Determining Impact of Actors and Factors of Supply Chain on the Consumer's Price of Vegetables in Dhaka City

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***Abstract*—this research was aimed to find the impact of actors, seasons and e-technology of the supply chain on the consumer's price of vegetable in Dhaka city. Most importantly the objective of the research was to determine a consumer's price model of the vegetable considering actors and factors as independent variable and price as dependent variable. The research was conducted based on 349 primary sample data collected from farmer, rural retailer, whole-seller, transporter, aratdar, urban whole-seller and retailer and consumer; and on the secondary data, i.e. extract from literature, journals, books and different publications. Multiple regression model, simulation and percentile techniques were used to analyse data. It was found that intermediate actors like rural and urban whole-seller, retailer, transporter, aratdar, etc increase consumer's price of vegetables with the increased numbers of these intermediate actors.Farmer's price as well as the ratio of consumer's price and farmer's price increases with change of seasons from full season to lean season to before-season. On the other hand it was found that if farmer and all the middle actors use mobile phone (e-technology) then consumer's price decreased compare to the situation when no one use mobile phone. A consumer's price model has been developed by which one can determine consumer's price of vegetables if farmer's price, numbers of intermediate actors, season and use sate of mobile phone is known.**

Keywords*—**Vegetable ***supply chain, e-technology, middle-actor, season, aratdar, consumers' price, farmer's price, multiple regression and simulation

1. INTRODUCTION

Bangladesh has an overwhelmingly agricultural economy. Agriculture accounts for 32% of its gross domestic product (GDP), and absorbs 63% of the country's labour force. Sustained government investment in irrigation facilities, rural infrastructure, agricultural research, and extension services has helped Bangladeshi farmers achieve dramatic increases in agricultural production.

The process of agricultural production is, however, underpinned by the increasing use of agrochemicals and multiple cropping. And while significant production transformation has been achieved and food production has more than doubled since independence in 1971, these have mostly supported the country's large population base rather than uplifting the living standards of the average citizen. Food security still remains a major development issue. Thus, the government of Bangladesh has called for a departure from "rice-led" growth to a more diversified production base that includes several non-rice crops. [11]

Diversification into vegetable crops and increasing commercialization can support the development of the agricultural sector in several ways. Commercialization is characterized by households moving from subsistence systems into semi-commercial and commercial systems (with the main objective of achieving food self-sufficiency), thereby maximizing profits and generating surplus. It implies increased market transactions since farmers participate in the process to capture gains from specialization. Similarly, increasing capital intensity in production and processing leads to growth in the agribusiness sector. As a result, the number of agro-processing, distribution and farm-input provision companies increases. Commercialization can take place on the output side—when the farmer sells their products on the markets—or on the input side with increased use of purchased inputs. [11]

Electronic technology provides new methods for increasing productivity in agriculture such as use of machine operated automated processes. Livestock are encouraged and checked by electronic sensors and ID frameworks. Offering or purchasing online started to end up famous on the planet. Notwithstanding, it's most critical part remains correspondence, and the Internet has given us a great opportunity to do as such.

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It is clear that the needs and the services required by rural communities will determine how ICT are used, adapted and thus evolve. To enable and empower these communities to improve their livelihoods is likely to involve a mix of traditional communication channels (neighbours/family, local news, announcement boards, etc.), as well as new ones (Internet, mobile phones, etc.). An example of this mix can be seen in Peru, where, due to the region's dialect preference, radio is the most important information source for farmers in the Cajamarca region. The NGO SolucionesPrácticas is using a mixture of old and new technologies to reach these farmers, by disseminating important agricultural information through podcast radio programs, which are saved in digital format, recorded in discs and distributed to the local radio stations. [13]

Government of Bangladesh have been working to improve our IT environment and to ensure efficient use of information and electronic technologies not only to strengthen our agricultural production but also to also to help the farmers and facilitate rural economic development.

2. RESEARCH OBJECTIVES

The objectives of the research are:

a. To find the status of middle-actor, mobile phone (e-technology) and seasons in the supply chain of vegetables from producing area to Dhaka city.

b. To determine the impact of middle-actor, use of mobile phone (e-technology) and season on consumers' price of vegetables in Dhaka city.

c. To establish a consumers' price model taking farmer's price of vegetables, middle-actor, use of e-technology and seasons as independent variables and consumers' price at Dhaka city as dependent variable.

3. METHODOLOGY

This research was focused to identify the flow of vegetables from farmer's point of sales to retail market of Dhaka city and to collect data on farmer's price, numbers of middle actors, transportation cost, spoilage of vegetables, seasons and status of using e-technology by the farmers and middle actors. , marketing channels, consumers to evaluate performance of the farmers, marketing system, To do this, all types of farmers (small, medium and large farms) of the selected producing areas were surveyed with middle actors (Foria, Aratdar, Bepari, whole seller, retailer)and consumers of Dhaka city.

On the other hand, discussion with members of farms association, transport association, traders association, mobile and GPS operators, consumers association, police, shop-owners association was done to find critical factors affecting cost, price and flow of vegetables as per demand & supply of the market.

3.1 Sampling Design and Survey Area

Lots (all vegetables that were taken to market by the farmers for sales) of vegetable from farmers point of sales to Dhaka city was considered as a sample. A random sampling design was used to select upazillas in the districts. Total 15upazillasthatwas regarded as the minimum number of sample needed to have a statistically representative sample of a population by internationally recognized survey design.. Survey of farmers and some middle actors (Foria, Bepari) was carried out in Bogra, Jamalpur, Savar of Dhaka, NarshingdiandGaibandha districts. To collect information, other middle actors (Aratdar, Wholesalers, and Retailers) and consumers of Dhaka city were surveyed. Flows of vegetables-lot were marked from the above district to retail markets of Dhaka city. One hundred twenty seven farmers from 11 upazillas of the above districts, their 349 lots of vegetables were marked and followed, 95 middle-actors and 290 consumers of Dhaka city were surveyed.

3.2 Analytical Techniques

Descriptive statistics and different type of charts were used to find the impact of middle actors, season and use of e-technology on the consumer's price of vegetables. Simulation and multiple regression were used to find the co-relation between the factors, farmer's price and consumer's price.

4. LITERATURE REVIEW

A good number of studies have been conducted home and abroad on food security. Some of the highlights of different studies relevant to the proposed study have been presented here so that a conceptual framework on the overall situation of the marketing system of Vegetables and Fruits in Bangladesh can be formed. Agricultural marketing involves in its simplest form the buying and selling of agricultural produce. This definition of agricultural marketing may be accepted in olden days, when the village economy was more or less self-sufficient, when the marketing of agricultural produce presented no difficulty, as the farmer sold his produce directly to the consumer on a cash or barter basis. But, in modem times, marketing of agricultural produce is different from that of olden days. In modem marketing, agricultural produce has

to undergo a series of transfers or exchanges from one hand to another before it finally reaches the consumer. The National Commission on Agriculture of India (2005) defined agricultural marketing as a process which starts with a decision to produce a saleable farm commodity and it involves all aspects of market structure of system, both functional and institutional, based on technical and economic considerations and includes pre and post-harvest operations, assembling, grading, storage, transportation and distribution. The Indian council of Agricultural Research (2003) defined involvement of three important functions, namely (a) assembling (concentration) (b) preparation for consumption (processing) and (c) distribution.

The agricultural sector is the main livelihood strategy for the vast majority of rural people in Bangladesh. It contributes around 21 percent of the country's GDP and provides for 52 percent of its employment (Bangladesh Economic Survey Report 2007). Thus, to eliminate rural poverty, special attention is needed to make agriculture industries more profitable. In the past, Bangladesh suffered from a deficit in food production. In recent years however, due to the efforts of agriculturists and farmers, it has attained the status of a food grains surplus country. Demonstrating this, in the fiscal year of 2004-05, Bangladesh had a surplus of 5.83 million tons food grains (28.384 million tons produced compared with a demand of 22.55 million tons) and 4.98 million tons of surplus rice (26.13 million tons produced compared with a demand of 21.15 million tons) (Department of Agriculture Marketing 2005, New Age 2006).

According to Hossain (2004), in Bangladesh, more than 60 different types of vegetables of indigenous and exotic origin are grown. At present, total vegetable growing area in the country is about 253,036 hectares (2.47 acre is equal to a hectare), of which 60% are cultivated during winter. These crops were neglected and relegated in the past, as research and extension work mostly concentrated on cereals. It is, therefore, not surprising that vegetables contribute only 3.68% to the GDP with a production area of less than 2% of the total cropped area.Current production of vegetables is considerably below the domestic requirement. There is, therefore, a big gap between the vegetable production estimated at 2.6 million MT and the national vegetable requirement estimated at 10 million MT. This gap is likely to expand further with increase of population and per capita income, unless more land is brought under vegetable production and productivity increases. Presently, only about 33% of the estimated vegetable area is under vegetable production. Nationally, the consumption of vegetable is reckoned to be 50-70 g/head/day or 18.25-25.5 kg/head/year, as against the requirement of 200 g/head/day from nutritional point of view.

Vegetables are generally sold by farmers immediately after harvest because of their need for cash and lack of storage facilities. According to the FAO survey, about 82% of farmers in all the regions sell horticultural crops immediately after harvest. About 66% of the farmers sell their produce in weekly markets and 22%, in the daily markets. Farmers usually get price information from other farmers, traders, radio, television and newspapers. Marketing channels and involvement of intermediaries vary among regions. The FAO survey indicates that about 19% of retailers, 41% of traders and 21% of consumers buy vegetables directly from farmers. The two major marketing channels are producer-trader-retailer-consumer and producer-trader- wholesaler/commercial agent-small holder/retailer-consumer. The commission of intermediaries varies by region and from crop to crop. The margin between the trader's price and the retailer's price could be as high as 150% during peak season and 200% during off season. Retail and wholesale prices of vegetables fluctuate substantially from year to year and also from month to month, depending on the supply situation. Seasonality, under developed marketing and transportation system, poor infrastructure and insufficient storage facilities intensify price volatility.

Marketing system of fruits is similar to that of vegetables. FAO survey indicates that about 36% of retailers, 27% of traders and 22% of consumers buy fruits directly from the farmers who usually sell their crops mostly in the weekly markets and partly in the roadside and daily markets. In general, production of fruits is an attractive alternative for farmers, as gross margins may go up to 10-12 times compared to paddy. But the risk involved is much higher for many fruits, because of price volatility and market gluts during peak season. Like vegetable crops, retail and wholesale price of fruit crops also fluctuates substantially from year to year and also from month to month, depending on the supply situation. The reasons of this price volatility are also similar to those of vegetables.

Hanemann and Ahmed in their study "*Constraints and Opportunities Facing the Horticultural Sector in Bangladesh"* further stated that Multiple actors -- local collectors, local traders, local market *aratdars*and their agents, urban wholesalers and their commission agents, rural and urban retailers -- constitute the important components of the marketing system. The wholesalers and their agents mainly determine the market price of fresh produces. This is the most popular and common marketing structure. It is estimated that, in the process of marketing, as much as 10-40% of the produce is lost due to mishandling, improper packing and transportation. Market price is determined by the marginal cost of supply and

demand. The wholesalers are able to pass on their entire risks, partly to farmers in terms of lower farm gate prices, and partly to consumers in terms of higher wholesale prices than what would have been the outcome had the farmers been able to sell their produces directly to consumers. This partially explains the large differential between farm gate price and wholesale/retail price as observed in the market. The more elastic is the demand, the higher would be the farm gate wholesale price differential. There are about 13,319 markets in the country. The markets located in the rural or semi-urban areas are mostly in poor condition with limited logistics, infrastructural, management and institutional facilities. Roads, especially the link and approach roads of the rural markets are not in good condition.Road transportation has relatively improved, but the cost remains very high which, in turn, raises the product price. The pattern of agricultural markets in Bangladesh consists of the following:

Primary Rural Markets: this market is composed of farmers and small retail traders having few permanent shops. This market operates usually twice in a week.

Rural Assembly Markets: traders from distant places gather in these markets with a view to collecting marketable surplus. Because of the presence of sizeable number of traders, commercial trading takes place in these markets. Significant numbers of permanent shops (i.e., "mokam") and processors are found in these markets. The presence of commission agents, banks and easy transport systems make these markets more useful to the operators. This type of market operates every day, or every other day.

Secondary Markets: this market is large and composed of traders who operate nationally. Commission agents, *jothdars*, wholesalers, processors, exporters – all are active in this market. Normally, such markets are easily accessible by various means of transport. With large numbers of permanent shops and service institutions, these markets operate on all working days.

Urban Wholesale Markets: these are specialized markets operating in a particular line of products (e.g., rice, vegetable, and fruits). These markets bridge the gap between distant wholesalers and large number of retailers. Commission agents called *Aratdars*organize and operate these markets.

Urban Retail Markets: in these markets, consumers collect their necessary items directly. The retailers present a variety of items in these markets to meet the daily necessities of the consumers.

Information and Communication Technologies (ICT) plays a vital role in Development & Economic growth of the Developing countries of the World. Political, Cultural, Socio-Economic developmental & behavioural decisions today rests on the ability to access, gather, analyse and utilize information and knowledge. ICT is the conduits that transmit information and Knowledge to individual to widen their choices for Economic and social empowerment. [4]

ICT also has an impact on a country's development and growth. Recent World Bank study shows that a 10% increase in mobile phone subscribers is associated with a 0.8% increase in economic growth while 10% increase in high-speed internet connections is related with a 1.3% increase in economic growth. ICT infrastructure development attracts foreign direct investment, generates fiscal revenues, and creates employment opportunities. Local information technology service industries generate exports, improve a firm's productivity, and offer equalizing job opportunities, especially for youth and women. [4]

Mobile phones and other ICTs can provide a broad range of public and social services to the poor in remote areas and they have become an essential as well as an essential utility for the poor. Farmers in remote villages use mobile phones to access the most current crop prices and migrant workers use mobile banking services to transfer money to relatives back home. Increasingly, land registration, education, health care and voting are being conducted electronically using ICT. ICT is the conduits that transmit information and knowledge to individual to widen their choices for Economic and social empowerment. By integrating technology into development, more effective and speedy solutions can be found for sustainable human development & economic growth. [4]

e-Agriculture involves application of information and communication technologies (ICTs) in an innovative ways to use with a primary focus on agriculture in the rural development domain. FAO proposes the following definition: "e-Agriculture is an emerging field in the intersection of agricultural informatics, Agricultural development and entrepreneurship, referring to agricultural services, technology dissemination, and information delivered or enhanced through the Internet and related technologies. More specifically, it involves the conceptualization, design, development, evaluation and application of new (innovative) ways to use existing or emerging information and communication technologies (ICTs)". [4]

According to Chandra & Malaya (2011) the role of e-Agriculture is:

Ensure the systematic dissemination of information using ICTs on agriculture, animal husbandry, fisheries, forestry

and food, in order to provide ready access to comprehensive, up-to-date and detailed knowledge and information, particularly in rural areas.

Public-private partnerships should seek to maximize the use of ICTs as an instrument to improve production (quantity and quality).

The interaction between ICT and agriculture has globally become known as e-Agriculture. More precisely, e-Agriculture has been de1ned as an emerging 1eld for enhancing sustainable agriculture and food security through improved processes for knowledge access and exchange using information and communication technologies (ICT). e-Agriculture continues to advance at a spectacular rate. The Internet, for example, has many advantages as a medium of information and knowledge exchange, but limited access and poor connectivity continue to constrain many individuals, particularly in rural areas in developing countries. The most successful use of ICT in agriculture development has proved to be mobile telephone, which has been a major breakthrough in communications and as a means of accessing market prices, weather and other advice. It is currently the most accessible ICT available, allowing access to a broad spectrum of people, including marginalized people in remote rural areas. 5e technology is adaptable, being capable of handling voice and data, and the cost of advanced features continues to fall. The mobile telephone and the hand-held computer are becoming almost indistinguishable. In Tanzania, 1shermen are using mobile phones to communicate among themselves regarding weather forecasts, where to get the best catch, local market information, and to coordinate pick-up of catches. [13]

The importance of information and communication technology in executive decision-making has been extensively documented (Averweg, 2008). Information is critical for sustainable development. Without concise and timely information, executives will not be able to determine whether their views of the environment and their organization's position within it remain appropriate (Vandenbosch and Huff, cited in Averweg, 2008). Because of this, the use of e-infrastructures is gaining ground in many African countries. E-infrastructures in agriculture, health and other sectors are the order of the day. What is missing though is contextualized research that will inform service providers to know what those using e-infrastructures prefer. [6]

e-Agriculture is a recent term in ICT that defines a global community practice, where people from all over the world exchange information, ideas, and resources related to the use of information and communication technologies (ICT) for sustainable agriculture and rural development. A study conducted by (Epstein, 2008) found that majority of farmers in Kenya are not able to sell their produce at market price due to lack of sufficient information available. This makes them to sell their products at throw away prices which lead to losses and food insecurity. For such farmers to produce and sell their products at market based and competitive prices, information communication technologies (ICT) tools have be availed to them. This is because the development of agriculture depends on how fast and relevant information is provided to the end users. [18]

According to (Meera&Jhamtani, 2004), e-agriculture describes an emerging field focused on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICTs) in the rural domain, with a primary focus on agriculture. It is a recent term that was coined by United Nations to embrace all Information communication technologies that supports agriculture. In fact, Food and Agriculture Organization of the United Nations (FAO) conducted a survey in 2006 on the usage of the term e-agriculture. The study found that half of those who replied identified "e-agriculture" with information dissemination, access and exchange, communication and participation processes improvements around rural development. In contrast, less than a third highlighted the importance of technical hardware and technological tools. [18]

Adhau, 2010 argues that e-agriculture is today affecting all the spheres of human life. We can exploit these advances to design a cost effective system to provide expert advice to the farmers. Here, we explain some of the advances in e-agriculture that can be used to build proposed system. [18]

Inklaar, O'Mahony, &Timmer, 2005, notes that with the advent of modern information technology revolution (mainly the database and Web technology), it is possible to provide latest expert advice in a timely manner to the farmer and thereby reduce the effect of the factors that disturb the crop. By exploiting the advances in information technology especially e-agriculture, we can enable the agriculture assistance to get the status of the crop in a cost effective manner. An architecture that depicts the use of e-agriculture can be modelled based on the database available for different products and dissemination of this information to the farmer. Due to the low cost and availability of mobile phones, farmers will use this ICT tools to get the data required. [18], [19]

According to Maumbe (2012), e-agriculture is a newly emerging field that is receiving increasing attention from

governments, agribusiness industry, and the agriculture community worldwide. Over the past decade, the world has witnessed major growth and expansion of e-agriculture projects that integrate information and communication technologies in agriculture value chains and rural development.

E-agriculture aims at offering services which includes timely information on weather forecasts and calamities, better and spontaneous agricultural practices, better marketing exposure and pricing, reduction of agricultural risks and enhanced incomes, better awareness and information, computerization of land records, improved networking and communication, facility of online trading. However, these systems are generally limited in scale and have not been effectively replicated beyond the local level. The expert/scientific advice related to crops does not reach the farming community at the appropriate time. India has priceless agricultural knowledge and expertise and there exists large information gap between research and practice. The unequal access to information and communication technologies is hindering the capacity and productivity of rural agricultural activities carried out by the marginalized farmers in India. Although India has been one of the emerging super powers in IT, the benefits have been remarkably slow, particularly in rural and remote areas. In this context an attempt has been made by the authors to propose an E-Krishi Model in agriculture for J&K state. Our vision is to bring technology and the opportunities it provides to underserved and under resourced communities across the state. The study of existing E-Governance in agriculture in Indian system has been carried out from the Govt. published available literature, personal observation through questionnaire and personal interviews. Based on the observations made through the data analysis and making thorough investigations of the similar E-Governance model in agricultural development in other states of India, authors propose an E-Krishi Model in agriculture for Jammu And Kashmir State. [14]

The global development of information and communication technologies (ICT) has created a new agricultural development paradigm that promises to transform the performance of the agricultural sector and improve rural livelihoods in developing countries. Over the past five years, South Africa has witnessed a swift ICT-led transformation of its public service delivery with major innovations in key development sectors. The growth of e-agriculture is seen as an engine to accelerate agriculture and rural development, promote food security, and reduce rural poverty. [23], [7]

Globalization is influencing several agriculture aspects: market globalization has increased export from producing to consuming countries where different food safety or pesticide residue regulations apply, and has raised awareness of global problems linked to agriculture production (i.e., chemical pesticide pollution). Pests, diseases and weeds may cause significant damages to growers and the cost of pesticide increases. Environmental pollution and risk of unwanted residues on food forced researchers to find ways to optimize pesticide applications. However, extension services and research in pest management is often fragmented and efforts to develop support tools for pest management are often duplicated. Furthermore, sometimes the knowledge does not spread from research centers to growers due to difficulties in knowledge transfer. Decision support systems (DSS) are widely used for assisting with integrated pest management (IPM), crop nutrition, and other aspects of information transfer. Developing highly portable and especially web-based DSSs that can be easily adapted to new environments is therefore desirable in view of agriculture globalization. Web-based models and DSSs have the major advantage of reducing software development, maintenance, and distribution costs, while making the relevant knowledge easily accessible to growers world-wide. [11]

Technological advancements have been a great support for making decisions in various fields especially in agriculture. The development of agriculture has been on under development for the past few years due to lack of Agriculture knowledge and environmental changes. The main aim of this paper is to reach farmers for their awareness, usage and perception in e-Agriculture. The study used statistical survey design technique to collect data from farmers for their awareness in e-Commerce. The results obtained indicated the level of awareness is less such that there is a need for e-agriculture for their support. e-Agriculture is a platform for supporting marketing of agricultural products. [24]

The development of agriculture has been had the history of ten thousand years. It has experienced the primitive agriculture, traditional agriculture and modern agriculture. The long history of agricultural development (Xi Ding, 2009). ICT provides huge, advance information on just a click of the computer mouse. The rural masses are largely disconnected with the outer world due to lack of ICT facilities, ICT can be used as catalyst for positive change in rural underdeveloped areas. [20]

E-Agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-Agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (IT) in the rural domain, with a primary focus on agriculture. E-Agriculture is a

relatively new term and we fully expect its scope to change and evolve as our understanding of the area grows. [5]

e-Agriculture as an emerging field in the intersection of agricultural informatics, agricultural development, and entrepreneurship, referring to agricultural services, technology dissemination, and information delivered or enhanced through the Internet and related technologies (FAO, 2005).The application of e-Agriculture is still in its elementary stage, evolving around the immense multiplier impact tendency that can significantly change the farmer's economic and social condition i.e. empowerment. This ensures the effective and efficient use of information and communication technologies for analysing, designing and implementing existing and innovative applications to help the agricultural stakeholders and uplift of agricultural sector. In 2008, Bangladesh Institute of ICT in Development (BIID), in collaboration with Katalyst (Partner of Swiss Contact & a local agro-based NGO) and Grameenphone launched the e-krishok initiative (New Agriculturist, 2015). [22]

Agriculture concentrate on the upgrade of farming and provincial advancement through enhanced data and correspondence forms (IT & ICT). All the more particularly, e-Agriculture includes the conceptualization, outline, advancement, assessment and utilization of imaginative approaches to utilize data and correspondence advances (IT) in the country space, with an essential spotlight on horticulture. E-Agriculture is a generally new term and we completely anticipate that its extension will change and develop as our comprehension of the zone develops. [12]

A study by Islam & Rashid (2016) suggested that farmers had a favorable attitude towards e-Agriculture in Bangladesh. In addition to that, the study also revealed the factors that effective farm size, annual household income, farming experience, participation in training, knowledge on e-Agriculture, organizational participation and cosmopoliteness had significant contribution on farmers attitude towards e-Agriculture. These variables contributed total 61.9 percent in farmers attitude towards e-Agriculture. Based on these findings, the researcher would like to suggest that it is high time prepare the farmers to use these e-Agriculture tools for their wellbeing through proper educational activities and to popularize this service, government should implement integrated marketing communication using the popular print and electronic media so that more and more people get aware of this service.

The concept of e-Agriculture is still in the nascent stage in Bangladesh context, so does it in the academic arena. In 2003, under the "Support to ICT" taskforce program the ministry of agriculture of Bangladesh did set up an agricultural information system (MoA, 2003). In 2005, a group of researchers of D.Net (Development Research Network, Bangladesh) proposed the idea of "Pallitathya Help Center" and conducted a project on it. The idea centered on the use of relatively less fashionable ICT, the mobile phone, as an effective 'last mile solution' to improve access to livelihood information for the rural people. They found it most challenging to understand the problems (related to health, agricultural, weather information) of rural people and to provide the appropriate information (Raihan et. al, 2005). Lwoga (2010) reported language barrier as a constrain to better dissemination of agricultural knowledge through community radio to the local communities and thereby the improvement of agricultural activities of the farmers was constrained by language restriction. Chilimo (2008) revealed that a number of problems in using ICT media like telecenters and rural radio in dissemination of Information and knowledge for sustainable agricultural practices in Tanzania constrained the farmers from meeting their information need which specially included high cost of ICTs, illiteracy, distance to telecenter, language barrier, lack of electricity, frequent power outage, sustainability issues and lack of awareness of most of the telecenter managers about the farmers' information needs. [9]

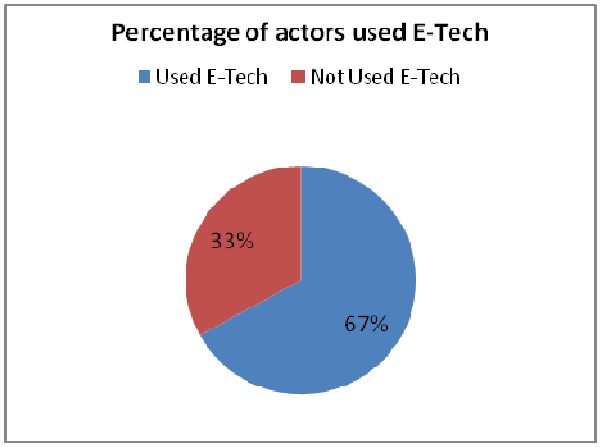
Almost 80 percent of Bangladesh's population lives in the rural areas, with 54 percent of them employed in agriculture. Agriculture is the primary occupation for a major segment of population. The performance of the agricultural sector has a great impact on major macroeconomic objectives like employment generation, poverty alleviation, human resources development and food security. The problems and challenges in the agricultural sector in Bangladesh was summarized by World Bank as Low agricultural productivity, Poorly functioning input and output markets, are some of the needs to be addressed urgently. The agriculture needs to be devloped and e-Agriculture is an emerging field for providing farmers with relevant agricultural information for their development and business, and, therefore, it need the conceptualization, design, development and application of innovative ways to utilize existing or emerging Information and Communications Technologies (ICTs). [17]

5. ANALYSIS AND FINDINGS

Samples were collected; four factors (Farmer's price, use status of e-technology, number of middle-actors and season) of each sample were identified and analysed.

5.1 Use of Mobile by the Actors

Use status of e-technology by farmers and middle-actors is shown with the following chart.



Fiqure 1: Sample wise use status of mobile phone (e-tech) in percentage

It was found that farmer and middle-actors of 67% samples used e-technology whereas 33% didn't.

5.2 Samples from different Season

Samples were collected in different seasons. There were three seasons for almost all the vegetables; full season, lean season and before season.

Among 349 samples 62% were collected during full-season, 21% during before-season and rest 17% were collected during lean-season.

Season wise collected data is shown in the following chart.

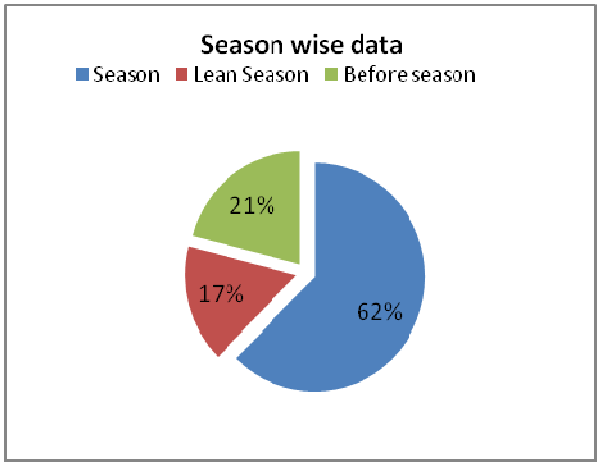


Figure 2: Season wise sample in percentage

5.3 Middle Actors in the supply chain of vegetables

It was found that there were no middle-actor to six middle-actors in the supply chain of vegetables. No middle-actor mean farmers directly sold their vegetables in the retail market of Dhaka city. They sold their product only during full-season of the vegetables.

From the research it was found that middle-actor(s) are the main factor for increased consumer's price of vegetables in Dhaka city.

Number of middle-actors (NOM) in the supply chain of vegetables are shown with the following chart.

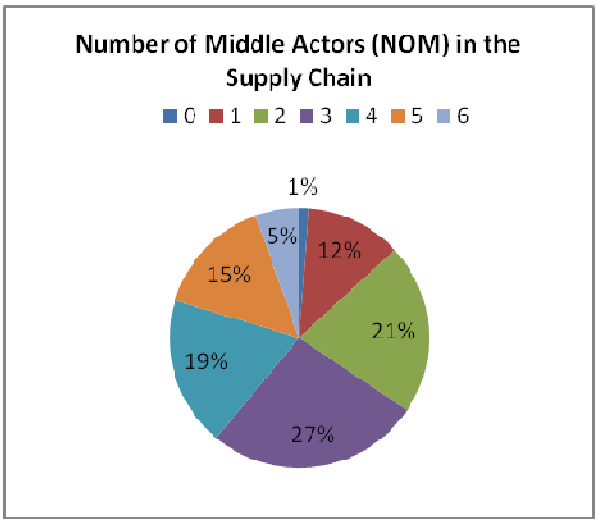


Figure 3: Number of middle Actor (NOM) in the sample (percentage)

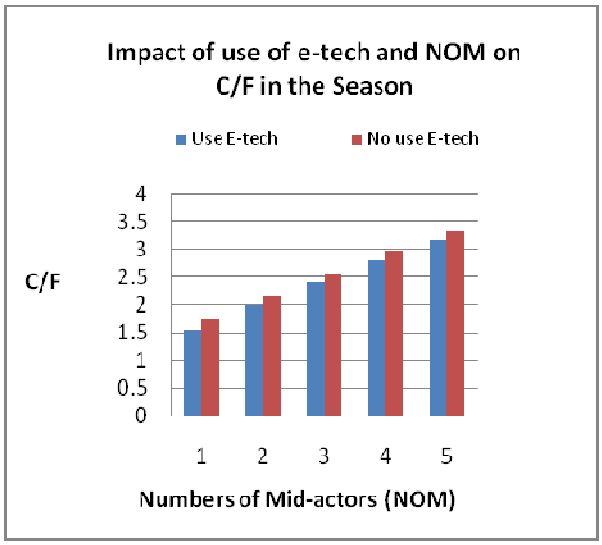
5.4 Imapct of Middle Actors (NOM) and Use State of Mobile phone on Consumer's Price

It was found that around 1% lot of vegetables were sold by the farmer in Dhaka city. There was one middle actor in 12% cases, two in 21% cases, three in 27% cases, four in 19% cases, five in 15% cases and six middle-actors were in 5% cases.

To find impact of factors and actors of the supply chain, ratio of consumer's price and farmers price (C/F) were calculated. It was found that the ratio of consumer's price and farmer's price were between 1.27 to 4.05 with an statistical average of 2.85. That is price of vegetables in Dhaka city is upto 365% of the farmer's price and on an average it is 285% of farmer's price.

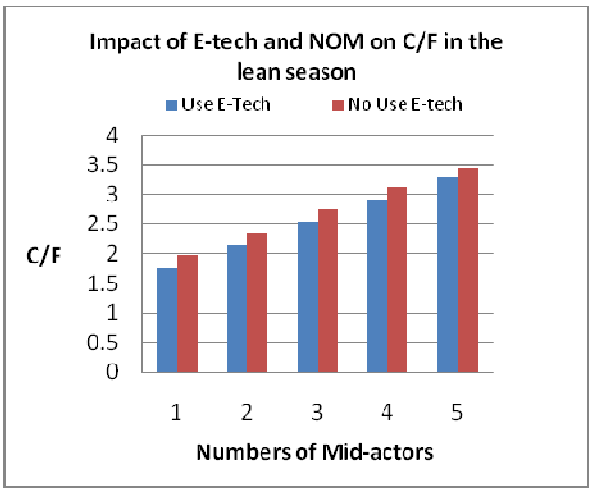
If the actors of the supply chain use e-technology then there is a decrease in consumer's price at Dhaka city by around 12%.

The following chart shows the ratio of consumer's price to farmer's price in full season. It is found that the ratio (C/F) was from 1.55 to 3.2 with the change of middle-actors in the chain if the actors used e-tech where is the ratio (C/F) was 1.75 to 3.8 if actors did not use e-tech.



Fiqure 4: Impact of number of middle actors (NOM) on ratio of consumer's price and farmer's price (C/F) in full season

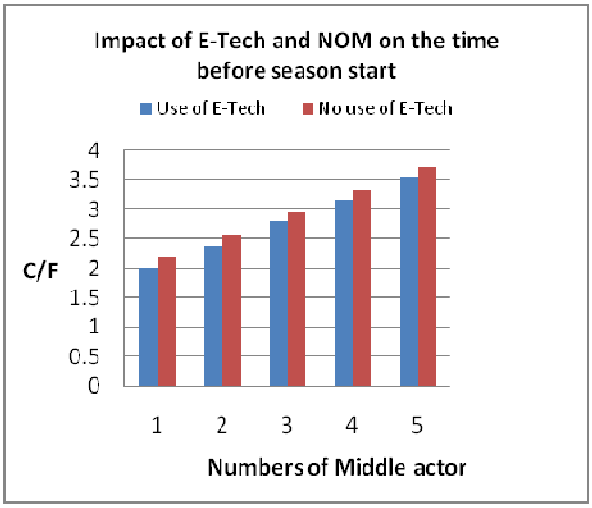
Again It is found that in the lean season with the increase of number of middle-actors the ratio (C/F) was in increasing trend from 1.75 to 3.35 if the actors used e-tech where is the ratio (C/F) was 1.95 to 3.45 if actors did not use e-tech. It is dipicted in the following chart.



Fiqure 5: Impact of number of middle actors (NOM) on ratio of consumer's price and farmer's price (C/F) in lean season

Vegetable price was highest during before-season time. The middle actors make highest profit in this time. During before-season time it was found that with the increase of number of middle-actors the ratio (C/F) was in increasing trend from 2.0 to 3.55 if the actors used e-tech where is it (C/F) was 2.20 to 3.75 if actors did not use e-tech.

The chart below shows the ratio of consumer's price and farmer's price in the before-season.



Fiqure 4: Impact of number of middle actors (NOM) on ratio of consumer's price and farmer's price (C/F) in before-season

5.5 Consumer's Price Model

Simulating the data and from above analysis consumer's price model can be formed as follows.

CONSUMER'S PRICE, $CP = 0.96 * FP + (0.39 *NOM + 0.25 * SF – 0.18 * ET) * FP + 1.90$

Where,
FP = Farm price (price of vegetables at farmer's point)
NOM = Numbers of middle actors (0 to 6)
SF = Seasonal factor (1, 2 & 3 for three seasons)
ET = Use of e-technology (1for use & 0 for no use)

Box 1: Consumer's Price Model

Microsoft Excel output for the regression model that include farmer's price (FP) and interactions of farmer's price and number of middle-actors, use state of e-technology and season is shown in the following table.

Table 1: Excel output of Multiplicative Multiple Regression Analysis for Consumer's Price.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.989
R Square	0.978
Adjusted R Square	0.966
Standard Error	0.284
Observations	349

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	220889.006	55222.3	925943	0.000
Residual	344	20.516	0.1		
Total	348	220909.521			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1.863	0.035	53.5	0	1.794	1.931
FP	0.958	0.004	263.8	0	0.951	0.965
FP X SF	0.249	0.001	274.0	0	0.247	0.251
FP X ET	-0.185	0.002	-122.5	0	-0.188	-0.182
FP X NOM	0.390	0.001	732.9	0	0.389	0.391

6. DISCUSSION

From findings, analysis and consumer's price model it is clear that for each additional middle-actor consumer's price is increased by 39% on farmer's price. On the other hand 25% consumer's price is increased on farmer's price if season is changed from full season to lean season and 50% increased if season is changed from full season to before-season.

Use of e-technology plays a important role in consumer's price. If all the actors of a vegetable supply chain used e-technology then 18% price was decreased from the price when e-technology was not used at all.

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