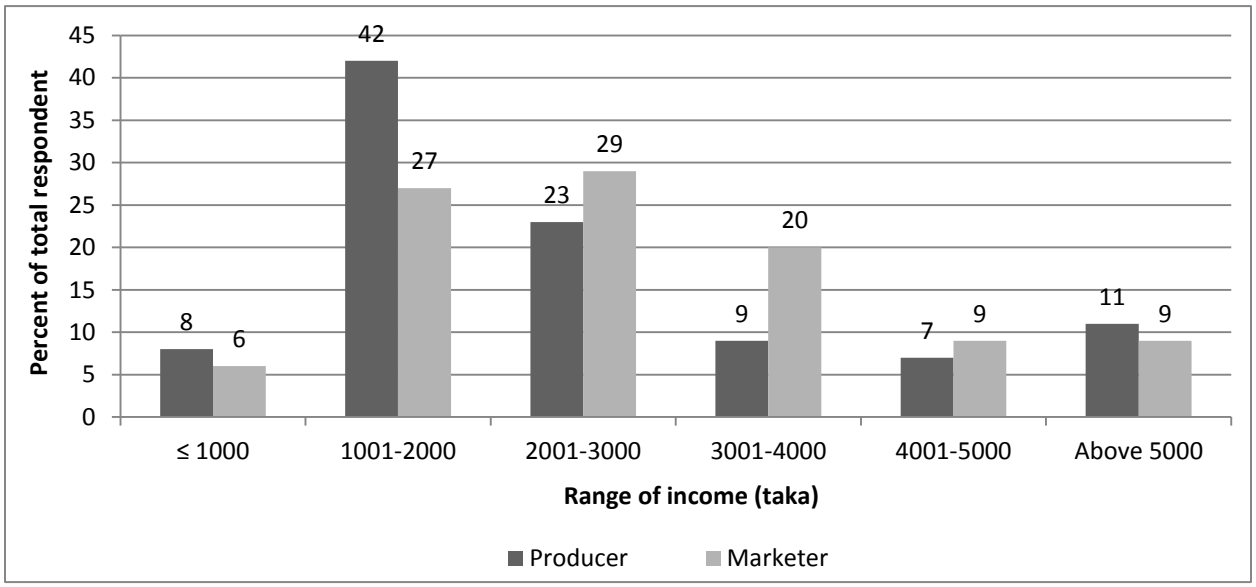
The endeavor has been put on place to find the problems and prospects of the market channel with regard to provision of safe fruits and vegetables. The primary foci were on identifying the existing market channels for the selected fruits and vegetables and look into the issues thoroughly. To accomplish the objective, a primary field survey on producers and marketers were conducted. The survey data analysis and findings are presented in this part of the report.

8.1.Characteristics of the Sample Respondents

The basic characteristics of the respondents and their family are assumed to have influence on the market behavior. Family size and income, age, education and experience of respondents have

been taken as the basic characteristics of the respondents. Average family size of both producer and marketer household is 5.6. Per capita income of the member of respondent family is presented in figure 4. Total income level has been separated into six groups. Respondents are presented as percent of total respondent according to their income level. Income of the marketer family members seems better than the producers falling in the income group of Tk 2000-5000. Beyond this range the income level is reverse in both the side. In general, income level is better for the marketers than the producers.

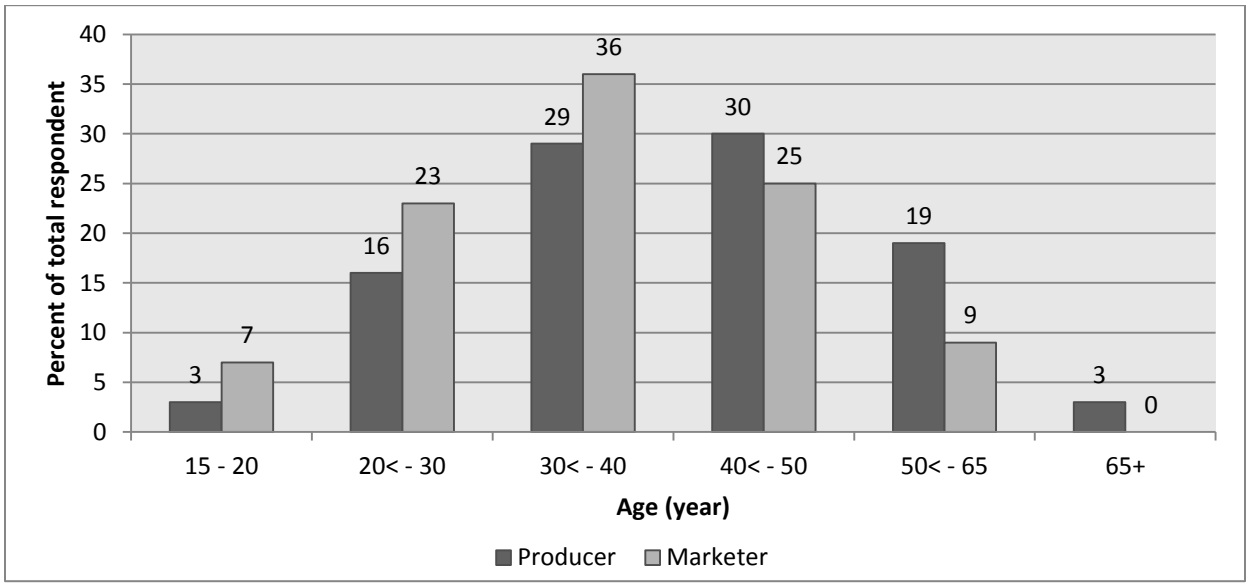
Figure 4: Per Capita Monthly Income of the Households



Source: Author`s calculation from survey data

About 93 percent of the producers and 94 percent of the marketers are in the age group of 20 and 65 years. Participants in the supply chain are found to be in the highly active age group. There is no marketer in the sample whose age is above 65 years and only 3% of the producers are over 65 years. The lowest age is 18 years for producers and 15 years for marketers, and the highest age is 75 years for producers and 65 years for marketers in the sample.

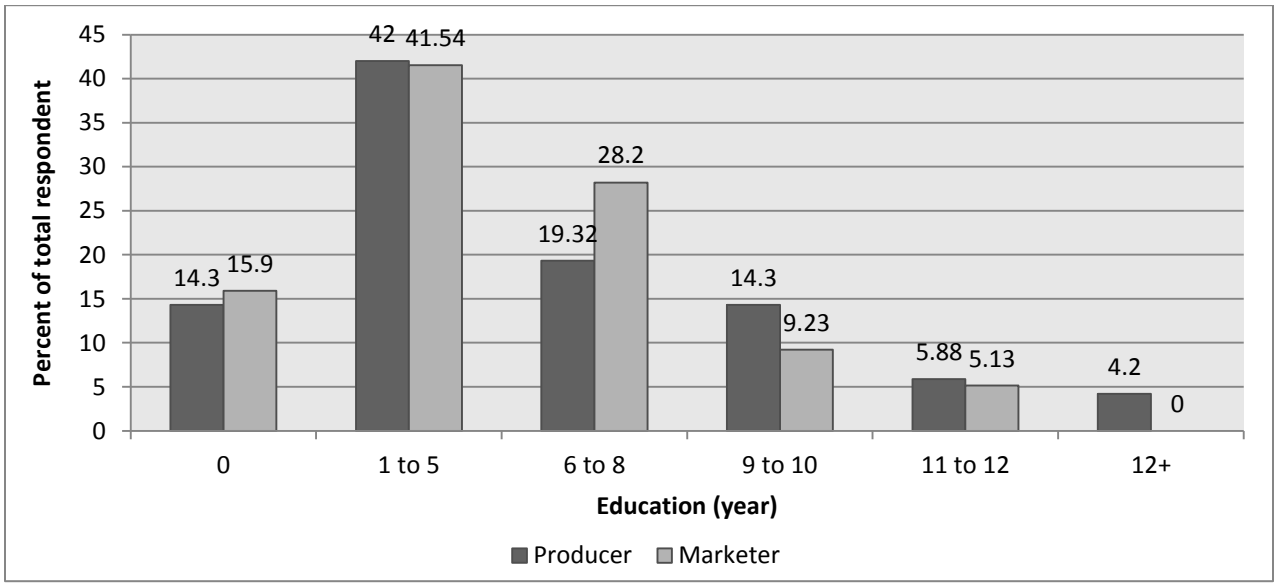
Figure 5: Age Distribution of the Respondents



Source: Author`s calculation from survey data

Surprisingly, there is no education among 14 percent of the producers and 16 percent of the marketers in the sample population. Without having any education these people are controlling the market channel. About 42 percent of both producers and marketers have attended schools for a period of 1 - 5 years. 4 percent of the producers have completed 12 years while none of the sample marketers have this level of education. This represents the education level of those who generally controls fruits and vegetables market channel in Bangladesh. The situation is better for the producers.

Figure 6: Education Level of the Respondent



Source: Author`s calculation from survey data

About 56 percent of the producers have 15 or above years of professional experience as opposed to 40 percent for the marketers. Correlation between experience and age of the respondents was found to be 0.5 and 0.6 for producers and marketers respectively. The age distribution in the figure above validates the correlation result.

A disaggregated mean value of the characteristics of the sample items are presented in table 4 (annex). Among the respondents` families, number of family member varies between 2 and 18, which is 2 and 11 for producer, and 2 and 18 for marketer. The average family size for each of the group is 5.6. Family income varies between 1000 and 100000, for producers it is 1000 and 50000, and for marketer it is 4000 and 100000. For all items except brinjal, per capita income of the family member shows better look for marketer than the producers. Education level of the respondents is higher for the producers than for the marketers. It is true for all the selected items. This reflects preference for involving in agriculture rather than as market intermediary. The educated people in Bangladesh who live in their own locality, are mostly engaged in agriculture as main occupation or as subsidiary besides other occupations, if there is any opportunity. The data characteristics of our survey slightly support this behavior. The experience of our sample respondents varies between 0 and 45 in total, 2 and 45 for producers and 0 and 40 for marketers. The average year of experience for producers is 17 years and for marketers is 13 years.

8.2.Existing Market Channel

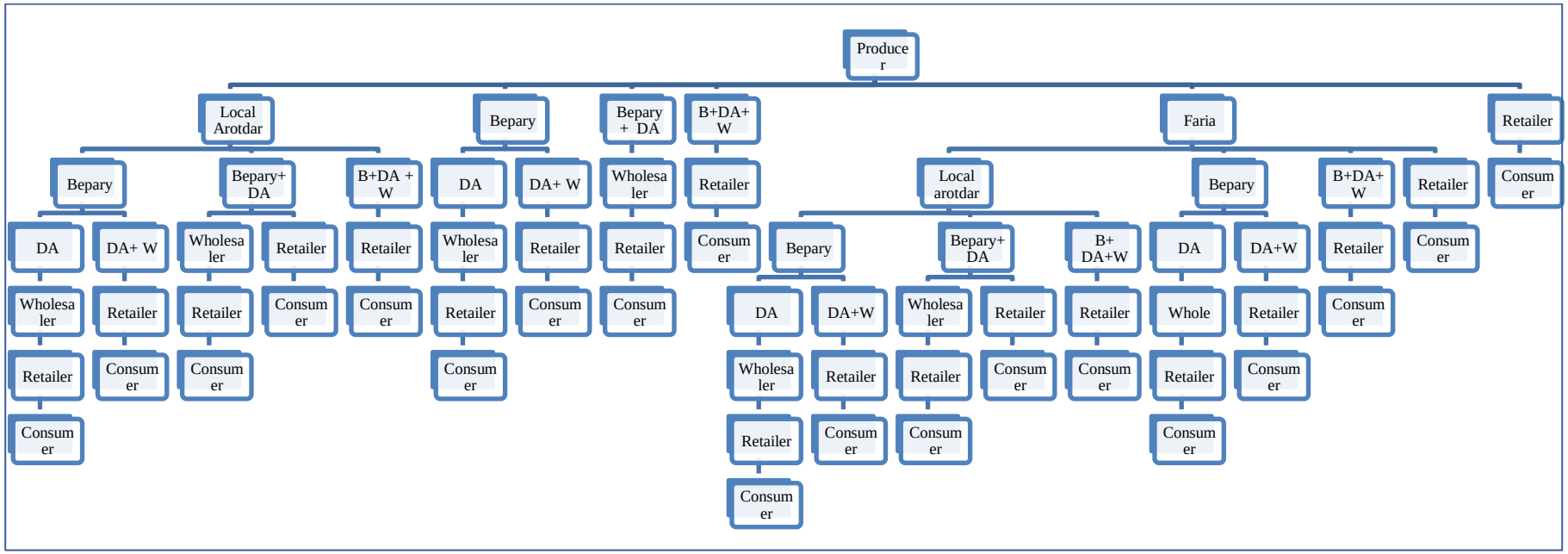
Market channel plays the key role in reaching the produces to the consumers from the producers. Transparent and efficient market channels ensure easy and viable access to safe food. Supply channel consists of all the stages from production to retailing. Different actors identified by different names are active across the channel with similar or dissimilar responsibilities. In this study, supply channel of four items have been observed. The key actors of the channels are producers, local faria, local arotdar, bepary, babshayee, arotdar, wholesaler, faria and retailer. These key players necessarily or unnecessarily act throughout the market channel in different ways and bring the produce to consumer against the received benefits from the channel. The clarification of the term of different players and their role is presented in the annex of the report. Observing the whole supply channel is crucial to identify the problems and prospects of the channel. The supply channel for all the four items of fruits and vegetables of the study are presented below. There is high degree of similarity between the channels of different fruits and vegetables.

Banana: Market channel of banana is mostly captured in the figure below. In our sample the producer of banana sell to bepary, wholesaler, local arotdar, local faria or retailer. There may be occurrence of producer`s directly selling to the consumers. But the sample of this study has been selected in such a manner that producer necessarily participate in market. The minimum bunch of banana sale by the producer is 123 in the sample which is little high. The large scale producers normally try to avoid retail selling. Hence there is no producer to consumer sale in this study and again this study has covered up to retailer but not up to consumer. In some cases after the producer there is another player called as local faria and local arotdar. But the attendance of local faria is not much extensive so this paper discarded this actor or did not pay much attention in this stage. Different banana supply chains are presented below:

1) Producer - Local Arotdar – Bepary - Destination Arotdar (DA) – Wholesaler – Retailer - Consumer

2) Producer - Local Arotdar – Bepary - Destination Arotdar & Wholesaler (DA+W) – Retailer- Consumer
3) Producer - Local Arotdar - Bepary & Destination Arotdar (B+DA) – Wholesaler – Retailer - Consumer
4) Producer - Local Arotdar- Bepary & Destination Arotdar (B+DA) - Retailer- Consumer
5) Producer - Local Arotdar – Bepary & Destination Arotdar & Wholesaler (B+DA+W) - Retailer- Consumer
6) Producer – Bepary – Destination Arotdar (DA) – Wholesaler – Retailer - Consumer
7) Producer - Bepary – Destination Arotdar & Wholesaler (DA+W) – Retailer - Consumer
8) Producer - Bepary & Destination Arotdar (Bepary+DA) – Wholesaler – Retailer - Consumer
9) Producer - Bepary & Destination Arotdar (Bepary+DA) – Retailer – Consumer
10) Producer - Bepary & Destination Arotdar & Wholesaler (Bepary+DA+W) – Retailer – Consumer
11) Producer – Faria - Local Arotdar – Bepary - Destination Arotdar (DA) – Wholesaler – Retailer - Consumer
12) Producer – Faria - Local Arotdar – Bepary - Destination Arotdar & Wholesaler (DA+W) – Retailer- Consumer
13) Producer – Faria - Local Arotdar – Bepary & Destination Arotdar (B+DA) - Wholesaler – Retailer- Consumer
14) Producer – Faria - Local Arotdar – Bepary & Destination Arotdar & Wholesaler (B+DA+W) – Retailer- Consumer
15) Producer – Faria – Bepary - Destination Arotdar + Wholesaler – Retailer - Consumer
16) Producer – Faria – Bepary - Destination Arotdar & Wholesaler (DA+W) - Retailer - Consumer
17) Producer – Faria - Beparty & Destination Arotdar & Wholesaler (B+ DA+W) – Retailer- Consumer
18) Producer – Faria – Retailer - Consumer
19) Producer – Retailer - Consumer

Figure 7: Market Channel of Banana



Source: Author`s presentation from survey data

Pineapple: The market channel for pineapple is highly similar to the market channel of banana. One of the dissimilarities between banana and pineapple channel is that the pineapple producers don't typically sell to retailers. One of the observable reasons behind this is that there is organization of pineapple producers and they sell even bulk amount. In this sample minimum number of pineapples sold by the producers is 3920. That is why they do not typically sell to the retailers. The pineapple producers sell to local arotdar, bepary, wholesaler, arotdar and faria.

The available market channels of pineapple are:

1) Producer - Local Arotdar – Bepary - Destination Arotdar (DA) – Wholesaler – Retailer – Consumer
2) Producer - Local Arotdar – Bepary - Destination Arotdar & Wholesaler (DA+W) – Retailer- Consumer
3) Producer - Local Arotdar - Bepary & Destination Arotdar (B+DA) – Wholesaler – Retailer – Consumer
4) Producer - Local Arotdar- Bepary & Destination Arotdar (B+DA) - Retailer- Consumer
5) Producer - Local Arotdar – Bepary & Destination Arotdar & Wholesaler (B+DA+W) - Retailer- Consumer
6) Producer – Bepary – Destination Arotdar (DA) – Wholesaler – Retailer – Consumer
7) Producer - Bepary – Destination Arotdar & Wholesaler (DA+W) – Retailer – Consumer
8) Producer - Bepary & Destination Arotdar (Bepary+DA) – Wholesaler – Retailer - Consumer
9) Producer - Bepary & Destination Arotdar (Bepary+DA) – Retailer – Consumer
10) Producer - Bepary & Destination Arotdar & Wholesaler (Bepary+DA+W) – Retailer – Consumer
11) Producer – Faria - Local Arotdar – Bepary - Destination Arotdar (DA) – Wholesaler – Retailer – Consumer
12) Producer – Faria - Local Arotdar – Bepary - Destination Arotdar & Wholesaler (DA+W) – Retailer- Consumer

13) Producer – Faria - Local Arotdar – Bepary & Destination Arotdar (B+DA) - Wholesaler – Retailer- Consumer

14) Producer – Faria - Local Arotdar – Bepary & Destination Arotdar & Wholesaler (B+DA+W) – Retailer- Consumer

15) Producer – Faria – Bepary - Destination Arotdar + Wholesaler – Retailer – Consumer

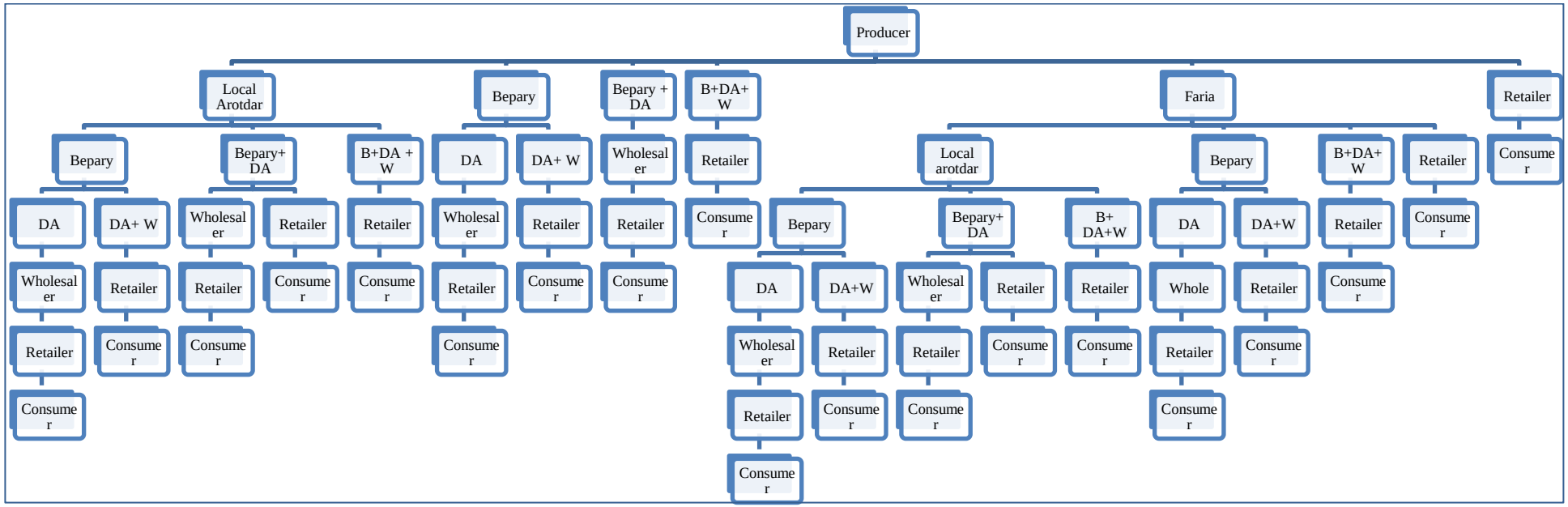
16) Producer – Faria – Bepary - Destination Arotdar & Wholesaler (DA+W) - Retailer - Consumer

17) Producer – Faria - Beparty & Destination Arotdar & Wholesaler (B+ DA+W) – Retailer- Consumer

18) Producer – Faria – Retailer – Consumer

19) Producer – Retailer - Consumer

Figure 8: Market Channel of Pineapple

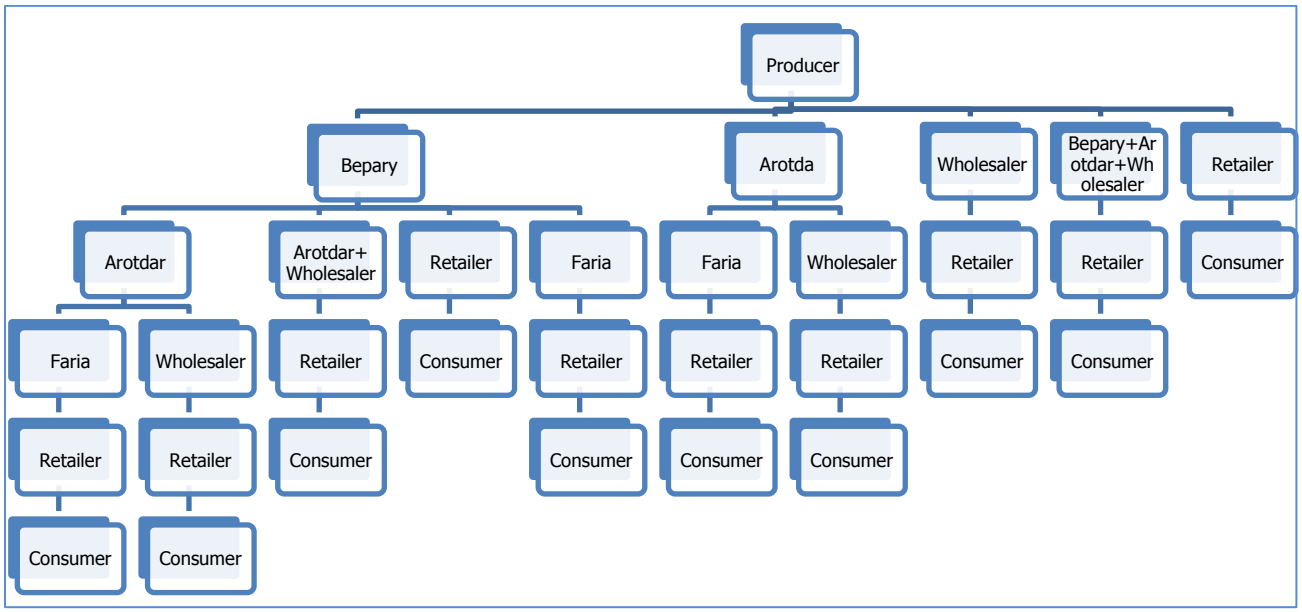


Source: Author`s presentation from survey data

Brinjal: Brinjal, being one of the perishable vegetables, has a substantially perspicuous and simple market channel. There is little scope to keep the produce for more than one day and change hands for many times like fruits. It is the target of the market player to reach the produce to the consumer in the same day of harvesting. This is done so because if the produce is not finished overnight, the produces lose its fresh and original look. So the channels for vegetables are simpler than that of the fruits. However, the channels identified are the following:

i. Producer-Bepary-Arotdar-Faria-Retailer-Consumer
ii. Producer-Bepary- Arotdar-Wholesaler-Retailer-Consumer
iii. Producer-Bepary- Arotdar&Wholesaler-Retailer-Consumer
iv. Producer-Bepary - Faria-Retailer-Consumer
v. Producer-Bepary-Retailer-Consumer
vi. Producer-Arotdar – Faria - Retailer-Consumer
vii. Producer-Arotdar-Wholesaler-Retailer-Consumer
viii. Producer-Wholesaler-Retailer-Consumer
ix. Producer – Bepary&Arotdar&Wholesaler – Retailer – Consumer
x. Producer – Retailer - Consumer

Figure 9: Market Channel of Brinjal (Eggplant)



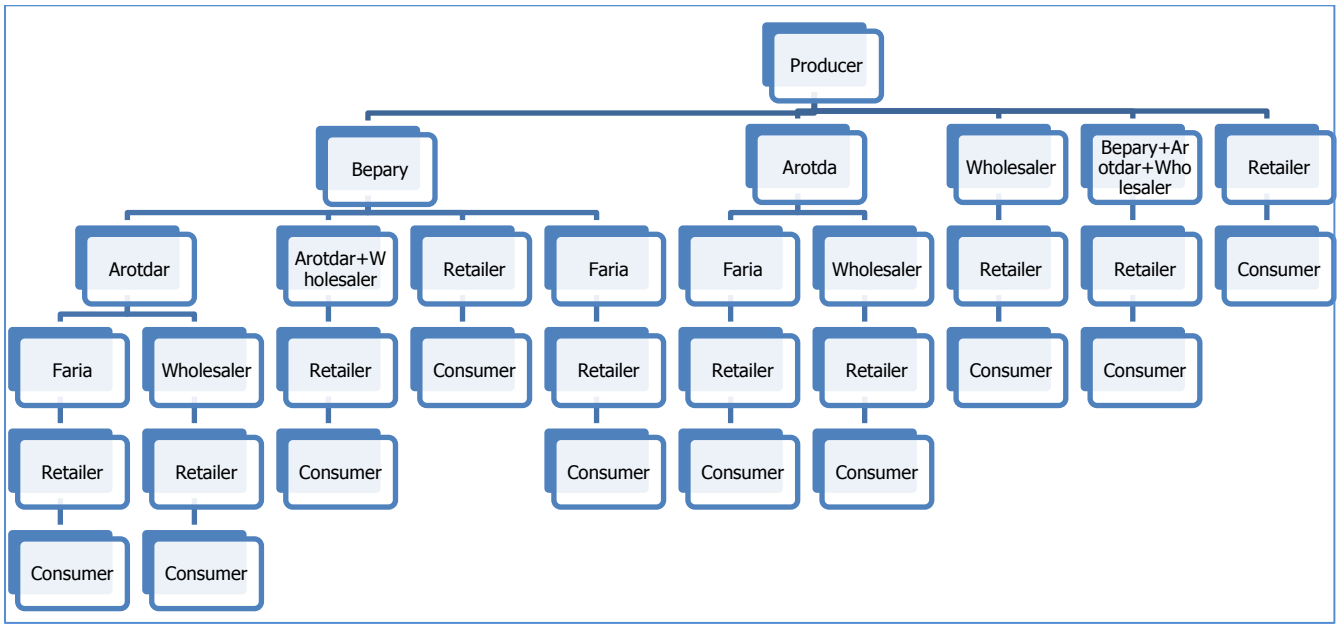
Source: Author`s presentation from survey data

Bitter gourd: Having the same characteristics as brinjal, the bitter gourd market channel is also pretty simple. Since the sample study location is the same for both the vegetable items – brinjal and bitter gourd, and they bear similar features, the market channels for them are found highly similar.

The channels are:

i. Producer-Bepary-Arotdar-Faria-Retailer-Consumer
ii. Producer-Bepary- Arotdar-Wholesaler-Retailer-Consumer
iii. Producer-Bepary- Arotdar&Wholesaler-Retailer-Consumer
iv. Producer-Bepary - Faria-Retailer-Consumer
v. Producer-Bepary-Retailer-Consumer
vi. Producer-Arotdar – Faria - Retailer-Consumer
vii. Producer-Arotdar-Wholesaler-Retailer-Consumer
viii. Producer-Wholesaler-Retailer-Consumer
ix. Producer – Bepary&Arotdar&Wholesaler – Retailer – Consumer
x. Producer – Retailer - Consumer

Figure 10: Market Channel of Bitter gourd



Source: Author`s presentation from survey data

8.3.Capacity and Performance of the Channel Participant

To assess the capacity of the market participants, total cultivable land, land for cultivating the sample items and the total volume of marketing produce have been taken for producers. Similarly, from marketer side, total amount of items marketed have been considered. The intermediary or marketers are not involved in the production activities. Even if the marketers are involved in the production activities, the study does not consider the multiple roles of one individual. That is why for marketer this study considers only the amount of produce they deal with for marketing purpose. This data would help to identify the type of channel participant and the extent of benefit they reap from the channel. The capacity of participant is presented in Table 5.

Producers` capacity is found higher than the capacity of marketers in this study. Average sale of banana by each producer is 1795 bunches and for each market 164 bunches. On the other hand, average sale of pineapple is 29191 and 5600 pieces per producer and marketer respectively. Producers sell 5918 kg brinjal and marketer 1659 kg on average. In case of bitter gourd, average sale by producer is 1366 kg and by marketer is 697 kg. The reason behind higher average capacity of producer is that the agricultural production is location specific. Therefore, in any specific area those who involved in production of any item produce much intensively and seasonally. On the other hand, marketers were taken from different stages of the channel which shows higher number of marketer and lower average capacity.

Table 4: Capacity of the Channel Participant

Items		Indicators	Mean	Std. Dev.	Min	Max
Banana	Producer	Total land cultivation (decim)	445.93	520.30	60	1980
		Banana cultivation (decim)	183.2	164.86	13	750
		Amount of sale (bunch)	1795	1755	123	6500
	Marketer	Total marketing (bunch)	164.17	199.82	1.5	700
Pineapple	Producer	Total land cultivation (decim)	354.2	364.75	30	1568
		Pine apple cultivation (decim)	265.47	317.98	20	1568
		Amount of sale (piece)	29191	37763	3920	164640
	Marketer	Total marketing (piece)	5600.92	5723.47	50	19000
Brinjal	Producer	Total land cultivation (decim)	106.97	73.30	20	350
		Brinjal cultivation (decim)	32	16	15	70
		Amount of sale (kg)	5918.50	2983	1200	12200
	Marketer	Total marketing (kg)	1659.73	2434.98	5	10000
Bitter gourd	Producer	Total land cultivation (decim)	159.86	95.25	30	378
		Bitter gourd cultivation (decim)	36.96	27	14	158
		Amount of sale (kg)	1366.69	766.78	595	3600
	Marketer	Total marketing (kg)	697.24	917.55	10	4000

Source: Author`s calculation from survey data

Performance is mainly measured by the level of profit. It is expected that the higher the capacity the larger would be the profit level. To understand the performance, unit profit margin is presented along with total profit in the table for both producer and marketer. For all the items except pineapple, total profit is higher for the producer as their capacity is higher. At the same time, average unit profit is also higher for producers. The unit profit of producer is higher for two reasons- the cost of producer might be low and the time cost of producer is not considered. The marketer deals only for single day or a few days but the producer for a few months even year.

Table 5: Performance of the Channel Participant

Items	Participants	Indicators	Mean	Std. Dev.	Min	Max
Banana	Producer	Total profit (tk)	125028	150941	6700	522500
		Unit profit	76.72	36.20	25	220.83
	Marketer	Total profit (tk)	5680	8630.87	80	38880
		Unit profit (tk/bunch)	58.02	50.82	1.44	207.90
Pineapple	Producer	Total profit (tk)	17626	294790	35800	1120000
		Unit profit	9.56	3.20	4.80	15.60
	Marketer	Total profit (tk)	22442	29288	110	163400
		Unit profit (tk/piece)	3.70	3.30	.20	15.17
Brinjal	Producer	Total profit (tk)	22574	21611	2100	96000
		Unit profit (tk)	4	1.79	.88	9.21
	Marketer	Total profit (tk)	2883	4450	14	19420
		Unit profit (tk/kg)	3.20	2.83	.44	12.89
Bitter gourd	Producer	Total profit (tk)	9725.69	9156.18	425	38000
		Unit profit (tk)	8.06	3.63	.47	14.98
	Marketer	Total profit (tk)	1092	1780	26	9733
		Unit profit (tk/kg)	2.43	1.93	.26	7.4
Total (195)	Producer	Total profit (tk)	100910	189724	425	1120000
	Marketer	Total profit (tk)	6826	16673	14	163400

Source: Author`s calculation from survey data

8.4.Seller-Buyer Connection

To understand the extent of formal or professional performance, it was inquired how the buyers and sellers come in contact with each other, and whether there is any professional linkage between these two parties. The process of this buyer-seller contact determines the performance and degree of benefit. Six options were identified in this study on how a seller finds a buyer. These include prior contact between them, through the local broker known as dalal, automatically managed, buyer come to field, buyer wait on the way of market, and anywhere and anyhow suitable can be managed. The response presented on table 7, shows that prior contact is lower for producer than that of the marketer for all the items. The reported rate of broker settlement is very high for producers but negligible for the marketer. The response in favour of

auto managed is excessively high for marketer but negligible for the producers. The way of coming into of each other –with the buyer and seller, is highly important. This manifests scenario of low market handling capability of the producers than the marketer. The marketer has the higher prior contact rate with buyer and seller, which reduces the loss of marketer but producers are far behind this way of contact. Producers come mostly in contact through broker than the marketer. The producers have to bear lower benefit due to profit share of broker. In market contact, the producer is behind the marketer in respect of communication.

Table 6: Form of Buyer-Seller Connection (%)

Items	Stakeholder	Pre contact	Through broker	Auto managed	House/ field	On the way of market	Anywhere suitable
Banana	Producer	3.33	33.33	13.33	53.33	36.67	0
	Marketer	20.83	6.25	70.83	0	2.08	0
Pineapple	Producer	16.67	50	13.33	3.33	36.67	0
	Marketer	18.37	4.08	83.67	0	0	0
Brinjal	Producer	0	3.33	0	83.3	93.3	0
	Marketer	14.29	0	85.71	0	0	0
Bitter gourd	Producer	0	3.44	6.90	0	86.20	3.40
	Marketer	6.12	0	89.80	0	0	0

Source: Author`s calculation from survey data

8.5.Quality Market Participation

Man can do all the work more or less but the professionals do the job more efficiently than the non-professionals. From this point it was asked whether the respondent is professional or non-professional producer/marketer, and whether this work is their main means of livelihood. The sample population of this study is mostly found professional vegetables and fruits market channel participants.

Professional training invigorates the efficiency of performance. Food safety is mostly a supply chain issue specially the concentrated segment of this study. Training to the professional would shed light on the safety issue and of course the quality participation. Keeping these in mind it was asked whether the respondents have received any professional training or any type of training ever related to the market/supply channel. Nearly cent percent of the respondents don't have any professional or any type of training in their whole life. It is seen that the fruits and vegetables market channel participants are mainly professional though never received any professional training.

Table 7: Professional Quality Determinants of the Stakeholders (%)

Items & Stakeholders		Training	Occupation
Banana	Producer	0	100
	Marketer	0	96
Pineapple	Producer	13	100
	Marketer	0	96
Brinjal	Producer	7	100
	Marketer	0	96
Bitter gourd	Producer	3	100
	Marketer	2	100
Combined	Producer	6	100
	Marketer	0.5	97

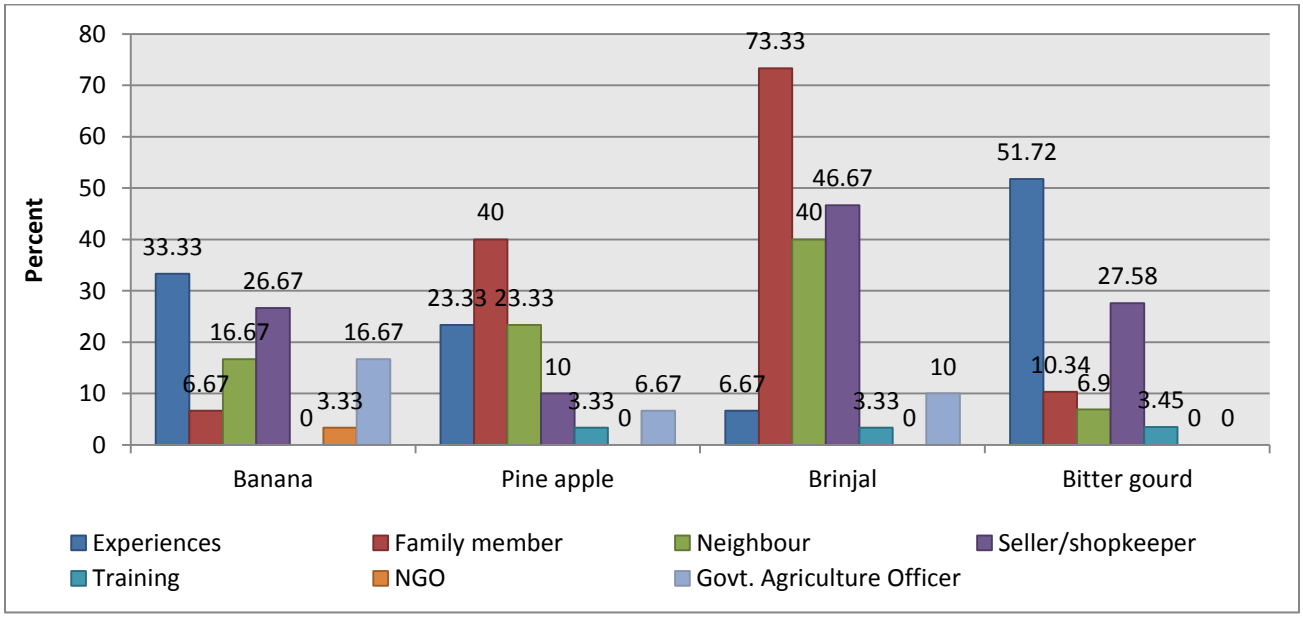
Source: Author`s calculation from survey data

8.6.Knowledge Development

It is one of the assumptions of this study that an acceptable level of chemical material used for production level to increase the production and reduce the spoilage is not harmful. But concern is which material is used, how those are used and who guide the user to maintain the acceptable level. From this concern it was asked how the producer knows the user guide of the material and what is their source of knowledge. Seven options were given them to find out their source of

knowledge about the use of different risky material in production level. The response result is presented in figure 11. For banana, 33 percent producers report that experience is their source of knowledge about the use of risky material in production level. Seller/ shopkeeper of the material is source of knowledge for 26 percent producer and neighbor is for 16 percent. The seller of the material does not have any institutional back up or formal authorization in most cases and the neighbor of the respondent is possess similar educational qualification. In total, 20 percent respondent`s sources of professional knowledge are formal such as Training, NGO, and government agricultural officer. In case of pineapple production, nearly all the knowledge comes from experience, family member and neighbors where 20 percent`s source is training, NGO and government agricultural officer. For brinjal major sources of knowledge of the respondents include family member, neighbor and seller, and for bitter gourd this is for experience of the seller. General observation from the survey is the source of knowledge of risky material use is hardly institutional or formal. The response result about the risky material use is presented in Figure 11.

Figure 11: Source of Knowledge about the Use of Risky Materials in Production (%)



Source: Author`s calculation from survey data

8.7.Market Information

Information is considered as an important asset. At the present time accessing information is easy because of the development of different types of media for communication. Extent of access to information and the availability of the sources have critical role in the market channel. It was asked how the players get information about the state of market. Television, radio, newspaper, internet and other formal media have very negligible role in this case both for producer and marketer. The source of information predominantly is own observation both for producer and marketer but larger for marketer. Gathering information from other persons is higher for producers than the marketers. This indicates the producers` limited use of dependable and reliable information sources. Considering all other sources alongside the above it appears that producers lag behind the marketer for information sources. Table 9 presents data on the use of information sources by types of market players.

Table 8: Sources of Market Information (%)

Items	Stakeholder	Radio, TV, Newspaper, Internet	Own observation	Other people	Attending market	With whom transaction have	Phone contact	Don't get information
Banana	Producer	0	56.67	30	46.67	0	13.33	0
	Marketer	0	66.67	4.17	35.42	10.42	6.25	0
Pineapple	Producer	0	43.33	13.33	66.67	6.67	3.33	3.33
	Marketer	2.04	67.35	4.08	14.29	12.24	10.20	8.16
Brinjal	Producer	0	46.67	15	56.67	10	0	0
	Marketer	0	85.71	10.20	36.73	8.16	6.12	0
Bitter gourd	Producer	0	33.33	41.40	34.50	6.90	6.90	0
	Marketer	0	63.26	16.33	28.60	16.33	8.16	0

Source: Author`s calculation from survey data

8.8.Supply Chain Efficiency

The efficiency throughout the supply chain is one of the foremost determinants of safe fruits and vegetables supply. Therefore efficiency in supply chain gained the importance in this study. Under supply chain efficiency, the study made an attempt to examine the losses in different stages of the supply chain along with the share of profit for different stakeholders. In an efficient supply chain, incurred loss in different stages should be minimum and every participant will make profit according to their contribution in the channel. This will result in elimination of the commission takers from the channel.

8.8.1. Loss in different stages

It is highly expected that efficient supply chain will lower the loss in the chain (FAO 2011; Lipinski et al. 2013; Parfitt, Barthel and Macnaughton 2010). Efficiency in agricultural supply channel may have multifaceted dimensions. In this study, both production and market stages of the channel have been considered. There are several reasons behind losses at the production and marketing levels. At the production level, the loss occurs mainly due to attack by insects, pests, and animal, climatic variation, inefficient and improper care and application of treatment material. At the market level, the main causes of loss are spoilage for colossal amount of transportation, sales delay, disturbed market transaction because of natural and political hazards. Except for pineapple, the study shows that losses are lower at the marketing level compared to the losses at the production level. In the case of Pineapple the reasons for higher losses at the production level include high degree of unsafety practices – legally or illegally. At the marketing level fraudulent acts like cheating the customers are practiced for making extra profit. Adoption of supportive measures at the production level and regulatory measures at the market level could contribute to significantly reduce unsafe consumption of fruits and vegetables.

Table 9: Average Loss Total Sale in Different Stages (%)

Stakeholders	Indicator	Banana	Pineapple	Brinjal	Bitter gourd	Total
Producer (30)	***Loss (%)***	***12.24(30)***	***4.57(30)***	***12.12(30)***	***13.35(29)***	***10.55 (119)***
	Std. Dev.	10.81	4.68	10.08	7.73	9.25
Faria	***Loss (%)***	***2.8 (5)***	***6.23(5)***	***12.5(1)***	***0.27 (3)***	***4.18 (14)***
	Std. Dev.	2.14	7.39	..	0.46	5.43
Bepari	***Loss (%)***	***4.95 (10)***	***10.90 (10)***	***4.85(15)***	***8.03 (10)***	***6.92 (45)***
	Std. Dev.	3.60	5.45	2.71	3.07	4.39
Arotdar	***Loss (%)***	***3.61 (6)***	***10.37 (9)***	***3.12 (5)***	***6.08 (5)***	***6.44 (25)***
	Std. Dev.	2.57	12.24	1.66	5.33	8.16
Wholesaler	***Loss (%)***	***6.15 (11)***	***9.43 (10)***	***6.25 (10)***	***8.74(11)***	***7.63 (42)***
	Std. Dev.	3.98	4.42	2.70	6.42	4.69
Retailer	***Loss (%)***	***4.26 (16)***	***7.14 (15)***	***9.05(18)***	***8.97 (20)***	***7.50 (69)***
	Std. Dev.	3.92	5.93	5.66	5.06	5.44
Total (marketer)	***Loss (%)***	***4.60 (48)***	***8.87 (49)***	***6.65 (49)***	***7.90 (49)***	***7.02 (195)***
	Std. Dev.	3.59	7.21	4.51	5.24	5.51

Observation in parenthesis

Source: Author`s calculation from survey data

8.8.2. Share of profit margin

Cost, benefit and profit are some of the indicators of any economic activity. Profit is derived from cost and benefit analysis. Hence profit is mainly taken as an indicator of performance in this case. The producers are the core participants in the supply channel. They invest money, labour, and time in real term. The marketer in many cases invests little or no money, a little labour and time. They take the benefit as intermediary or middle men. Market has contribution to reach the produce from producer to ultimate consumer. But their amount of contribution and investment need to be judged comparing with the producers. It is also a matter of justification how many stages are needed in the market channel after producer. If we consider only the production cost and final sale price, total profit in the channel is found where no marketer cost is involved. Total profit of the market channel is distributed among the players of the channel according to their investment, contribution and highly by level of channel exploitation. Considering this profit level for four items of fruits and vegetables, it is seen that maximum share is distributed among the marketers. When we compare the share of profit margin, the

substantial amount is distributed at different stages of marketing. Share of producer is very little. The study reveals that the share of producer benefit or profit is 16 percent for banana, 54 percent for pineapple, 19 percent for banana and 68 percent for bitter gourd. The remaining portion of profit goes to the marketers in different stages. The share of producer profit is high for pineapple. There is a noteworthy reason behind this. In sample region, colossal amount of pineapple is produced and there is producer organization. Hence the producer can take part in the bargaining in an organized way and can influence the market. Existence of producer organization helps producers make higher profits from the market channel of pineapple. In case of fruits the market channel is much complex and there are many players in the channel. This take time and distance cost and give the opportunity to intermediary to take much benefit. Brinal is highly produced in Narsingdi district and there is no way to control the market by producer so they have to take lower market benefit. Bitter gourd is produced in larger amount but not like as brinjal. There is higher demand for bitter gourd and the channel is simple that give the producer opportunity to make a little more profit.

Table 10: Profit Share between Producer and Marketer

Items	Unit	Total profit	Producer	Marketer
Banana	Per bunch	488.80	76.72	412.08
	%	100	15.70	84.3
Pineapple	Per piece	17.58	9.56	8.02
	%	100	54.36	45.64
Brinjal	Per Kg	21.60	4.07	17.53
	%	100	18.84	81.16
Bitter gourd	Per Kg	13	8	5
	%	100	62	38

Source: Author`s calculation from survey data

9. Food Safety

Now, concern is food safety in the backdrop of causes and consequences. Information gap is the major cause that prevents the fruits and vegetables market to be competitive with safe food provision. Information gap is followed by structure of supply chain, capacity and quality of

supply chain participants. Limited scope of the chain facilities and the potential low level of profit provide disincentive towards the supply of safe fruits and vegetables. Following the above mentioned causes, certain factors emerged which mainly contribute to potential food hazards. The factors include improper agricultural practices, poor hygiene at all stages of the food chain, lack of quality control measures in food processing operations; misuse of chemicals, contaminated raw materials, ingredients and water; inadequate or improper storage, etc. (FAO & WHO 1997). As this study does not include the food processing sector, rather only market channel of raw fruits and vegetables, it only considers the agricultural practices and misuse of chemicals and contaminated raw materials. The unsafetyness issue arising from natural sources is not the concern of the study but the human contributed sources are. The main focus of this study is the supply channel - from the production to the retail level. For a comprehensive supply chain, a general look was given to the production practices. The structured questionnaire cannot reveal the actual unsafe practices both in production and market level, as stakeholders are afraid of regulatory body. But actual situation was captured in researcher and surveyors` observation, retrieved by informal discussion and key informants` interviews. Using the tools mentioned, it has been found that the vegetables are mostly vulnerable in the production level and fruits are vulnerable in both production and the marketing level of the supply chain.

9.1.Agricultural Practices

In the supply chain, the unsafety practices begin at the production field of the fruits and vegetables. It may go further back to seed level and so on, which is beyond the scope of the current study. It is assumed that unauthorized practices are the sources of danger, not the authorized. Again authorized practices may be revised over time depending on the outcome of the previous application, for example integrated pest management (IPM) instead of pesticide, *vermi* compost instead of chemical fertilizer. This is another research issue whether the existing authorized practices should be settled, resettled and revised, or not. However, the scope of this study is to reveal whether the existing authorized practices are followed properly.

About 100 kinds of chemicals, including 'ripen, tomtom, denofix, superfix', are being used in pineapples for different purposes Hormone is used to get the size bigger, carbide for ripening and formalin for preservation of pineapple. Pineapple can be harvested in other season by using hormone spray. Growth hormone is used to attract the consumers, carbide and formalin to prevent the pineapple produces from being rotten for 10 to 15 days after harvesting. Various types of risky materials are used in vegetables to secure size, prevent disease, death of plant and so many. Farmers are not aware of those materials. The chemical companies also apply marketing policy to the uneducated and ignorant farmers to use chemicals. Proper application requires adequate knowledge about the application process which is developed through education, training and experience, consciousness and carefulness. The education, training and experience background of the farmers of Bangladesh has been found quite depressing that is reported in the previous section. To validate the previous observation, questions were asked whether farmer sell the fruits and vegetables pre-matured, over matured or in just time; whether they know the proper system of applying fertilizer, insecticide, hormone (for fruits only); whether they have ever tried not to use any of the risky items. The findings are presented in the following table.

Table 11: Indicators of Good Agricultural Practices (%)

Indicators	Banana	Pineapples	Brinjal	Bitter gourd
Just time sale	100	97	100	100
Know system of fertilizer use	90	93	100	79
Know system of insecticide use	83	30	97	79
Know system of hormone use	90	93	----	---
Follow system of fertilizer use	97	93	97	67
Follow system of insecticide use	93	93	97	66
Follow system of hormone use	93	93	----	----
Ever tried to not use the above materials	23	33	3	3

Source: Author`s calculation from survey data

Mostly the respondents think that they are conversant with the rule of use of the material though not tried these materials yet. When sources of knowledge about the rule of use were asked, they failed to provide consistent and reliable information.

9.2.Harmful Preservative Use

One of the main sources of threat to provision of safe food is unethical use of harmful chemicals in the food items as preservatives. It falls under criminal act as there is no safety standard. It is difficult to reveal the type of food adulteration through any empirical and standard survey research. This current research has made an effort to reveal the type of food adulteration taking place in the country. In the questionnaire, there was a question to the producers whether they need to use any preservative to keep the food fresh in between production and sale, and to marketer in between buy and sale. From the producers' side, there was only one 'yes' for pineapple among a total of 119 sample producers for the four food items considered under the study. In case of marketers, there were 7 responses as 'yes' out of the 195 sample responses - 5 for bananas and 2 for pine apples. From the survey and close look into the market channel it is observed that the market level of vegetables supply chain is not vulnerable but the fruits are. Vegetables are vulnerable in production stage but the fruits are vulnerable in both production and market level.

9.3.Safe Transport

For transportation purpose, there is hardly any unsafe practice in the considered fruits and vegetables supply chain. But unsafetyness issue at the transportation level arises from other perspectives. Two types of problems are observed in the supply chain - unfair practices of policeman, smuggling and the like, and poor infrastructure facilities e.g., roads, and market condition. In political turmoil period, problems were disruption in the entire supply chain. All these raise the cost of supply and result in rise in the price level. The stakeholders of market channel do not expect any profit while transporting from anyone but they want smooth transportation facilities to supply the fresh and safe fruits and vegetables. To facilitate the

smooth supply of fruits and vegetables and to attract the good supply chain entrepreneurs, it is imperative that transportation system is smooth and meet the required quality criteria.

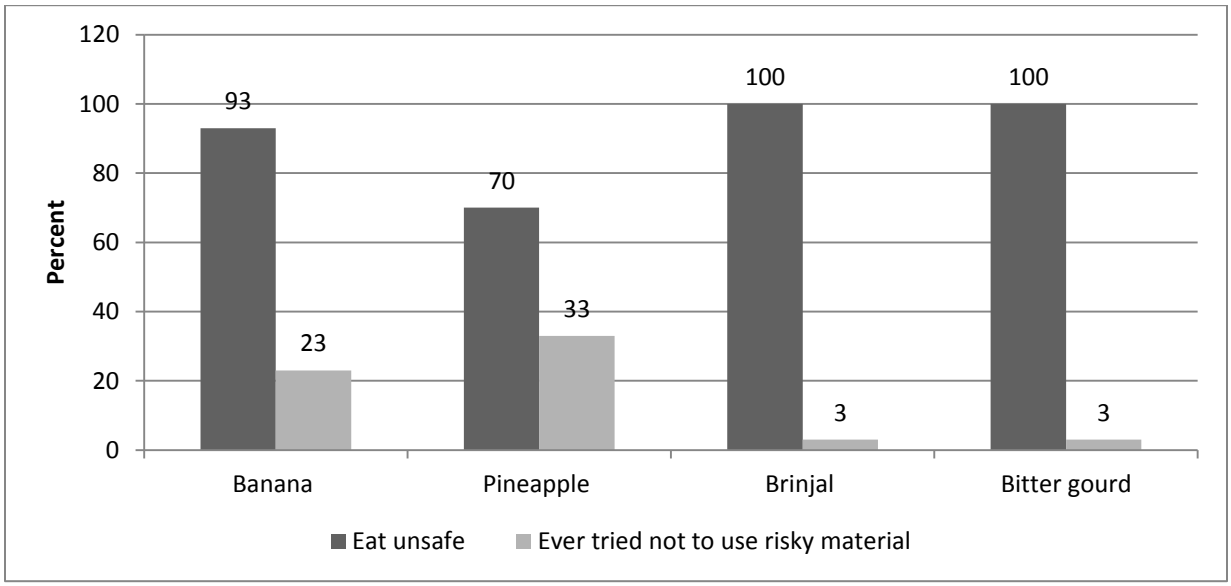
9.4.Awareness and Knowledge

The producers are not even sure whether the materials they use are safe or unsafe due to the lack of education, appropriate training and any campaign for those. However, they think the materials they use are mostly safe and they are following proper rules of use. Special attention immediately required to address these critical issues and come up with safe practices.

Producers are not aware of the risky materials they use or their effectiveness in production. Even they do not know the name of those materials. They sometimes go to the shopkeeper or seller of the materials, or neighbours and tell about the problem, take their suggestions and use in the field. Vegetables are highly pest affected items. The producers extensively use pesticides without knowing the serious health hazards caused by these even for the users.

It is important to know whether the producers are aware of the negative health implications of these harmful materials on the consumers to assess the level of consciousness and extent of fraudulence. The growers of all items consume what they produce. It is found that level of consumption by the producers of the risky produces is significantly low for pineapple than the other items. Many of the pineapple producers are ignorant of using the unsafe materials in production level but they are compelled to use those materials to remain competitive in the market. The bitter gourd and brinjal producers are mostly not that much concerned about the use of unsafe materials. They think what is destined to luck will happen in many cases. They need to survive and if the food items are washed out the unsafe materials will not do any harm. It was asked whether the producers ever tried not to use those materials. The findings suggest that majority of the vegetables producers never try to produce without using the risky materials and the fruits producer though tried but very insignificantly. Figure 12 depicts the summary of the responses to this question.

Figure12: Consumption and Effort towards Risky Materials



Source: Author`s calculation from survey data

9.5.Monitoring and Regulation

To ensure safe fruits and vegetables provision, monitoring and supervision along with strict regulatory rules are overridingly important. There are fraudulence practices right through the supply chain especially for fruits items. Supervisory rule would provide cautionary signals to the market participants about their practices, and monitoring and regulation would override the fraudulence practices. Enactment of rules and regulations bring all the practices and authoritative rules into a formal framework. There is hardly any monitoring in the supply channel. There is 10 percent response for having monitoring in the production level and 9 percent in the marketing level. No monitoring is done for the standard use of pesticide and others. Although there are few rules and standard guide (e.g., krishi projukti hat boi), there is basically no implementation of those. Sometimes though steps for enforcement are seen these are not at all regular.

10. Discussion

Issues revealed by the current study relating to the market chain for safe fruits and vegetables include unsafe agricultural practices, fraudulence practices in the market channel, intermediary controlled market channel, lower producer benefit from the market channel. Inefficiency and unsafe practices are critical issues in field, in harvesting, in marketing. Numerous factors contribute to these unexpected outcomes. Unsafetyness at the local levels arise from agricultural practices but in the urban markets, addition of stages adds to the unsafetyness issue further.

In market level, the technology is not so developed. The fruits are kept fresh using unsafe materials but there are no available alternatives to keep those fresh for few days. Vegetables cannot be kept for a few days even unsafe materials are used. Vegetables are daily handling items that must be sold out within the same day. If there were any opportunity to keep fruits and vegetables fresh for few more time, it would be easy for producers and marketers to supply without spoilage loss. Availability of safe technology and facility to keep produce fresh and safe is a challenge in the fruits and vegetables supply channel.

Fruits are used in processing industry in some cases but hardly any vegetables. Again fruits are more durable than the vegetables. Fruits processing industry plays good role in providing processed fruits. But fresh fruits also supplied late after harvest using the preservative and such chemicals. If good storage system was developed fresh produce could be supplied without creating much health hazard.

Education, training, profession, experience, consciousness are the keys to the quality performance. Educational and training background of the sample population is quite depressing. Professionalism, experience, consciousness are built on education and training. Without education and training the professional experience may stand on wrong doing. Consciousness also grows on education, training, environment, intrinsic value judgment. Henceforth, quality market performance is challenged by the lack of intertwined quality developed with professional experience.

Existing market channels are posing challenges to supplying safe fruits and vegetables. The market channel for the fruits is complex. There are several channels through which the produces

reach consumers. There is scope to justify whether these so many stages and participants are needed to supply the items without disturbance of the safe fruits and vegetables provisions. All the stakeholders secure their profit from the market channel. With so many stages and so many stakeholders total profits are divided among them and the ultimate consumers have to pay more. Again the producers, who invest actually the highest, can secure a little portion of the total profit and consumer payment. Review of the existing supply chain is urgent to devise a few rewarding supply chain.

It is not recommended to ban the pesticide and all the elements used in production and distribution channels of fruits and vegetables, but to identify the harmless materials, define the standard level of use, and to ensure proper application of these materials is critical. Banning of pesticide can affect the fruits and vegetables cosmetic appearance; limit the distance fresh produce can be shipped to market; raise costs for users switching from the banned pesticides; reduce income for producers in certain regions; and reduce yields and storability, thereby increasing food costs (Buzby and Skees, 1994).

Fruits and vegetables become unsafe for various reasons among which human contributed sources are agricultural practices, unauthorized material mix and careless handling. These are basically caused by to the rapacious behavior of stakeholders, lack of appropriate rules and regulations, and regular monitoring and supervision by the relevant authority. Training facility, awareness building campaign, smooth and quality transportation facilities, monitoring and regulatory rules are critical for ensuring supply of safe fruits and vegetables. Causes behind not accepting the already available method (e.g., IPM) are time cost, competitive pressure, consumer demand, information, monitoring, limited access to available resources, and knowledge and conscious level. Reducing qualitative loss by practicing safety along with the reduction in quantitative loss will provide increased nutritional value in those food items.

In brief, the challenges of supplying safe fruits and vegetables through the market channel are mainly lack of symmetric information about product quality, controlling market by intermediary, lack of education, training, knowledge, awareness, lack of formal communication between buyers and sellers.

Invisibility of quality and safety characteristics of fruits and vegetables is one of the main challenges of safe provision. The characteristic of the produce is not possible to change or interfere in at least in short term. What can be done is to make the information available to the consumers. Steps should be taken to provide the symmetric information to the controllers and the users of the channel. Market channel is controlled by the intermediaries in various stages who reap the major benefits from the channel with minimum effort. The quality of channel participants and available facilities are also the challenges in the channel. The communication factors like information, performance factors like training, education are predominantly informal than institutional or formal in fruits and vegetables supply channel in Bangladesh. Providing information and technical assistance are important to the producers and the marketers. The socioeconomic factors that cause post-harvest losses include inadequate marketing system, inadequate transport facilities, government regulations and legislations, unavailability of needed tools and equipment, lack of information (Kader 2005). These factors are similarly influential in the safe fruits and vegetables supply channel.

11. Conclusions and Recommendations

Three broad things might be supportive to make sure an acceptable level of food safety: determining a minimum level of food safety for all, disclosing all information concerning the pattern of safety and justifying the consumers` willingness to pay for safe food non-linearly. First one is for supply side initiative, second one is for both side initiative to make the market comfortable for the suppliers and the demanders, and the third one is for demand side initiative. Here the primary concern is the first one that is, ensuring minimum level of safe food for all and supplementary concern is the second one - making information easily accessible to all. Based on the findings of research result on these two concerns, some recommendations have been drawn.

There should not be so many players in the supply chain who will fight for reaping the maximum portion of the benefits. Producer-one or two intermediary- retailer is sufficient to run the whole supply channel. There should be clarified responsibility of the entire safe food supply chain and the participants of the chain should share the responsibilities. When producers become strong

market participants, activities of some of the commission takers like faria, local arotdar, broker (dalal) will be abolished. Training, financial support to the producers, local cooperatives can provide necessary support in this regard.

Producers should be more communicative and organized. Producer organizations can empower the producers and make sure their benefits are properly reaped. When producers will be assured of their benefits, it will motivate them to behave in a society-friendly way. Again message to producer will be easily reached at producer when they are organized and connected. If producers can come forward with their capacity and there is improvement in the capacity of producer organization, the marketer lead channel would be converted into producer lead channel.

Safety branding is the demand of the present time. Talented young brains will come forward with sustainable safety concept to handle the agricultural food market chain in Bangladesh. Food safety practices not only bring the benefits to the consumers and the society it will also benefit the producers in terms of reliability, trust, efficiency, sustainability etc. Proper marketing facilities, processing centre and cold storage facilities could empower the producers and attract the potential safety branders. Technology and storage facility should be developed regarding this matter. Policy should be taken providing the incentives for organic branding.

Inclusive agro business-compliance involves quality and safety assurance, brand development, product niche definition and shifts in the chain coordination. In brief, changing the way farmers are doing business. Therefore, inclusive agricultural business will be one of the ways to resolve this agricultural food tension.

There is growing concern about pesticide and efforts are being made to find safe and environment friendly pest control methods. Messages should be targeted toward changing behavior and the rules should be stricter and if needed new rules should be imposed in this regard.

Illegal practice of collecting tolls by the musclemen and traffic police has to be strictly dealt with to provide smooth and tension free environment of supplying fruits and vegetables.

After satisfying a minimum level of safety standard for all groups of consumers, information about the materials and level of risk for using those materials should be made available that the consumers can apply their choice and judgment. Consumer preference will be reflected in market mechanism after assuring a minimum level.

In Bangladesh discrete monitoring is done to check food adulterations, but there is no provision to monitor the fruits and vegetables for pesticide use. And the monitoring does not also take place in a continuous manner. Even if there are some rules of use of the risky elements, farmers are not well introduced with those rules.

Finally, appropriate measure taken by the government to prevent unethical use of hazardous materials, awareness of the key players involved at all levels of the supply chain and continued pressure from the active and legit civil society groups can be quite instrumental in dealing with the situation which become a serious concern for the current and the future generations to come.

References

Akter, S., Islam, M. S. and Rahman, M. S. (2011). An economic analysis of winter vegetables production in some selected areas of Narsingdi district, *J. Bangladesh Agril. Univ*. Vol. 9 (2), pp. 241–246.

Alinia, S., Hels, O. and Tetens, I. (2009). The potential association between fruit intake and body weight – a review, *Obesity Reviews*, Vol.10 (6), pp. 639–647.

Anonymous, (1998). Ensuring Safe Food: From Production to Consumption. National Academy Press, Washington DC, 206 pp. retrieved on 11 July 2014 from: http://www.nap.edu/catalog.php?record_id=6163

BBS. (2011). 2010-2011 statistics of 2011 Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

BBS. (2011). Preliminary Report on the Household Income and Expenditure Survey (HIES) 2010, Dhaka: Bangladesh Bureau of Statistics (BBS), Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

Buzby J.C. and Skees J.R., (1994). Consumers Want Reduced Exposure to Pesticides on Food. *Food Review, the magazine of food economics*, May-August 1994, p. 19-22. U.S.D.A., Economic Research Service.

Crutchfield, Stephen R and Allshouse, Jane. (1998). The Economics of Improving Food Safety. Increasing Understanding of Public Problems and Policies Proceedings of the 1998 National Public Policy Education Conference, Clackamas, Oregon, September 20-23, 1998, pp. 53-64. Retrieved on 12 July 2014 from: http://107.1.34.163/news/articlefiles/38-98nppec.pdf#page=65

FAO. (2010). Improving Food Safety, Quality and Food controlling Bangladesh, Report - Seminar on Food Safety Challenges in Bangladesh, Food and Agriculture Organization of the United Nations. Retrieved on 21 July 2014 from:

http://bdfoodsafety.org/admin/uploadimg/Food%20Safety%20Seminar%20Report-31%20May%202010%20FINAL.pdf

FAO & WHO. (1997). Assuring Food Safety and Quality: Guidelines For Strengthening National Food Control Systems. Food and Agricultural Organization and World Health Organization, Joint FAO/WHO Publication. Retrieved on 15 July 2014 from: http://www.who.int/foodsafety/publications/capacity/en/Englsih_Guidelines_Food_control.pdf

FAO. (2011). Global food losses and food waste – Extent, causes and prevention. Rome. Retrieved on 27 August 2014 from: http://www.fao.org/docrep/014/mb060e/mb060e.pdf

NFPCSP. (2012). Strengthen diversification to further improve food and nutrition security, FPMU food security policy brief December 2012, National Food Policy Capacity Strengthening Programme, Retrieved on 3 September 2014 from: http://www.nfpcsp.org/agridrupal/content/strengthen-diversification-fns

Grunert, Klaus G. (2005). Food quality and safety: consumer perception and demand. *European Review of Agricultural Economics*, Vol 32 (3), pp. 369–391. Retrieved on 5 July 2014 from: file:///C:/Users/User/Downloads/download.pdf

Haider, M.L., Kashem, M.A., Das, A.K. Uddin, M.S., and Kabir, L.I. (2012). A Study on Integrated Pest Management (IPM) Practices by the Brinjal Growers of Belabo Upazila under Narshingdi District, *Bangladesh Research Publications Journal*, Vol. 7 (3), pp. 212-219. Retrieved on 17 August 2014 from: http://www.bdresearchpublications.com/admin/journal/upload/09332/09332.pdf

Huq, A. S. M. Anwarul, Alam, Shamsul, and Akter, Shaheen. (2004). Marketing Efficiency of Different Channels for Potato in Selected Areas of Bangladesh, Bangladesh J. Agric. Econs, Vol. 27 (1), pp. 67-79.

Kader. A. A. (2005). Increasing Food Availability by Reducing Postharvest Losses of Fresh Produce, In F. Mencarelli, P. Tonutti (eds.) ISHS Acta Horticulturae 682: V International

Postharvest Symposium. Retrieved on 28 July 2014 from: http://ucce.ucdavis.edu/files/datastore/234-528.pdf

Karim, M. R., Hossain S., Rashid, M. A., Azad, M. A.K. and Jahan, M.A.H.S. (2011). Comparative Advantage of Vegetables Production in Bangladesh, *Bangladesh J. Agril. Res.*, Vol. 36 (1), pp. 87-95.

Lipinski, B., Hanson, Craig, Lomax, James, Kitinoja, Lisa, Waite, Richard and Searchinger, Tim. (2013). Reducing Food Loss and Waste. Working Paper, Installment 2 of Creating a Sustainable Food Future. Washington, DC: World Resources Institute. Retrieve on 27 August 2014 from: http://www.worldresourcesreport.org.

Mahoney, Deon. 2010. Food Safety Challenges in Bangladesh - Protecting the Consumer. Keynote paper at the National Workshop on Building a Food Safety Advocacy Network in Bangladesh (Dhaka, Bangladesh, 9-10 November 2010). Retrieved 11 July 2014 from: http://bdfoodsafety.org/admin/uploadimg/Food%20Safety%20Challenges%20in%20Bangladesh%20Mahoney.pdf

Matin, M. A., Baset, M. A., Alam, Q. M. Karim, M. R. and Hasan, M. R. (2008). Mango Marketing System in Selected Areas of *Bangladesh*, *Bangladesh J. Agril. Res.* Vol. 33 (3), pp. 427-438.

Matin, M. A., Karim, M. R., Hossain, M. I. and Hossain, M. A. (2008). Tomato Marketing System in Bangladesh, *Bangladesh J. Agril. Res.,* Vol. 33 (1), pp. 67-81.

Medeiros, Lydia C., Hillers, Virginia N., Kendall, Patricia A. and Mason, April. (2001). Food Safety Education: What Should We Be Teaching to Consumers, *Journal of Nutrition Education*, Vol. 33 (2), pp. 108-113. Retrieved on 11 July 2014 from: http://www.sciencedirect.com/science/article/pii/S1499404606601747

NCTB. (2007). Agricultural Education for Class VII, National Curriculum and Textbook Board, Dhaka. Retrieved on 1 August 2014 from: http://www.ebook.gov.bd/nbook/classVIIenglishAgriculture-7.pdf

Oger, Raphaelle, Woods, Timothy A. & Jean-Albert, Pierre, Allan, Daniel. (2001). Food Safety in the U.S. Fruit & Vegetable Industry: Awareness and Management Practices of Producers in Kentucky, (Eds. Daniel Allan and Matt Ernst), Agricultural Economics Staff Paper # 423B, December 2001, University of Kentucky, Department of Agricultural Economics.

Parfitt, Julian, Barthel, Mark and Macnaughton, Sarah. (2010). Food waste within food supply chains: quantification and potential for change to 2050, Phil. Trans. R. Soc. B, 365, 3065–3081. Retrieved on 27 August 2014 from: http://rstb.royalsocietypublishing.org/content/365/1554/3065.full.pdf+html

Rahman, Mohammad Munsur, Jun, ABE, Rashid, Abdur, Bari, M A and Guowei, Wan. (2006). Identifying Profitable Urban Markets for Vegetables from Rural Areas: A study in the Northern Part of Bangladesh. *Journal of International Farm Management*, Vol.3 (4), pp. Retrieved on 12 July 2014 from: http://www.ifmaonline.org/pdf/journals/Vol3Ed4_Rahman_etal.pdf

Robson, Mike. (2014). Food safety in Bangladesh, *The Daily Star*, Thursday May 08, 2014, Retrieved on 21 July 2014 from: http://www.thedailystar.net/business/food-safety-in-bangladesh-23177

Sabur, S. A., Hossain, A. and Palash, M. S. (2006). Marketing System, Seasonality in Prices, and Integration of Onion Markets in Bangladesh, *Bangladesh J. Agric. Econs*, Vol. 29 (1&2), pp. 93-105.

Stevens, Graham C. (1989). Integrating the Supply Chain, *International Journal of Physical Distribution & Materials Management*, Vol. 19 (8), pp.3 – 8. Retrieved on 16 August 2014 from: http://cc.sjtu.edu.cn/G2S/eWebEditor/uploadfile/20130422113932110.pdf

Unnevehr, L.J. and H.H. Jensen. (2001). Industry Compliance Costs: what would they look like in a Riskbased Integrated Food System? Working Paper No 01-WP 278. Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa, pp. 30.

Retrieved on 6 July 2014 from: http://ageconsearch.umn.edu/bitstream/18559/1/wp010278.pdf

Valeeva, Meuwissen and Huirne. (2004). Economics of food safety in chains: a review of general principles. *NJAS - Wageningen Journal of Life Sciences***,** Vol. 51 (4), pp. 369–390. Retrieved on 5 July 2014 from: http://www.sciencedirect.com/science/article/pii/S1573521404800034

van Roekel, Jan, Kopicki, Ronald, Broekmans,Carry J.E. and Boselie, Dave M. (2001). Building Agri Supply Chains: Issues and Guidelines. World Bank, New York. Retrieved on 17 August 2014 from: http://siteresources.worldbank.org/INTARD/864438-1112682945622/20716483/AgriSupplyChains.pdf

bank paper on Cross Boarder Agri-Supply Chain Management, 19 August 2002.

Weinberger, K. and C.A. Genova II. (2005). Vegetable production in Bangladesh: commercialization and rural livelihoods. Technical Bulletin No. 33. AVRDC publication number 05-621. Shanhua, Taiwan: AVRDC–The World Vegetable Center. 51.

Weiss M.D., 1995. Information Issues for Principals and Agents in the "Market" for Food Safety and Nutrition. In *Valuing food safety and nutrition,* J.A. Caswel (ed.). Westview press. Boulder. San Francisco. Oxford. P. 69-79. Retrieved on 17 August 2014 from: http://ageconsearch.umn.edu/bitstream/25968/1/bkvp1c4.pdf

Website:

Hortex Foundation. Retrieved on 1 August 2014 from: http://www.hortex.org/vegfruit.htm

Annexure

Annex 1

Definition of the channel stakeholder

Producers: They are directly or indirectly involved in production of fruits and vegetables. The producers necessarily supply for the market in the requirement of this study.

Faria: These are small middle men who involved in accumulation of products from producers and sell to different market intermediary at local area. In some cases there is faria in the market place as well who deal as small intermediary in between two other market player (e.g., buy from arotdar sell to retailer)

Bepary: They are larger stakeholder who involved in collection of large amount of products directly from producers or through broker and contracted agent, and from faria. They conduct business as single or multiple intermediary or jointly with other intermediary. This group hand over the item to wholesaler, retailer or consumer through the arotdar. The multiple role of Bepary is woking as bepary, arotdar and wholesaler.

Babshayee: Another name of bepary is Babsayee. The only difference between bepary and babshayee is that in some region the bepary who come from other district or regions are know as babshayee.

Arotder: Only the commission taker for space, room, supervision, and market contract.

Wholeseller: Dealer of large amount from bepary/arotdar to retailer

Retailer: Deal with final consumer with small amount of fruits and vegetables.

Annex 2

Table 4: Descriptive Statistics of Respondent`s Characteristic Factors

Item	Variables	Producers-marketers combined					Producers					Marketer				
		Obs	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
All Items	Per capita monthly income (tk)	*314*	***3067***	*2215.34*	*250*	*22500*	119	***2794***	1991.70	250	12500	*195*	***3233***	*2331*	*500*	*22500*
	Education (year)	*314*	***5.32***	*3.53*	*0*	*15*	119	***5.61***	3.89	0	15	*195*	***5.133***	*3.28*	*0*	*12*
	Experience (year)	*314*	***14.94***	*9.64*	*0*	*45*	119	***17.25***	10.50	2	45	*195*	***13.53***	*8.81*	*0*	*40*
	Age (year)	*314*	***39.05***	*11.55*	*15*	*75*	119	***43.10***	12.28	18	75	*195*	***36.57***	*10.36*	*15*	*65*
Banana	Per capita monthly income (tk)	*78*	***3144***	*2365.14*	*500*	*15000*	30	***2707***	1614	1136	6667	*48*	***3417***	*2713*	*500*	*15000*
	Education (year)	*78*	***5.24***	*3.78*	*0*	*15*	30	***5.3***	3.98	0	15	*48*	***5.21***	*3.69*	*0*	*12*
	Experience (year)	*78*	***12.23***	*8.69*	*2*	*40*	30	***10.6***	6.95	2	30	*48*	***13.25***	*9.55*	*2*	*40*
	Age (year)	*78*	***37.71***	*12.35*	*15*	*75*	30	***39.6***	12.82	20	75	*48*	***36.52***	*12.03*	*15*	*65*
Pineapple	Per capita monthly income (tk)	*79*	***3419***	*2897.06*	*500*	*22500*	30	***2878***	2092	500	8333	*49*	***3750***	*3271*	*800*	*22500*
	Education (year)	*79*	***5.38***	*3.61*	*0*	*15*	30	***5.8***	4.27	0	15	*49*	***5.12***	*3.17*	*0*	*12*
	Experience (year)	*79*	***17.41***	*10.23*	*1*	*40*	30	***23.17***	8.51	7	40	*49*	***13.88***	*9.65*	*1*	*35*
	Age (year)	*79*	***41.15***	*10.99*	*18*	*68*	30	***45.73***	11.18	24	68	*49*	***38.35***	*9.99*	*18*	*60*
Brinjal	Per capita monthly income (tk)	*79*	***3069***	*1828.22*	*250*	*12500*	30	***3345***	2477	250	12500	*49*	***2900***	*1283*	*857*	*8000*
	Education (year)	*79*	***5.38***	*3.34*	*0*	*14*	30	***5.8***	3.58	0	14	*49*	***5.12***	*3.19*	*0*	*11*
	Experience (year)	*79*	***15.72***	*10.03*	*0*	*45*	30	***18.9***	11.45	3	45	*49*	***13.78***	*8.59*	*0*	*35*
	Age (year)	*79*	***37.62***	*10.36*	*18*	*65*	30	***40.03***	11.55	18	65	*49*	***36.14***	*9.38*	*18*	*55*
Bitter gourd	Per capita monthly income (tk)	*78*	***2630***	*1463.38*	*667*	*7143*	29	***2227***	1567	667	7143	*49*	***2868***	*1359*	*1000*	*6250*
	Education (year)	*78*	***5.26***	*3.43*	*0*	*15*	29	***5.55***	3.87	0	15	*49*	***5.08***	*3.17*	*0*	*11*
	Experience (year)	*78*	***14.36***	*8.93*	*1*	*40*	29	***16.31***	10.74	2	40	*49*	***13.20***	*7.54*	*1*	*38*
	Age (year)	*78*	***39.69***	*12.24*	*18*	*70*	29	***47.17***	12.22	25	70	*49*	***35.27***	*9.98*	*18*	*60*

Source: Author`s calculation from survey data