

## Developing Technology Supported Management Approaches for Reducing Food Safety Problem Based on Bangladesh

Iffat Tasnim Haque, Youji Kohda

Japan Advanced Institute of Science and Technology, Ishikawa, Japan

**Abstract**—Bangladesh is one of the countries in South-Asian Region, which is dominated by agricultural production and the major portion of the rural livelihood is surviving on this sector. But the rural farmers of the country are still living under the poverty line. On the other hand, food safety and food adulteration problem currently are the burning issues not only in Bangladesh but also in other developing countries as well. Due to improper knowledge about agricultural technique, market price and poor infrastructural facilities in supply chain, a large amount of perishable agricultural products like fruits and vegetables becoming unsafe for the consumers. The traditional value supply chain system is dominated by middlemen, who are responsible for poor economic condition of farmers and food safety issues as well. Therefore, it is essential to replace the traditional supply chain system by some technology supported new system which not only improve the food safety situation but also empower the rural smallholder farmers through economical benefit. This conceptual paper proposes the implementation of some technological system in the value chain from production to the consumption. The major focus of such concept is to develop the awareness among producers and consumers which will be supported by a proper supply chain system.

### I. INTRODUCTION

Bangladesh is a developing country in South-Asian Region and agriculture is the single largest producing sector of economy since it comprises about 30% of the country's GDP and employing around 60% of the total labor force [1]. Though agriculture dominates the major portion of the economy, still the issues like the poverty of the small-holder farmers and overall food security of a densely populated country are the major areas to be focused. Not only the population density but also the rapid urbanization, climate change, globalization and natural calamities have increased the demand of food supplies [2]. Moreover, in Bangladesh, food safety has become a major public health concern which ultimately impacts on food security [3].

One of the recent food safety problems in Bangladesh is food adulteration, caused by unacceptable or more than permissible levels of hazardous chemicals, such as formalin, carbides, and textile dyes, in fruits, vegetables, fish, spice, etc. These chemicals are added to the food for making it more attractive, long-lasting and hence more profitable. The long-term health consequences of consuming adulterated food are cancer, liver and kidney damage, skin diseases, abdominal discomfort, and much more [3].

Besides poor hygiene practice and unintentional deterioration of food, a lot of other factors like poor knowledge about farming techniques among the rural farmers,

health consequences of unsafe food production and consumption, lack of knowledge about the law and policies of food fraud, market information, middlemen interference are responsible for the deterioration of food safety and adulteration problems, especially in the perishable items like fruits and vegetables. In addition, lack of post-harvest facilities increase the risk of deterioration and wastage of the perishable products, hence increases the occurrence of adding the harmful preservatives [5]. Many activities have been taken by government and other Non-Governmental Organizations (NGOs) to improve the condition of food safety and security problems along with the poverty issues in Bangladesh. Unfortunately, the concerns and attempts to ensure safe food had been only sporadic, *ad hoc*, incomplete and ineffective [6]. Unstructured communication and management system in food supply chain are major barriers for achieving the positive outcome of the government and NGOs initiatives.

Therefore, the major objective of this paper is to develop a conceptual model of value chain process from production to consumption which fosters benefits both for the farmers and the consumers. The strength of this model not only focuses on developing awareness about food safety, but also provides user friendly product delivery system using the simple technologies. The proper implementation and management of the proposed model can be a significant solution to improve the farmers' economic condition as well as reduce food safety problem.

### II. CURRENT SCENARIO OF FOOD SUPPLY AND SAFETY ISSUES IN BANGLADESH

#### A. Scenario 1 (improper supply chain system):

Though there are lands to cultivate a good amount of agricultural products, but the farmers are not in a good condition from the economic perspective as they do not get the fair price of their products. There is a significant difference between the price what the consumers pay and the price what farmers get. This means that farmers of the country are not getting the price at which products are sold in the market as shown in Fig 1 [7].

Government and NGOs have concentrated on the high production through different initiatives like distribution of fertilizer and seeds, introducing modern technologies in production yield etc. for the farmers. Due to these initiatives, crop production has been increased by two to three times but it is evident that, without an efficient marketing system, high crop production cannot be sustained for a long time. When farmers do not get the fair prices for their products, they

become demotivated or unable to continue farming as for financial crisis [7].

On the other hand, agricultural marketing needs an uninterrupted, adequate and timely supply of agricultural product, especially the perishable products like fruits and vegetables and this service system includes all the stakeholders like producers, consumers, wholesalers etc. A proper agricultural marketing service means not only distributing agricultural product but also a way of stimulating new forms of production [8].

There are a large number of interconnected activities like planning, production, growing and harvesting, grading, packaging, transport storage distribution and sale happened in a total supply chain procedure [9]. But unfortunately, farmers in Bangladesh only perform a few of that marketing activities as for their illiteracy and improper infrastructure in terms of the agricultural knowledge transfer and marketing system. Intermediaries in agricultural product marketing are playing prominent role in making the agricultural business as a risky business which actually absorbing the major portion of the benefits from the real farmers and gaining high profit by setting a high price for ultimate consumer of agricultural commodities. Therefore, supply chain of agricultural food product are artificially interrupted and adversely affected by some intermediaries who are not actually the major player in this sector. Thus the value chain dominated by the intermediaries have created the barriers in getting the fair price for the farmers' hard work [7].

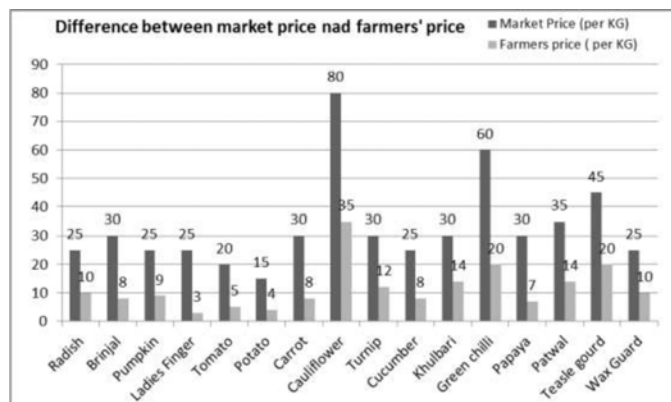


Fig 1 Difference between farmers' price and market price

Moreover, due to improper storage facilities, farmers bound to sell their product to the intermediaries at a very low cost. Ultimately, the farmers who produce and bear the risks associated with their farming and production are deprived of the major benefits of their products [7].

*B. Scenario 2 (Food safety issues due to improper supply chain):*

There are two types of food safety issues major in Bangladesh. One is the unintentional contamination of food products, caused by pathogenic microorganisms which results

diarrhoea and other health problems. Another one is food adulteration which is caused by intentional and sometimes unintentional addition of harmful pesticides and chemicals in food products results long term health problems. Moreover, perishable items like fish, fruits and vegetables are main sources of nutrition. Therefore, the population in urban areas are deprived from the nutritional benefit that causes serious health impairment.

Both types of food safety problems directly related with poor system of food supply chain in Bangladesh described in scenario 1. In case of bacterial contamination, lack of proper management system regarding storage and transportation system are responsible for the deterioration. If we consider the knowledge level of the farmers, they do not aware of using the right amount of pesticides which is actually used for protection of crops from pests and insect attacks. They use the pesticides so heavily and frequently that pesticides get leached into water bodies and remains in the crops including processed crops [6].

On the other hand, due to lack of proper marketing knowledge and storage facilities, farmers are bound to sell their product to middlemen or intermediaries in a very low cost. The middlemen use artificial ripeners, formalin, and inedible textile colors etc. for long term storage and for gaining huge profit [6]. Moreover, it is very difficult to trace the actual culprit in the total food supply chain. The traditional methods of farmers training, education on agricultural farming, the system of middlemen interference in food supply chain and existing marketing approaches may be inappropriate for proper traceability of the food in the value chain.

III. SIGNIFICANCE OF THE STUDY

In many countries like Bangladesh, it is necessary to focus on developing technology based approaches in agricultural knowledge sharing and supply chain by which, rural farmers can be able to improve their production, shorten their valuable time and can get proper linkage to trade their products [10]. There are three major parts in the agricultural sector where at least some technological approaches are needed for being scaled up;

1. Enhancing productivity of the farm
2. Accessing markets and value chains
3. Improving and maintaining the food safety of the agricultural products

Bangladesh has taken the concept of 'Digital Bangladesh' that includes the IT and related technology utilization in management, administration and governance to ensure transparency, accountability and answerability at all levels of society and state [11]. Targeting this vision, many stakeholders, government and NGOs are working on implementing advanced research and digital technologies in capacity building of the product yield. However, only implementation of technology is not enough in achieving the

objective, whereas, management of such technology, behavioural change of all stakeholders regarding adaptation of those technological innovations are major areas that need to be studied as well.

#### IV. METHODOLOGY AND PROBLEM ANALYSIS (CASE: BANGLADESH)

This conceptual paper is based on the observations of previous literatures where we have found potential gaps in the area of technical support for the rural smallholder farmers. We also have found significant gaps in the system where consumers cannot be assure about the products that they are consuming regularly.

Considering the gaps in mind, two conceptual models for knowledge development and capacity building or new system in supply chain using technologies, have been developed to fulfill the objective of the study. The primary factors that can motivate the rural farmers towards changing the behavior of producing safe food and deliver safe food are the combination of awareness development with proper supply chain management approach and this has been examined by the theoretical lens of Rogers' Diffusion of Innovation (DOI) Theory [22]. Literature on DOI theory based cases have shown successful adoption or late adoption or rejection of new ideas. Therefore, this theory has been found more appropriate for this study to explain the behavioral change pattern as shown in Fig 2.

#### V. CASES ANALYSIS FROM OTHER COUNTRIES

In India, where agriculture comprises the major portion of the rural farmers' income, the large amount of informational asymmetry in all stages of the agricultural supply chain has been found and this causes exploitation of the farming community and generates inefficiencies across the chain [12] [13]. Most farmers having small holdings, lack information on the global supply-and-demand conditions that affect the products' actual prices. Largely controlled by unscrupulous middlemen, farmers only get a small shares and this has lock the farmers into a vicious cycle of low income, low investments and low productivity [14].

Similarly, many countries in Africa like Mozambique, Cameroon, Burkina Faso, Senegal etc. are suffering from the food security and poverty issues and part of this problem lies in market structures, poor institution, infrastructure and policies serving in the agricultural sector [15].

In terms of food safety situation, not only the developing countries, but also in developed countries like United States and Europe, consumers are demanding quality food at lower cost, healthy, tasty, safe, organic/eco-friendly for maintaining healthier and sustainable lifestyle. Moreover, they want those foods where they can be assured about the production and delivery transparency [16].

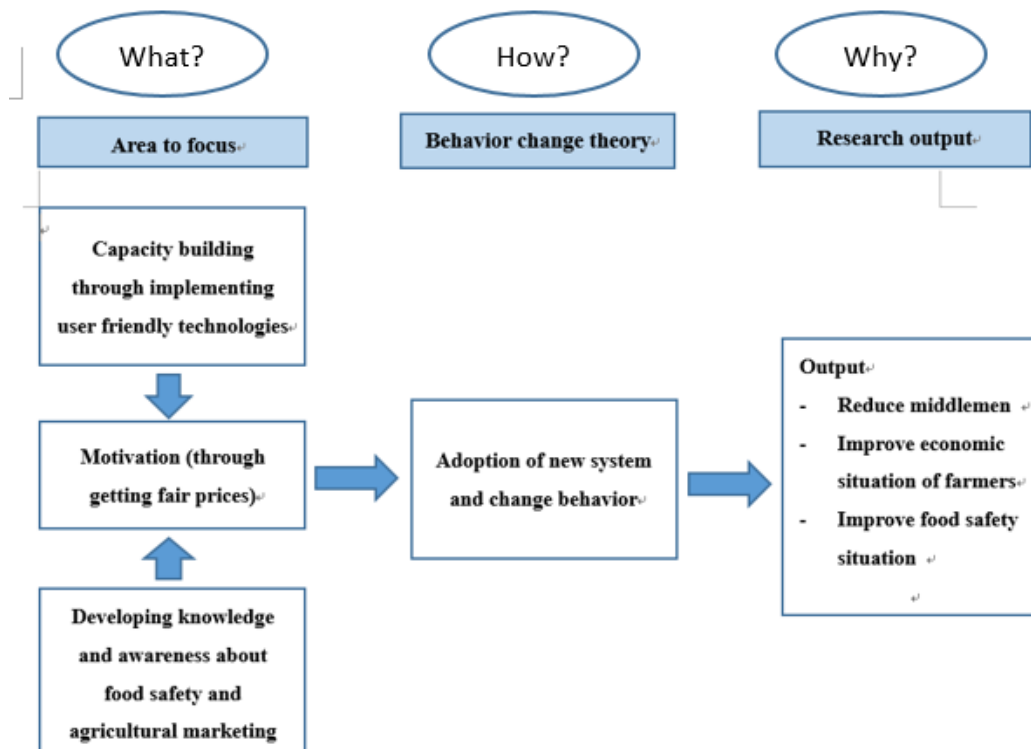


Fig 2: Concepts behind the development of Proposed Conceptual Model

### VI. TECHNOLOGY BASED MANAGEMENT APPROACHES IN OTHER COUNTRIES

#### *A. ITC-Choupal Initiatives in India*

Indian Tobacco Company (ITC) Limited came out with an innovative idea called “e-Choupals” model to the rural areas in India, which is an Information Technology enabled intervention to scale up the farmers empowerment and accelerate the motivation and growth of Indian agriculture. The lead farmers, prior getting training on “e-Choupal system through internet connected computers provided by ITC, can help neighbouring farmers about how to access in the specially designed website in local languages to get information about the agricultural information like weather forecast, price etc. [14].

#### *B. Eating from the Farm initiatives in Europe*

Many European countries like France, Spain, Czech Republic, Hungary and Italy have developed sustainable food supply system using management and technology applications. Farmers' market is one of the examples in Czech Republic where local foods are brought in the city by investing small amount of budget and collaboration with NGOs. This alternative food market is capable of delivering seasonal and fresh foods for the city people. This is real successful example of a proper management system [17].

Another approach has been taken by France, where a small group including 40 to 50 farmers have developed online networking system to manage the demand and supply of the foods to be delivered. This technological innovation of utilizing local website has been enlarged into large scale and operating their nationwide activities. This is another example of scaling up the small-holder farmers through simple technologies [17]. Another example from Poland shows the implementation of EPC technology (Electronic product code) which ensures the transparency and safety of the food products to the consumers [18].

### VII. CURRENT TECHNOLOGICAL INITIATIVES IN AGRICULTURE IN BANGLADESH

In Bangladesh, The National Agricultural Technology Projects (NATP) have taken initiatives to decrease ‘yield gap’ which means improving the production amount by using technologies with a particular focus on small and marginal farm [19]. On the other hand, little researches and efforts have been taken to create a sustainable and smooth supply chain system from farm to fork, considering the farmers' right of getting fair prices and control the intentional malpractice with food quality and safety.

Telecom operators, government and NGOs are in collaboration planning to provide the possible services like weather forecasting, production and cultivation suggestion, diseases and insect information, latest price information. However, sustaining these service provision is also difficult due to lack of suitable technical platform and unstructured business model. At present, though the Village Local Workers (VLWs) do the responsibilities of disseminating the information regarding the above mentioned services, but the acceptance rate is very less [19] [20] [21].

Department of Agricultural Extension (DAE), Department of Agricultural Marketing (DAM) of the Ministry of Agriculture, Government of Bangladesh has undertaken an e-government initiative that would utilize the power of ICT to develop and disseminate critical Agricultural Market Information to farmers, traders, government, policy makers, development agencies and other stakeholders [20]. Several E-commerce sites like amardesheshop.com, bikroy.com, cellbazar.com in Bangladesh where farmers can get direct benefits of selling their products through directly contacting with the buyers.

### VIII. APPLYING THE DOI THEORY

To achieve the appropriateness or to modify the contents of the proposed model, we have to verify it through existing theories whether this model is suitable for changing the behavior of the stakeholders (farmers, markets and consumers) or it will need minor or major changes to solve the proposed problem. Rogers' DOI is one of the popular and most applicable behavior change theory that consists of four key elements: an innovation, the social system on which the innovation impacts, the communication channels of that social system and time [22].

In Rogers' DOI theory, the Innovation-Decision process is the process through which an individual or other decision making unit passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject to implementation of the new idea and to confirmation of that decision [22]. In Fig 3 we have explained how our proposed model links with the DOI theory.

The major activities of innovation-decision process needs proper understanding of the new idea of implementing technologies in agricultural value chain. Therefore, we have proposed two conceptual model. One is to fulfill the requirement of developing knowledge among the farmers' about the new innovation and how it works by using technology. The successful implementation of model one will help to implement the other model or proposed system of supply chain.

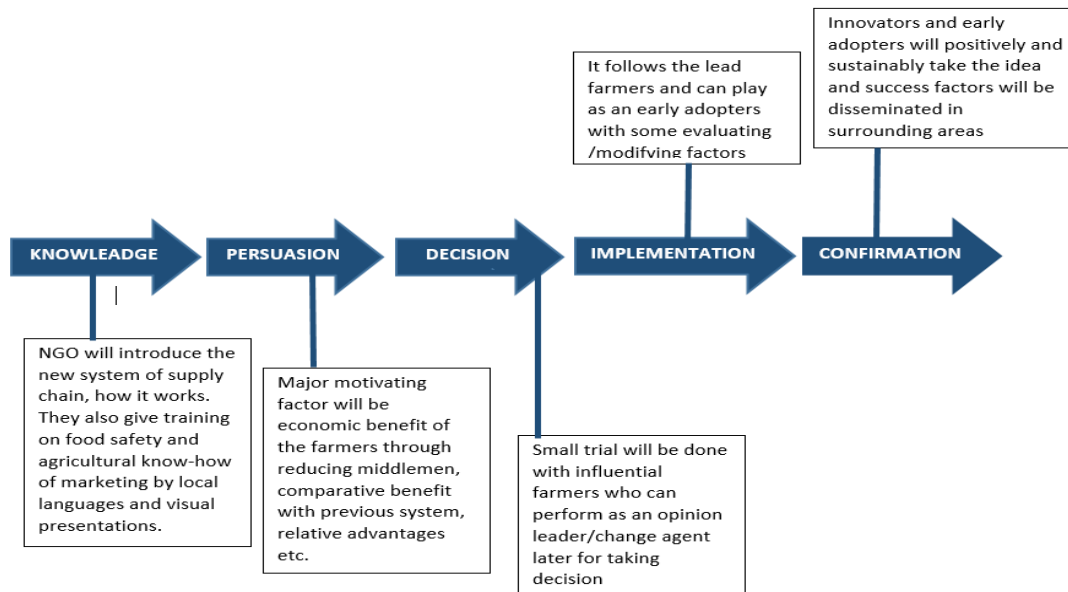


Fig 3: Adopting new idea of proposed model by (DOI) Innovation- Diffusion Process

## IX. KNOWLEDGE/AWARENESS DEVELOPMENT

The rural farmers of Bangladesh are not only very poor but also they are illiterate. Therefore, developing knowledge or awareness needed to be focused in three areas; i. Enhancing the production capability ii. Enhancing the market information iii. Enhancing the food safety information

### A. Enhancing the production capability

The agricultural knowledge on how to scale up the production needed to be translated in a local and understandable manner. Moreover, the information related to the fertilizer, land, types of seeds, machineries, seasonal crop plantation etc. are necessary information for the farmers which need to be reached very clearly.

### B. Enhancing Market information

As mentioned earlier that, poor and less educated farmers have little or no information about the actual price of their crops, how to bargain, where to sell, weather forecast, demand and supply information etc. For this reason, farmers are bound to sell their products at a very low cost to the middlemen and deprived from the fair prices.

### C. Enhancing the food safety information

Most of the farmers uses pesticides and fertilizers in a very high amount or they use harmful chemicals to ripen their products. They lack knowledge about the long term health impact not only for the consumers but also for their own families as well. Farmers also lack knowledge about how safely product can be harvested and stored. Farmers need to be educated with food safety information like good hygiene practice (GHP), good agricultural practice (GAP), good

manufacturing practice (GMP), Hazard analysis critical control point (HACCP) at local language.

Therefore, our conceptual model focuses on sharing knowledge about the current necessary information with the farmers as well as teaching the step by step approaches of delivering the product safely. Development of well-organized and informative video presentation can be introduced to educate both farmers and consumers as well. This needs collaborative approach of government, NGOs and experts from the related fields. These videos include information not only on educational contents but also in an entertaining approaches, that can grab the interest of farmers' very easily, like photo or flow chart presentation, drama or documentary covering all the above three areas step by step. Not only NGO but also some selected and experienced farmers will be trained in each sub-district, who can demonstrate the information on a regular basis through projector, which will be facilitated and supervised by local or District Health Officer. The total process shown in Fig 4 needed to be supported by government and NGOs by establishing the necessary infrastructure.

## X. ADVANTAGES OF THE PROPOSED KNOWLEDGE DEVELOPMENT FRAMEWORK

- Farmers can be able to learn and discuss all sorts of issues collectively. Farmers also can learn how to sell the product at a bigger market and how to get information about the current market price.
- Farmers also can be able to aware about the government laws and regulations if they make any fraudulence with the agricultural products.

- The video is also advantageous for the consumers to become aware, as the same videos will be telecasted in social media and shared through internet as well.

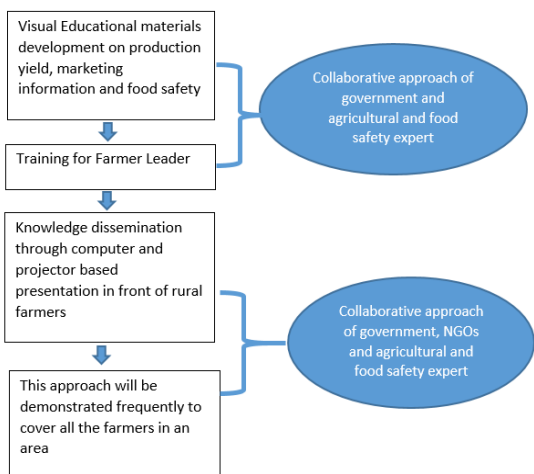


Fig 4: Proposed knowledge development framework using technology

XI. PROPOSED SUPPLY CHAIN MODEL

The current supply chain malpractices, especially in case of agricultural commodities has been shown in Fig 5.

The proposed conceptual model has been designed primarily focusing on the small-holder farmers whose main produces are fresh and perishable agricultural products. The model requires collaborative approaches of government and NGOs in terms of infrastructure development. The model of supply chain shown in Fig. 6 introduces the user-friendly technologies like common website with necessary information, using own transportation, National identification number (NID) and mobile banking. the following table will depict the comparison between the traditional system and newly proposed system by using technologies.

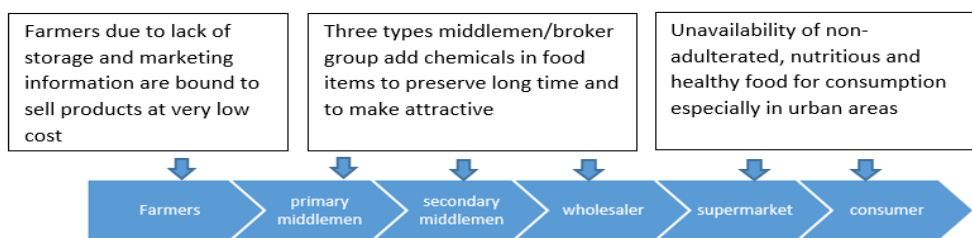


Fig 5: Loopholes inside the current supply chain process creating poverty and food adulteration in Bangladesh

TABLE 1: COMPARATIVE ANALYSIS OF TRADITIONAL SYSTEM VERSES NEW PROPOSED SYSTEM

Activities	Traditional system	Newly proposed model	Required items and how to manage
Demand and production	Lack of demand and forecast cause product wastage or economical loss	Developing common websites among supermarket and farmers community, provide all information	Implement internet facilities, website design, training of several persons who can operate by NGO
Market price	Similar problem as above and middlemen fraud farmers	Through same websites, farmers can get price updates as well	Updating the websites by supermarkets.
Product delivery	Lack of storage and transportation facilities cause middlemen interference, farmers get lower price and food adulteration and safety issues	Through the help of microfinance, farmers' community can be able to buy own transportation and deliver product safely.	NGO support for microfinance with easy installments.
Transparency and accountability	Almost absent in existing system. This cause increased level of food safety problems.	Direct trade between farmers to supermarket reduce food safety problems by reducing middlemen interference and increase transparency and accountability	Applying National identification number (NID) during locking the selling of product in websites. Also product testing and signing the log book prior receiving the product in supermarket
Transaction	Several middlemen in value chain, farmers receive cash in very low amount as a primary seller	Direct selling improve farmers economic situation and implementation of mobile banking will increase transparency and safety.	Mobile banking system is already available. Therefore need to be incorporated to serve for farmers.

XII. ADVANTAGES OF THE PROPOSED SUPPLY CHAIN FRAMEWORK

- Farmers can deliver their product directly and they can be able to get all sorts of information from website.
- Opportunities for middlemen interference will be reduced significantly.
- Product traceability can be maintained smoothly and wastage of the end product will be reduced.
- Application of NID number and mobile banking will ease the payment system as well.
- Consumers can be assured of the quality of the product and the whole system will be accountable for any kind of occurrence through producer identification.

XIII. ADDITIONAL RECOMMENDED IMPLEMENTATION IN THE MODEL

According to examples taken from Japan, minimum requirement of sufficient information, such as the source of food, producer name, their location, date of harvesting will be introduced as a registered seal on the products for consumer satisfaction.

In Bangladesh, every farmer have NID number which contains all the farmers' information in the backside of the card. Farmers will be received registered barcode, upon installing the local barcode system with the same information mentioned in NID card. This barcode will be stamped on each product pack and will be checked by barcode reader for traceability information at any point like retail or consumer.

XIV. CONTRIBUTION OF THE STUDY IN SOCIAL INNOVATION

Bangladesh has achieved several Millennium Development Goals (MDGs) in the past few years due to dedicated initiatives taken by government and NGOs. Every time, the population of Bangladesh has showed positive attitudes towards adopting the messages, education and practices. Therefore, farmers' motivation and food safety is significantly related with each other and if the farmers do not get right price, they cannot be driven towards maintaining safe food production. Our approach is not only implement the technologies but provide service both for farmers and consumers through proper management of the technological infrastructure.

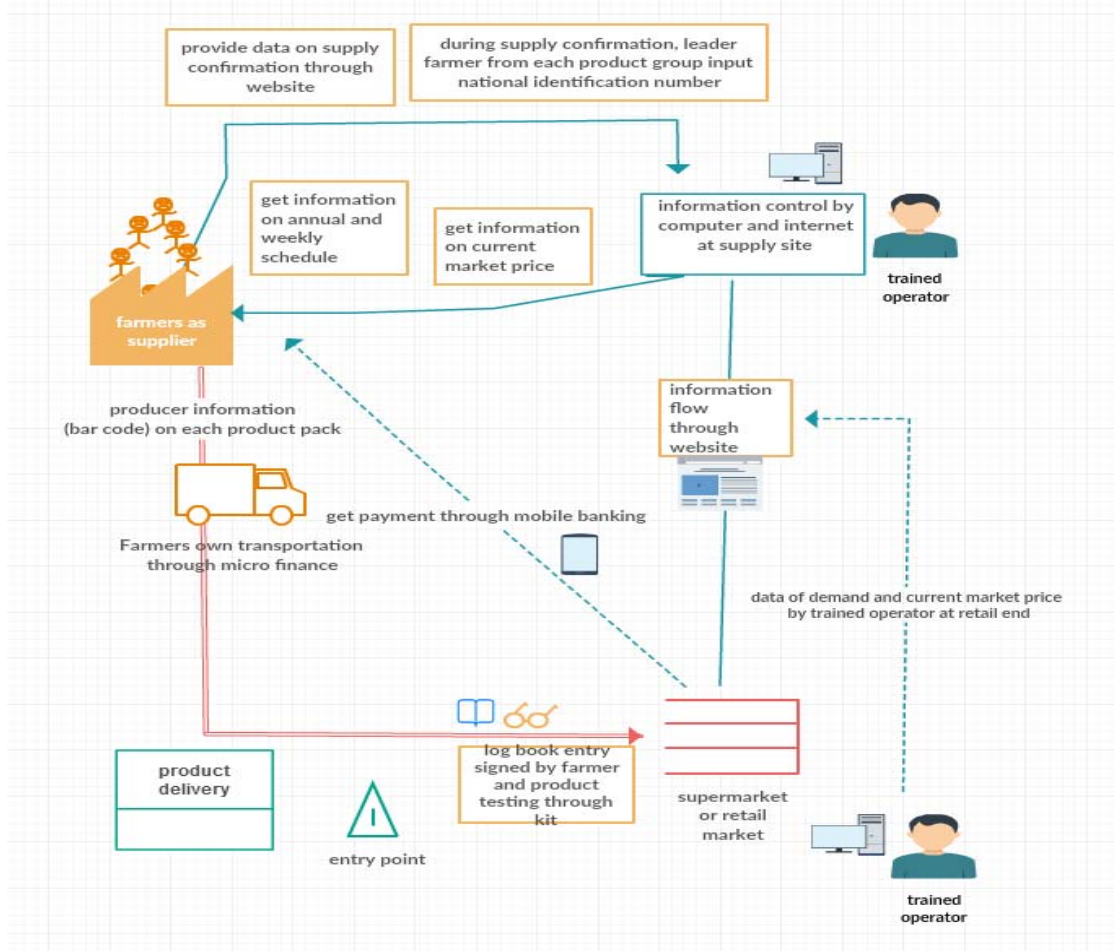


Fig 6: Proposed supply chain model using technologies (in diagrammatic form)

### XV. LIMITATION AND FEASIBILITY OF THE STUDY

The conceptual model that has been depicted in this paper is a theory based concept of technology related management approach that needs intervention program to be validated in practical. Therefore, future step of the study is to understand the adaptation of the proposed model and identify the obstacles and further modifications. Collaborative initiatives of all the stakeholders and proper facilitation and understanding of the model can bring significant positive outcome of the study.

### XVI. ORIGINALITY OF THE RESEARCH

This paper represents a very crucial social and health problem not only in Bangladesh but also other developing countries as well. The special focus has been demonstrated for developing country because these contexts need simple technological infrastructures for delivering safe food products to the consumers which are inexpensive and easy to adopt as well. The major strength of this study is the combination of developing knowledge and proposing structural management. Many government and NGOs are very much focused on creating awareness but if the proper facilities and infrastructure are not available, then it will be difficult to improve the situation only by focusing on awareness. Therefore, technology, especially Information and Communication (ICT) can be powerful tool if used appropriately, they can increase scale and impact, and multiply positive results as found in many other countries [23] [24].

The concept of this paper focuses on motivating farmers by understanding their economic benefit by using proposed idea based on user-friendly technologies for rural smallholder farmers. The adoption and proper management of this value chain system will automatically improve the food safety situation significantly.

On the other hand, in many researches, diffusion of innovation focused on user/client based approach, but in this paper, we have applied DOI to change behavior and provide facilities for producers, which will benefit both the producer and consumers. Such research may also uncover valuable information for providing leadership among public service providers who also may influence adoption of practice.

### XVII. CONCLUSION

Now-a-days, technology management is one of the significant component to scale up not only the big enterprises but also it is helpful to scale up the competitive advantages for rural and small entrepreneurs. Through proper management of simple technologies like computers, internet, mobile phones, digital identity cards, etc. even small holder farmers can be able to participate in bigger market and can compete with others. Using technologies for communication,

planning, monitoring, delivering, counselling etc. is easier approach than any other solution in current world.

The technologies that have been incorporated in the proposed model is already popular to the common people in Bangladesh. But the major challenge is, how to make the people understand about the benefit of adapting the innovative process. Moreover, food production and distribution systems are becoming more interdependent, integrated, and globalized. At the same time, emerging outbreaks of foodborne diseases through intentional and unintentional contamination have raised awareness of the need to ensure food quality and safety. Availability of proper service system from production to consumption and awareness measures would be appropriate to narrow down the risk of harm and close the loopholes for unsafe practices. Without the availability of non-adulterated food, only awareness cannot reduce the problem alone.

The success factor of this model is not only appropriate for the other sectors of the country but also it is appropriate for any other context as well. Proper management of less expensive technologies need minimum infrastructure. Especially in developing countries, cost effective technologies and collaborative approaches can reduce any other social problems. Finally, institutional, producer and consumer capacity building are highly recommended for achieving food safety. Additionally, good incentives can be approached for adapting the system and maintaining food safety to the successful farmers for their motivation.

### REFERENCES

- [1] Shahid, S., Chen, X.Y. and Hazarika, M.K.; "Evaluation of Groundwater Quality for Irrigation in Bangladesh Using Geographic Information System," *Journal of Hydrology and Hydromechanics*, vol. 54, pp. 3-14, 2006.
- [2] Osmani, A.G.; Hossain, E.; "Market Participation Decision of Smallholder Farmers and Its Determinants in Bangladesh," *Economics of Agriculture*, vol. 62, pp. 163-179, 2015.
- [3] Food and Agriculture Organization (FAO) of the United Nations. "Food Adulteration a silent killer," Retrieved 30 January, 2016 from <http://www.bdfoodsafety.org/food-adulteration-a-silent-killer/>
- [4] Hossain, M.M., Heinonen, V., & Islam, K. M. Z.; "Consumption of foods and foodstuffs processed with hazardous chemicals: A case study of Bangladesh," *International Journal of Consumer Studies*, vol. 32, pp. 588-595, 2008.
- [5] Food and Agriculture Organization (FAO) of the United Nations. "Scientific post-harvest management against food adulteration," Retrieved 30 January, 2016 from <http://www.bdfoodsafety.org/>
- [6] Asaduzzaman, M.; Ahmed, N.; Rokonuddwlah, M.; Faroque, A.B.M.; "Food Safety in Bangladesh: Practices, Impact, Policies and Institutions," *Research Report for IFPRI under the Policy Research and Strategy Support Program (PRSSP)*, Project Summary.
- [7] Abdullah, M.; Hossain, M.R.; "A New Cooperative Marketing Strategy for Agricultural Products in Bangladesh," *World Review of Business Research*, vol. 3, pp. 130-144, 2013.
- [8] Abbott, J.C.; "Agricultural Marketing Enterprises for the Developing World," *Cambridge University Press, Cambridge*, 1987.
- [9] Sultana, A.; "Rice Marketing in Bangladesh: From the perspective of village study at Cox's Bazar district," *African Journal of Agricultural Research*, vol. 7, pp. 5995-6004, 2012.



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- [10] Minten, B., Randrianarison, L., & Swinen, J. F.M.; "Global Retail Chains and Poor Farmers: Evidence from Madagascar," *World Development*, vol. 37, pp. 1728-1741, 2008.
- [11] Access to Information Programme. "Digital Bangladesh," Retrieved 30 January, 2016 from <http://www.a2i.pmo.gov.bd/digital-bangladesh>
- [12] Eggleston, K., Jensen, R., & Zeckhauser, R.; "Information and Communication Technologies, Markets and Economic Development," in *The Global Competitiveness Report*, World Economic Forum & Centre for International Development, Chapter 7, Harvard Business School, 2001-2002.
- [13] Ravallion, M.; "Testing market integration," *American Journal of Agricultural Economics*, vol. 68, pp. 102-109, 1986.
- [14] Anupindi, R., & Sivakumar, S.; "A Platform Strategy for Rural Transformation," in *Business Solutions for the Global Poor*, Jossey-Bass, Ed. Harvard Business School, 2007.
- [15] Conceição, P. and R. Mendoza.; "Anatomy of the Global Food Crisis," *Third World Quarterly*, vol. 30, pp. 1159-1182, 2009.
- [16] Serafin, R.; "Brokering shorter food supply chains," *The Journal of Partnership Brokering*, issue 5, 2015.
- [17] Malandrin, V., Dvortsin, L.; "Eating from the Farm" Retrieved 31 January, 2016 from [https://www.foceurope.org/sites/default/files/agriculture/2015/eating\\_from\\_the\\_farm.pdf](https://www.foceurope.org/sites/default/files/agriculture/2015/eating_from_the_farm.pdf)
- [18] Szymanowski, W.; "Information technology in formulation of transparency strategies for food chain and supply management in Poland," Retrieved 14 April from [http://anale.feaa.uaic.ro/anale/resurse/30\\_M11\\_Szymanowski.pdf](http://anale.feaa.uaic.ro/anale/resurse/30_M11_Szymanowski.pdf)
- [19] Ferdous, I.; "Pairing Agriculture with Technology in Bangladesh," *The World Bank*. Retrieved 30 January, 2016 from <http://www.worldbank.org>
- [20] "Use of ICTs in the Agriculture in Bangladesh," Retrieved 30 January, 2016 from <http://agricultureandfarming.wordpress.com>
- [21] "Possibility for ICT Adaption in Agriculture Sector: Bangladesh Experience" Retrieved 30 January, 2016 from <http://www.e-agriculture.org>
- [22] Rogers, E.M.; "Diffusion of Innovations," 5<sup>th</sup> Ed. New York: Free Press,
- [23] Rao, N.H.; "A framework for implementing information and communication technologies in agricultural development in India," *Technological Forecasting and Social Change*, vol. 74, pp. 491-518, 2006.
- [24] Rao, S.S.; "Social development in Indian rural communities: Adoption of telecentres," *International Journal of Information Management*, vol. 28, pp. 474-482, 2008