Influence of Dynamics of Actors and Information on the Organic Supply Chain

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***Abstract*— The agricultural sector throughout the world has seen shifting significantly by suitably using e-technology. A good number of studies have been conducted on agriculture and food security. The growth rate of world organic farming or business increases to more than the growth rate of traditional agriculture. In Bangladesh the pace of growth of organic agriculture is insignificant. The organic agriculture or organic supply chain in Bangladesh was scarcely studied. Hence, an intensive study is needed for the organic agriculture industry to pursue the organic supply chain that leads to a promising growth of organic business. A great deal of research has been conducted to explore the factors that may influence the organic supply chain and growth of the organic business. Several theories such as the diffusion of innovation theory, theory of planned behavior, marketing system and price of organic products, and quality function deployment have been studied and proposed to enhance the understanding of the issue. The integration of all these literature and theories has attracted the researcher's attention. Thus, this study aims to explore the influence of information systems, e-technology, and the dynamics of the actors (consumer, retailer, intermediaries, transporter, farmer, and basic suppliers) on the organic supply chain enhancing the growth of the organic business. By adopting secondary data with collected data (primary data) using self-administrated questionnaires the research work was evaluated. A total of 389 responses from the organic agriculture industrial actors, consumers, and transporters were collected using stratified random sampling methods. To inspect and analyze data, Path Analysis and Structural Equation Modeling (SEM) techniques were used with AMOS. The research objectives of this study were accomplished and research hypotheses were supported. The results of the study indicated that the proposed model provided a good understanding of the factors influencing the organic supply chain. From the result, it was revealed that the dynamics of the actors and the information influences the performance of the organic supply chain. This study theoretically offers useful information and collected data might help to further research relevant to the organic supply chain. In addition, the study finds a way to foster a better understanding and knowledge of the organic supply chain. It is encouraged to do future research to study the factors and information and impact of the organic supply chain from various aspects.**

Keywords: *Organic Supply Chain, E-Technology, Organic Agriculture, Growth of Organic Business, SEM, AMOS.*

1. INTRODUCTION

Agriculture plays a very important role in densely populated countries like Bangladesh. Bangladesh ranks eighth in the World population rank and fifth in Asia. A large portion of Bangladesh's population relies on agriculture for their lives & the country's economy. The conventional agriculture of Bangladesh after the Green Revolution heavily depended on chemical fertilizers and pesticides causing several problems to human health and the environment [4]. As a result, food safety has now become a big issue. Moreover, the cost of agriculture has increased manifold with declining yield levels and growing dependence on the market for the purchase of chemical fertilizers and pesticides. Hence the most urgent step is the application of bio-products to ensure a better and safer environment without any reduction in the yield of crops. Organic farming is a type of farming that puts natural processes and sustainability ahead of industrial procedures and synthetic chemicals. Instead, to preserve soil fertility and the general health of the ecosystem, it uses natural techniques like crop rotation, composting, and biological pest management. Technology and communication have been crucial in advancing the organic farming industry both globally and especially in nations like Bangladesh. Organic farming offers a wide range of advantages for human health and the environment. Due to its beneficial effects on human health, organic farming has become incredibly popular all over the world. Produce cultivated organically has less hazardous residue than produce grown conventionally, making it a safer option for consumers. A meta-analysis published in the British Journal of Nutrition found that organic foods had much greater antioxidant concentrations, which can help prevent chronic illnesses including cardiovascular issues and some malignancies. Furthermore, sustainable agriculture is promoted by organic farming. The worldwide organic agricultural industry has been greatly boosted by the combination of technology and communication. Social media and e-commerce platforms have made it easier for organic farmers and customers to communicate directly, resulting in a transparent supply chain and giving customers access to healthier food alternatives. The organic farming industry is expanding in Bangladesh as people become more conscious of environmental and health issues. The nation has a long history of agriculture, therefore organic farming is consistent with its objectives for sustainable agriculture. Over 1.5 million people are employed in the organic agricultural industry, which considerably boosts employment in rural areas, reported to the Bangladesh Bureau of Statistics. The development of organic farming in Bangladesh has been significantly influenced by communication and technology.

1.1 Background Study

A good number of studies have been conducted at home and abroad on food security. In modern times, the marketing of agricultural produce is different from that of the 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 [4].

However, there are many supply chain management issues that the organic agricultural industry had to deal with. Maintaining product purity, guaranteeing compliance with organic accreditation requirements, and effectively linking organic farmers with customers are some of these problems. Electronic technologies, often known as E-technology, have been included more and more in the supply chain for organic agriculture in response to these difficulties [1].

Organic farming (OF) is one such technology that can reduce the detrimental impacts of agrochemicals, and is considered by many scientists to be the best form of agriculture 1960s. People all over the world are expressing great concern over the indiscriminate use of chemicals. Therefore, importance is now focused on the use of organic and other byproducts of agriculture and industries. Scientific researchers have shown that the reduction or non-use of synthetic chemicals can lessen environmental hazards and possible adverse effects. In contrast to synthetic fertilizers, organic fertilizers could develop the physical, chemical, and biological properties of soil, and their use is important in sustaining soil productivity in the long term. Organic farming may be a good choice as the economical method that can trim down rural poverty and curb pollution. It is also the need in the present day perspective of serious threat to our ecology and environment. The farming method is the best means to make sure air, water, and soil are uncontaminated leaving the environment safe for the present and future generations [30]. For a sound future, organic farming offers a dynamic interaction between soils, plants, humans, ecosystems, and the environment [31].

1.2 Problem Statement

Now if we think from the context of Bangladesh then the International Trade Centre (ITC) reported that the Bangladeshi organic food market was worth about $5.5 million in 2019. Over the previous few years, the market has shown consistent expansion, with a CAGR (compound annual growth rate) of about 18%. Numerous factors, including an increase in health awareness, concerns about the environment, and government backing for organic agricultural methods, can be credited for this expansion [23].

Besides, in recent years, organic farming has remained a niche market in Bangladesh. But in the past decade, world organic agriculture has grown from a niche market to a market force, demonstrating that it is an option for profitable enterprises. Organic is the most rapidly growing food sector with a sustained 10% annual growth for more than a decade (FAO, Sustainable Agriculture and Rural Development 2012). As suggested by Burton et al., (2003), motivation, values, and attitudes determine individual farmers' decision-making processes. Thus, farmer types and their rationale for being organic have been identified by [24] and [33]. Reference [34] reviewed the evidence on the motivations of organic farmers and identified the most common factors among organic producers, including family's health, concern about husbandry (e.g., soil degradation, animal welfare), lifestyle choices (ideological, philosophical, religious), and financial considerations.

Farmers' attitudes towards organic farming should not be overlooked when exploring the potential to expand the adaptation of these practices. Previous studies have shown that farmers' attitudes are important determinants in their willingness and ability to adopt new technologies, including organic farming methods (e.g., [35], [37], [38]). According to [32], attitudes can be assumed to be relatively stable, although they may change due to new information received. [22] revealed that, compared to conventional farmers, organic farmers show greater enthusiasm and desire to learn about organic methods. However, the sources of learning materials or information on organic farming, health and environmental impact, sources of organic products, etc. are not available to farmers, customers, intermediaries, or retailers. The actors of the organic supply chain cannot decide to become organic due to a lack of proper information.

The rate of increase of the market of organic products is very poor in Bangladesh compared to the overall growth of the agricultural sector. There is no regular demand and supply pattern for organic products. The intermediaries or retailers do not know the areas or locations of the organic farmers, and the consumers have no idea about the time or retailers of selling organic products. The communications and flow of information among customers, farmers, intermediaries, and shops or retailers are not well established. There is no sign of industrialization in this sector. A very small portion of the farmers are aware of the economic and environmental benefits of organic farming compared to industrial farming. Likewise, consumer awareness about organic agricultural products remains at the beginning phase. The price of organic vegetables or fruits is very high compared to the vegetables or fruits produced through industrial agriculture due to the very low production of organic vegetables and fruits against the demand. So, it is evident that despite having a favorable growth trajectory, Bangladesh's organic agricultural food market is still modest in comparison to other nations.

Significant barriers prevent Bangladesh's organic agricultural food industry from expanding because of a lack of knowledge and understanding. The lack of understanding among farmers, customers, and legislators impedes the growth of organic farming in the nation despite its enormous potential. Firstly, a lot of farmers in Bangladesh are unfamiliar with organic farming practices, such as using organic fertilizers and insect control measures. Traditional farming methods mainly rely on chemical fertilizers, which makes it difficult for farmers to switch to organic practices without the right training and assistance [1]. This issue is further exacerbated by the lack of readily available training programs as well as data sources. Furthermore, there is little demand for organic food due to consumers' poor knowledge of its advantages. Many people choose conventional foods over organic ones because they believe that organic food is more expensive and difficult to get. Farmers have fewer reasons to adopt organic methods without the right incentives and assistance, and the industry struggles to grow [23].

The lack of customer knowledge and comprehension of the advantages of organic products also contributes to the assumption that they are more expensive. The importance of organic agricultural methods and the possible long-term advantages for human wellness and the environment may not be completely understood by many Bangladeshi customers [2]. Because of the lack of knowledge, consumers are reluctant to pay higher rates for organic goods, which discourages farmers from using organic farming practices.

To sum up, we can say the lack of information regarding the growth of the organic supply chain and in the view of research gap, the research anticipates that there are enormous opportunities in the field of technology adaptation in the organic supply chain, by filling the following research gap.

- Though organic farming or business continuously increasing insignificantly the factors behind the organic supply chain are scarcely studied.
- Existing agricultural supply chain studies focus on the traditional way but pay less attention to the contribution of information and communication to the organic supply chain.

From observation and by extensively reviewing the literature it is revealed that a lot of factors are being considered to explore the organic supply chain and the growth of organic business. To express the research aim and research objectives significantly, it is necessary to narrow down the scope of the study area into research questions. The following research questions are devised to focus on the research objectives.

- How do actors of the organic business influence the organic supply chain?
- What is the relation between information and communication system and the organic supply chain?

1.3 Research Objectives

R**esearch questions** pinpoint exactly what a researcher wants to find out in the research work. Good research questions is essential to guide a research paper. The following objectives of the study have been depicted in order to investigate the research questions.

1. To explore the influences of actors of the organic business on the organic supply chain.

2. To investigate the relationship between information and communication system on the organic supply chain

2. Literature Review

Organic farming (OF) is a farming system that uses environmentally friendly methods of weed, pest, and disease control. The principles and practices of OF have been expressed in the standards of the International Federation of Organic Agriculture Movements (IFOAM) as the principles of health, ecology, fairness, and care. In 1998, IFOAM adopted basic standards for OF and processing. Organic production methods are those where at least 95% of the ingredients of agricultural origin are organic. Organic content less than 70% in products may not refer to organic production methods. [39]

All countries have established special logos for organic production to indicate that products are covered by the inspection scheme. Certified OF is now practiced in approximately 120 countries of the world. According to the last survey, more than 31 million ha is currently managed organically by at least 623 174 farms worldwide. [39]

The dos and don’ts of organic farming give direction for scientific innovation to benefit both the environment and society. However, organic farmers are confronted with real production problems that are already solved in conventional farming systems.

Consumers are often seen as the limiting factor in the transition to organic. Studies show that consumers are well-informed about organic agriculture in most countries and a majority of them appreciate it as being the best option for agriculture and food [40]. In contrast with this positive marketing profile, organic food consumption is below 10% even in countries with developed organic markets.

Systems research is not always rewarding in the short term, as results take longer to produce, and inter- and transdisciplinary research tends to overextend scientists. Investment in organic farming research promises an efficient return in contrast to conventional farming, as the marginal utility of organic research is still high. Research funding in organic agriculture is insufficient in most regions of the world, and a critical mass of research teams is needed to address the problems faced by organic

2.1 Organic Agriculture

Organic farming (OF) is a farming system that uses environmentally friendly methods of weed, pest, and disease control. The principles and practices of OF have been expressed in the standards of the International Federation of Organic Agriculture Movements (IFOAM) as the principles of health, ecology, fairness, and care. The organic movement began after 1920, as a reaction by individual agricultural scientists and farmers against industrialized agriculture. Three important movements have been received within the first half of the twentieth century: biodynamic, organic, and biological agriculture. In 1998, IFOAM adopted basic standards for OF and processing. Organic production methods are those where at least 95% of the ingredients of agricultural origin are organic. Organic content less than 70% in products may not refer to organic production methods. [39]. All countries have established special logos for organic production to indicate that products are covered by the inspection scheme. Certified OF is now practiced in approximately 120 countries of the world. According to the last survey, more than 31 million ha is currently managed organically by at least 623 174 farms worldwide [39]. Organic agriculture not only conserves resources and nature; it is also conservative as a farming system. Rooted in the traditional knowledge of farmers, driven by consumer expectations like “nature knows best”, and guided by a precautionary approach, organic farming is skeptical of novel technologies.

The effects of traditional farming practices on public wellness as well as the environment have come under increasing scrutiny in recent years, raising awareness and concern. Consequently, there is now more demand for agricultural goods that are organic [1]. Profitable and environmentally friendly methods are promoted by organic farming, which forgoes the application of synthetic pesticides, GMOs, and chemical fertilizers. The significance of organic agricultural goods for preserving biodiversity, preserving the environment, and protecting human health are many. Natural fertilizers, including dung and manure, which nourish the soil with vital nutrients, are prioritized in organic farming practices. As a result, compared to crops farmed conventionally, organic crops typically have a better nutritional value. A robust immune system and the prevention of chronic diseases depend on antioxidants, vitamins, and minerals, all of which are frequently higher in organic fruits and vegetables [25]. Moreover, artificial pesticides and herbicides are not allowed in organic farming. These substances have been connected to many health problems, such as neurological diseases, malignancies, and respiratory problems. Customers can reduce their visibility to these dangerous compounds and promote a better lifestyle by buying organic agricultural goods [6]. Agriculture that is organic benefits the environment. Artificial pesticides and fertilizers, which can be harmful to ecosystems, are frequently utilized in conventional farming. These substances can pollute water supplies and destroy aquatic life when they are used to fields and then leach into rivers, lakes, and groundwater [26]. In addition, pesticide residues can linger in the soil for a long time, upsetting the usual equilibrium of microorganisms and lowering soil fertility [4]. Natural pest management techniques, like crop rotation, beneficial insects, and physical barriers, are emphasized in organic farming. These procedures encourage biodiversity while causing the least amount of damage to natural ecosystems. Additionally, organic farmers place a high priority on soil conservation practices that assist in avoiding erosion of soil and maintain the health of the soil, like cover crops and the usage of organic matter [23]

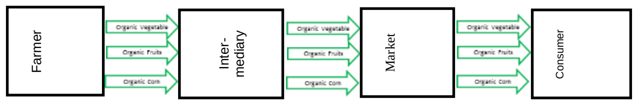


Figure 1: Organic Supply Chain

Consumers are often seen as the limiting factor in the transition to organic. Studies show that consumers are well-informed about organic agriculture in most countries and a majority of them appreciate it as being the best option for agriculture and food. In contrast with this positive marketing profile, organic food consumption is below 10% even in countries with developed organic markets. Therefore, the bottleneck to bring organic agriculture into the mainstream is not consumption but agricultural production. Technical problems lead to high costs, insufficient market supply, and reluctance by farmers to accept high risks and greater labor requirements.

Organic food and farming systems might be very attractive fields for scientists to search for system-oriented solutions. On the other hand, systems research is not always rewarding in the short term, as results take longer to produce, and inter- and transdisciplinary research tends to overextend scientists. Investment in organic farming research promises an efficient return in contrast to conventional farming, as the marginal utility of organic research is still high. Research funding in organic agriculture is insufficient in most regions of the world, and a critical mass of research teams is needed to address the problems faced by organic farmers.

2.2 Factors Encouraging the Development of Organic Agriculture

Over the past few decades, organic agriculture has expanded significantly around the world. The rise of the organic agriculture industry is mostly due to the spread of organic farming, the success of organic businesses, especially the growth of organic consumers. On a worldwide level, organic farming has experienced amazing development. Data from a number of reliable sources indicate that the organic farming industry has been expanding steadily over time. For instance, research by [17] revealed that the amount of organic agricultural land worldwide expanded by over 127% between 2000 and 2017, showing a significant upsurge in organic farming techniques. However, Bangladesh has also seen a considerable increase in organic farming, albeit at a slower rate than the worldwide norm. According to statistics provided by the Bangladesh Organic Products Manufacturers Association (BOPMA), the country's organic farming area rose by over 40% between 2010 and 2020. This increase is positive, but it's important to remember that Bangladesh's growth rate is below the world average because of a number of problems unique to the country.

A considerable movement in consumer tastes toward sustainably produced and ecologically friendly products may be seen in the expansion of organic agriculture internationally (IFOAM Organics International, 2019). Between 2000 and 2017 there was an average annual growth rate of 6.1% for the worldwide organic market, according to statistics from the Research Institute of Organic Agriculture (FiBL) and IFOAM Organics International [7]. Bangladesh, however, shows a comparatively slower development trajectory when compared to the rate of organic company growth experienced elsewhere. According to a research by [2] Bangladesh's organic agriculture has grown annually at a pace of about 2 to 3 percent in recent years. This rate is lower than the average for the globe, indicating that Bangladesh's organic industry has not witnessed the same level of growth and acceptance as in many other regions of the world.

Besides, this difference in growth rates is caused by a number of variables. First off, consumers' and farmers' insufficient knowledge of the advantages of organic farming in Bangladesh is a major factor. According to a research by [28], a sizable section of the Bangladeshi populace is still uninformed of the benefits of organic produce and how it affects both health and the environment. Because of this ignorance, there is less of a market for organic goods, which slows the industry's expansion. Second, difficulties like a lack of technical expertise and training, restricted access to organic inputs, and worries about the upfront costs of switching to organic farming can be blamed for the relatively low adoption of organic farming practices among farmers in Bangladesh [29].

Due to its potential advantages for promoting economic growth, human health, and environmental sustainability, organic agriculture has experienced tremendous global expansion. Numerous variables affect the growth of organic agriculture, with major supply chain players' decisions and active involvement being one of the most important. The factors promoting the growth of organic agriculture are covered in this section, with an emphasis on the participation, advantages, farming and business decisions, demand and supply dynamics, knowledge of the health and environmental benefits, transportation, and expertise of the involved actors, including suppliers, farmers, intermediaries, shopkeepers, wholesalers, and customers, both globally and specifically in the context of Bangladesh. The involvement of significant actors of organic supply chain including farmers, middlemen, store owners, wholesalers, and consumers, is crucial to the development of the organic agricultural industry.

Several variables might affect a person's decision to engage in organic farming or associated economic operations. Significant influencing factors include economic factors, market demand, environmental awareness, and legislative support. The decision to switch to organic farming is supported in industrialized nations by legislative frameworks, such as subsidies and awards for organic farmers. The decision is also influenced by farmers' willingness to use sustainable practices and diversify their sources of income.

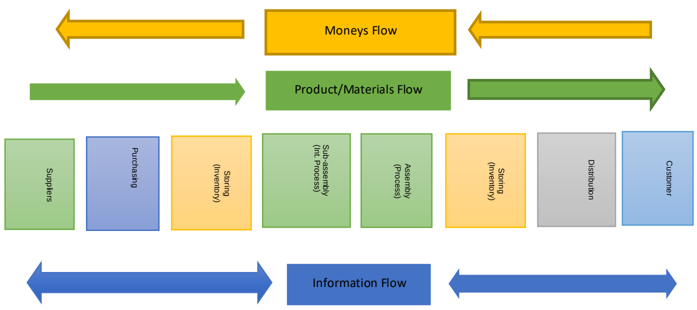


Figure 2: Supply Chain and the Flows

A supply chain is a business process from the procurement of raw materials and products required to end customers through cash, logistics, and information flow [8]. The agricultural supply chain refers to the initial breeding development, cultivating, ripening, harvesting, and producing validation or quarantine through grading, sorting, packaging, transporting, processing, storing, wholesale, retailing, promoting and sending and receiving market information, following into the market to sell until delivered to the final customer [9]. Agricultural logistics is a process in which agricultural products are delivered from original markets, wholesalers, retailers, and finally to consumers, via a set of logistical value-added activities including collecting, grading, packaging, transporting, processing, storing, promoting, and information collecting [15].

2.3 Market of Organic Agricultural Products

According to the latest FiBL/IFOAM survey (2006) on certified organic agriculture, there are 32.3 million hectares of organic agricultural land (including inconversion areas) in 160 countries. In terms of area, Oceania (12.1 million hectares) covers the top amount of land, followed by, Europe (7.8 million hectares), and Latin America (6.4 million hectares). Development of the organic industries in Australia, New Zealand, and the Pacific Islands has been strongly influenced by quick-growing overseas demand. On the other hand, Australia, Argentina, and the United States have the most organic land area. At present, 0.9 percent of the world's agricultural land is organic. Growth is strongest in Europe, where the area increased by almost one million hectares. The countries with the largest increases are Argentina, Turkey, and Spain [11]. The land under organic management in the world is shown in Figure 1. For instance, the world's coffee market was estimated to be worth over USD 102.15 bn in 2020, demonstrating the high demand for this well-liked beverage all over the world [1].

Among all producers in the world, forty percent of them live in Asia followed by Africa, and Latin America. The countries with the most producers are India (677,257), Uganda (187,893), and Mexico (128,862). Most of this grouping of land is used for cereals including rice, followed by green fodder from arable land and vegetables. Stable crops make up approximately six percent (2.4 million hectares) of the organic agricultural land. The most important crops are coffee after that olives, cocoa, nuts, and grapes [11].

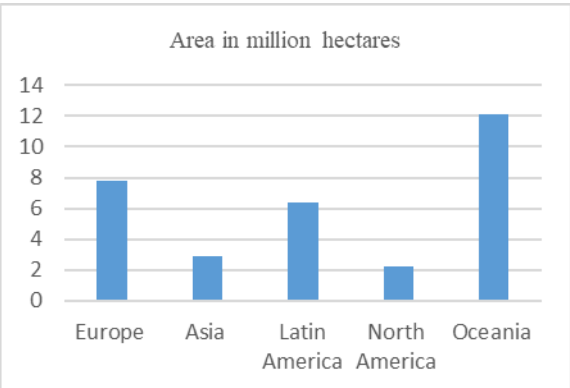


Figure 3: Continent-wise Organic Farming Land Area

2.4 Impact of Organic Farming

Compared to traditional agricultural products, organic agricultural products have many benefits. Choosing organic food is a step towards a better future for people and the environment, from sustainable agricultural methods and lower chemical contact to higher nutritional content and support for ecosystems. We will be able to observe notable changes by accepting organic agricultural products [26]. Farming practices are one of the key distinctions between conventional and organic agriculture. While conventional agriculture frequently uses synthetic chemicals and intense farming practices, organic farming promotes the use of natural means to maintain soil health. To improve soil fertility and structure, organic farmers use techniques including crop rotation, cover crops, and composting [25]. Organic farming methods tightly restrict or forbid the application of such substances, commonly limiting the exposure of consumers to potentially dangerous substances [1]. Numerous studies have connected pesticide exposure to a range of health concerns, such as neurological illnesses, cancers of the respiratory system, and difficulties with the nervous system. People may protect their health and the health of their families by purchasing organic products to reduce their visibility of these dangerous substances [4]. Compared to conventional counterparts, organically grown crops have been demonstrated to have higher nutritional value. According to research, vegetables, grains, and fruits grown organically are higher in important vitamins, minerals, amino acids, antioxidants, and phytochemicals [23]. It has been discovered that organic animal-derived goods, such as meat and milk, have higher concentrations of healthy omega-3 fatty acids. People can maximize the amount of nutrients they consume and boost their general well-being by selecting organic items [12].

2.5 Role of Information in the Organic Supply Chain

The way agricultural goods are handled, distributed, and promoted internationally has been completely transformed by the incorporation of electronic technology (e-technology) into the organic supply chain. E-technology is the umbrella term for a variety of digital tools, platforms, and systems that improve communication, information flow, and overall supply chain efficiency for organic agricultural goods. Information is crucial to decision-making processes in the modern organic agriculture industry. Real-time access to a variety of information sources, including as market trends, customer preferences, climatic data, and best agricultural practices, is made possible by e-technology. These sources may be used by farmers, suppliers, and distributors to make well-informed choices. E-technology also offers a variety of communication channels, including email, online discussion boards, social media, and video conferencing, allowing stakeholders to engage and work together without any difficulty. E-technology has revolutionized the way that information is gathered and shared. A McKinsey & Company research from 2020 claims that the digitalization of agricultural operations has greatly increased information exchange, resulting in a 20–30% rise in productivity throughout the world's agricultural supply chains.

Many nations have made significant progress in integrating e-technology into their supply chains for organic agriculture. One country that has made considerable investments in e-technology infrastructure is the Netherlands, which has enabled data analytics, automated monitoring, and precision farming. The country has advanced to the forefront of e-technology use in the agriculture sector thanks to government initiatives and private sector cooperation (European Commission, 2021). According to estimates from the United States Department of Agriculture (2019), the adoption of e-technology in the organic agricultural industry has reduced supply chain costs by 50% and inventories by 30%. This has increased American organic agriculture goods' ability to compete on the world market. However, Bangladesh hasn't experienced a commensurate development in the adoption of e-technology inside its organic agriculture supply chain. This difference is brought on by several variables. Digital inequality in the nation is one important cause. As of 2019, only over 21.8% of Bangladesh's population, according to the World Bank (World Bank, 2021) have access to the internet. The widespread use of e-technology by farmers and other agricultural stakeholders is hindered by the industry's low internet penetration. In order to fully utilize the potential of e-technology and raise the competitiveness of its organic agricultural goods on the international market, Bangladesh must address these issues.

Besides, Information and communication technology in agriculture (ICT in agriculture), also known as e-agriculture, focuses 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. ICT includes devices, networks, mobiles, services, and applications; these range from innovative Internet-era technologies and sensors to other pre-existing aids such as fixed telephones, televisions, radios, and satellites. Provisions of standards, norms, methodologies, and tools as well as the development of individual and institutional capacities, and policy support are all key components of e-agriculture.

Figure 4: Organic Information Flow

Many ICT in agriculture or e-agriculture interventions have been developed and tested around the world to help agriculturists improve their livelihoods through increased agricultural productivity and income, or by reducing risks. Some useful resources for learning about e-agriculture in practice are the World Bank’s e-sourcebook ICT in Agriculture – Connecting Smallholder Farmers to Knowledge, networks, and Institutions (2011), [2] ICT Uses for Inclusive Value Chains (2013), ICT Uses for inclusive value chains (2013) and Success stories on information and communication technologies for agriculture and rural development [5] have documented many cases of use of ICT in agriculture.

ICT applications can make a significant contribution to meet this future global food needs. Information and Communication Technology can do so by collecting and sharing timely and accurate information on weather, inputs, markets, and prices; by feeding information into research and development initiatives; by disseminating knowledge to farmers; by connecting producers and consumers, and through many other avenues [23].

Already, in the agricultural and food sectors of many countries, ICT companies, multinational farm input businesses, and large machinery manufacturers, but also small and medium farm input suppliers provide a number of services to farmers through ICTs, including extension advice. Downstream, supermarket, retailers, and agricultural product buyers also engage in the food value chain through ICTs, where the technology is also used by farmers’ cooperatives, international organizations, civil society, and governments to effectively provide information on many aspects of farming, including regulation. In many cases, ICTs form an integral part not only of information flows but of the actual farming operations and food processing from testing the soil in the farm to using 3D printers to process food [25].

ICTs can play a crucial role in bridging this critical information and knowledge gap. Then, Transaction costs explain why markets are missing or do not function well. Smallholders are not well integrated into markets due to high transport costs and their lack of ability to deliver consistent, quality, and large volumes of produce [25]. ICTs have the potential to reduce costs. In India, e-Choupal, a trading platform, reduces transaction costs by connecting buyers with farmers, using Internet kiosks. Through its ICT-kiosk platform, eChoupal also offers farmers additional services, such as sharing of best practices to improve productivity, and price benchmarking to increase sales prices [23]. Use of e-technology plays an important role in consumer’s price of agricultural products [41].

Nearly 70 percent of the bottom fifth of the population in developing countries own a mobile phone. The number of internet users has more than tripled in a decade, from 1 billion in 2005 to an estimated 3.2 billion at the end of 2015 [27].

2.6 Research Hypotheses

By studying literature, and theories, and considering the conceptual model the following hypotheses were

H1 There is a positive and significant relationship between the actors and the organic supply chain.

H2 Information significantly influences the performance of the organic supply chain

3. METHODOLOGY

This research study aims to investigate the influence of factors of the actors and information on the supply chain of organic agricultural products. This study used secondary and primary quantitative data in its research methodology. At first, secondary data was collected mostly for getting an idea about the population for primary data. The primary data of the research were survey output of the main stakeholders, such as farmers, intermediaries, retailers, and consumers of the organic supply chain. To gather data regarding e-technology adoption, factors, information, growth of farming and consumption, and supply chain changes, a thorough survey instrument has been devised. The survey were conducted face to face with hardcopy questionnaires in English and Bangla languages, and using google form for online survey. The survey data were gathered in SPSS database, and SPSS and AMOS were used for analyzing the data. Representative involvement was ensured via stratified sampling. To statistically evaluate the influences of factors. information, and the effect of e-technology, descriptive statistics & inferential techniques like chi-square testing, path analysis, and structural equation modeling were employed. The research advanced theoretical understanding and real-world applications in the industry by giving a thorough grasp of how e-technology affects the organic agriculture supply chain.

3.1 Target Population and Population Size

The target population of this study includes a wide spectrum of participants in the organic agricultural supply chain. Our study focuses particularly on the following significant groups:

- Farmers: This category comprises those who work in the supply chain and engage in organic agriculture methods, such as cultivate crops, supply manure & insectiside, etc.
- Intermediaries: Organizations that help transmit organic agricultural goods from producers to consumers are known as intermediaries. Distributors, wholesalers, arotdar, bepari, or logistic support companies may be among them.
- Retailers: Shopes or supershops that are crucial to the distribution & sale of consumers' access to organic agricultural products.
- Consumers: Also known as individuals and households, consumers are the people who buy and consume organic agricultural goods.

The researcher studied journals, books, articles, country's statistical data, etc to get secondary data. According to secondary data there are around 16.5 million farmaers in the country and only 2.2% of them (around 363 thousand) engaged fully or partially in the organic farming. Around 204 thousand intermediaries (Bepari, whole seller, arotdar, transporter, etc) playing in the business of agricultural products of them 43 thousand (around 21%) fully or partially engaged in organic business. Seasonal and full time retailers sell agricultural products in the country. There are around 700 thousand all type retailers of the agricultural products and 12% of them (around 84 thousand) sell organic products along with traditional agricultural products. There are around 42.3 million household and all of them are consumer of the agricultural products, but only around 2% (846 thousand) of the household are organic consumer along with traditional agricultural products.

Therefore, the total targeted population of the study was around 1.336 million (= 363 + 43 + 84 + 846 thousand) and the data was collected from all over the country.

3.2 Data Collection Method

In the study primry and secondary data were collected for analyzing and finding answer to the research questions. Self-administered hard copy and online questionnaire are used for collecting primary (survey) data. Various sources including country's statistical data, journals, articles, books, conference proceedings, etc were used to collect Secondary data for the study.

3.4 Sample Size

The choice of sample sizes is a crucial component of this study. This study used probabilistic, stratified sampling approach. Farmers, intermediates, retailers, and consumers are the four separate strata that best reflect core stakeholder groups.

The researcher assigned total sample size as well as sample sizes to each of the important four stratum, including suppliers, farmers, intermediaries, and consumer. In the study the researcher used probabilistic, stratified sampling approach.

To determine total sampling size the researcher considered a confidence level of 95% and corresponding value of Z is 1.96, p is 0.5 as the variability in the proportion is unknown, the margin of error is 5% (0.05); the sample size $n_0 = \frac{(1{,}96)^2(0.5)(1-0.5)}{(0.05)^2} = 384.16 \approx 385$.

The population of the four strata Farmers, intermediaries, retailers, and consumers are 363, 43, 84, and 846 thousands respectively.

Therefore, sample size for Farmers, n_f = 385 x 363/(363 + 43 + 84 + 846) = 105

Sample size for intermediaries, n_i = 385 x 43/(363 + 43 + 84 + 846) = 13

Sample size for retailers, n_r = 385 x 84/(363 + 43 + 84 + 846) = 24

Sample size for consumers, n_c = 385 x 846/(363 + 43 + 84 + 846) = 243

A total of 389 responses were collected from the four strata with 102, 21, 25, and 241 samples respectively

4. Analysis and Findings

The initial information analysis produced by SPSS Version 23.0 will be explained. The analysis of the data editing and coding, data screening (i.e., missing data, normalcy, assessment of outliers, as well as common method bias), and frequency analysis (i.e., demographic profiles and respondents' knowledge of the environment) are all included in the elaboration. Descriptive analysis (i.e. mean & standard deviation) as well as the reliability test (i.e. Cronbach's alpha) was carried out.

The Structural Equation Modeling (SEM) analysis was carried out using the AMOS GRAPHICS. The examination of the collinearity assessment & part coefficient analysis are incorporated into the analysis.

Utilizing questionnaires, the data-collecting procedures are conducted over the course of eight months. A total of 525 questionnaires have been sent over this time. Only 389 of those are genuine copies, and 437 of those copies are returned. As a result, 389 data in total might be used for additional research. The figures indicate that 78% of respondents responded.

4.1 Demographic and Business Factors of the Respondents

The respondents' demographic features are shown in Table 4.2 and include seven elements: actor type, gender, education level, age, marital status, area of living, and interested production system. Out of 389 respondents, 41.3% consumers, 21.56% farmers, 11.56% retailer/shop, 9.25% bepari, 6.94% whole-sellers, 4.62% arotdar, and 4.62% transporter respondents are reported. Among the respondents 52.60% are male and the remaining are female (47.4%)

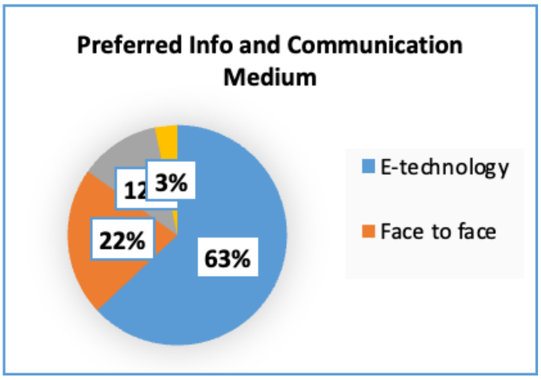
In terms of the overall sample, 98.77% of respondents have shown their interest in fruits, 93.83% in vegetables, 88.89% in cereal, 54.43% in potatoes, and 29.63% have shown their interest in other products. Regarding their residential structure, a sizable percentage of them are from upazila town (30.64%), followed by big city (23.7%), rural area (20.23%), city (13.29%), and remaining from district town (12.14%).

Regarding the production system, 43.35% of respondent showed their interest in the organic system, followed by 31.79% in both organic and traditional systems, and the remaining showed their interest in the traditional system.

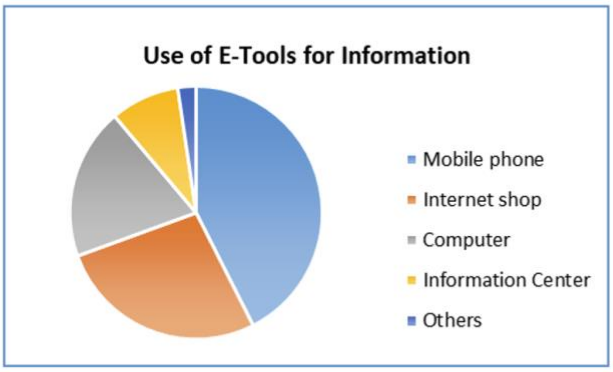
The majority of respondents (45.09%) are in the age range of 40 to 60 years. Respondents in the range of age of 25 to 40 years were in second place (41.04%), followed by those in the range of 18 to 25 years (9.25%), and at last those over 60 years of age (4.62%).

4.2 Technology Adaptation of the Respondents

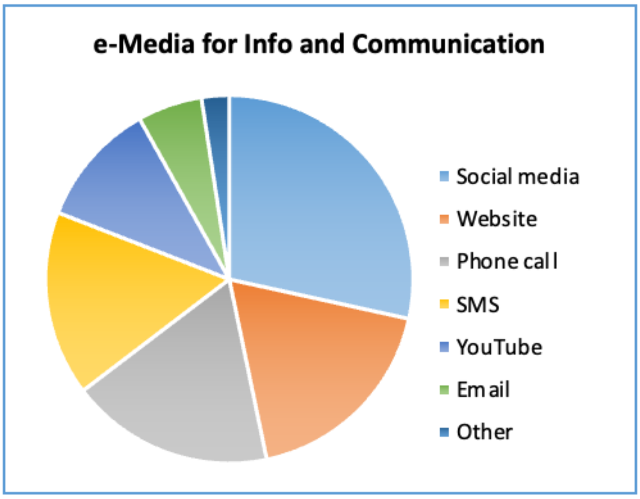
Among 389 respondents, 63.02% have shown their preference for getting information and communication using e-technology, followed by 21.79% in favor of face-to-face communication and exchange of information, 11.88% on electronic media, and the remaining fraction prefer print media.



Regarding their adaptation of e-tools, a sizable percentage (89.1%) use a mobile phone, 56.4% use the internet, 40.6% use computers, 18.5% use information centers, and 4.9% use other options.



The majority of the respondents (86.4%) are interested in getting information and want to communicate via social media, 55.56% via website, 54.43% using phone calls, 43.38% through SMS, 33.33% via YouTube, 17.28% using email, and 7.4% in other options.



4.3 Reliability Test

Internal consistency metrics are used in this study to assess the instrument's reliability. The most accurate way to assess the scale items' internal consistency for this purpose is to use Cronbach's alpha. Sekaran and Bougie (2016) state that the degree to which each scale item connects with the others is determined by Cronbach's alpha. Generally speaking, a scale is regarded as credible when Cronbach's alpha is above the cutoff value of 0.7 (Nunnally, 2017). Cronbach's alpha over 0.6, according to Hair et al. (2018), is suitable for preliminary study and scale development. The overall Cronbach's alpha is 0.852.

4.4 Hypothesis Testing

Testing of Hypothesis H1: There is a positive and significant relationship between the dynamics of actors and the organic supply chain.

Hypothesis H1 is tested by Structural Equation Modeling (SEM) analysis using AMOS 23. Figure showing exogenous variables of factors of the actors influencing the Organic Supply Chain.

Results: Maximum Likelihood Estimates

Chi-square = 256.970 Degrees of freedom = 35, Probability level = .000

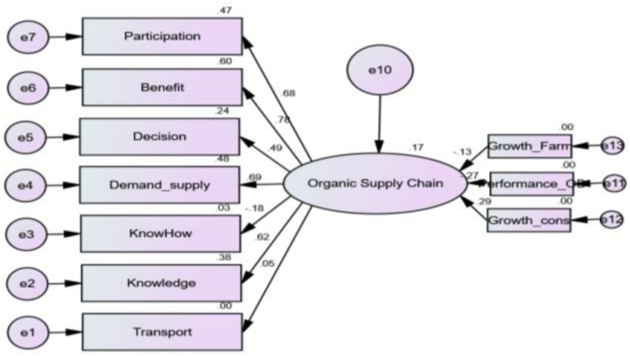


Figure 28 SEM- the influence of the exogenous variables (Dynamics of the Actors) on the Organic Supply Chain (OSC)

The results show significant regression weights, indicating good relationship of the dynamics of the actors and organic supply chain.

Table 4.33: Regression Weights (Hypothesis H1):

			Estimate	S.E.	C.R.	P	Label
F1(OSC)	<--	POB	1.192	0.13	9.175	***	
F1(OSC)	<--	GOF	0.963	0.11	8.763	***	
F1(OSC)	<--	GOC	1.459	0.16	9.119	0.015	
TRP	<--	OSC	1				
KHEB	<--	OSC	0.707	0.092	7.695	***	
KHA	<--	OSC	0.171	0.044	3.814	***	
DSOP	<--	OSC	0.657	0.064	10.138	***	
BDA	<--	OSC	0.358	0.046	7.735	***	
BA	<--	OSC	0.699	0.058	12.033	***	
PA	<--	OSC	1.153	0.09	12.793	***	

A considerable amount of variance is explained by the high Squared Multiple Correlation for OSC (0.629), highlighting the major impact of dynamics of the actors on the supply chain for organic agricultural products.

Model Fit Summary: The goodness-of-fit indices provide a conflicting conclusion. With 35 degrees of freedom, the chi-square goodness-of-fit test (CMIN) produced a value of 256.970, resulting in a significant p-value (p = 0), which suggests that the data are not well fitted. The CMIN/DF ratio, however, (7.342), which is within a respectable range, suggests a match that is rather good. The Root Mean Square Error of Approximation (RMSEA) was 0.070, which indicates a decent fit but is only a little bit more than the optimal cutoff. A pretty excellent fit of the model to the data is shown by the Relative Mean Root (RMR) value of 0.079 and the Goodness of Fit Index (GFI) value of 0.961. An acceptable fit of the proposed model is also suggested by other indices, including NFI Delta1 (0.899), RFI rho1 (0.884), IFI Delta2 (0.989), TLI rho2 (0.987), and CFI (0.957). These other indices also offer further insights into the model's fit.

Testing of Hypothesis H2: Information significantly influences the performance of the organic supply chain

The hypothesis H2 is also tested by Structural Equation Modeling (SEM) analysis using AMOS23

Figure showing the relation between exogenous variables of information and endogenous variables of Growth of Organic Business and influence on the Organic Supply Chain.

Result: Generalized Least Squares Estimates

Chi-square = 29.403, Degrees of freedom = 9, Probability level = .000

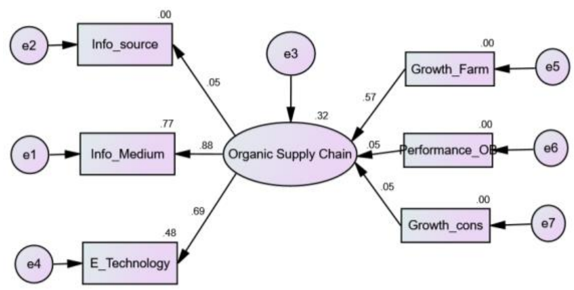


Figure 29: SEM- the influence of the exogenous variables (information of the actors) on the Organic Supply Chain (OSC

The result of the analysis found significant regression weight, also exploring relationship of information and organic supply chain.

Table 4.38: Regression Weights (Hypothesis H2)

			Estimate	S.E.	C.R.	P	Label
F1 (OSC)	<--	GOF	0.585	0.053	11.034	***	
F1 (OSC)	<--	POB	0.649	0.103	6.242	0.033	
F1 (OSC)	<--	GOC	0.638	0.124	5.111	0.006	
ICM	<--	OSC	1				
IS	<--	OSC	0.67	0.074	9.021	0.037	
ET	<--	OSC	0.704	0.075	9.429	***	

The squared multiple correlations OSC (R^2) was 0.732 indicating information's impact of the organic supply chain

Model Fit Summary: A mixed model fit was shown by the results. With 9 degrees of freedom and a value of 29.403, the chi-square goodness-of-fit test (CMIN) revealed an imperfect fit, with a significant p-value of 0 (p = 0). The CMIN/DF ratio, however, (3.267), which is acceptable, indicates a rather good match. The Root Mean Square Error of Approximation (RMSEA) value of 0.068 indicated a reasonable match, but one that was just a little bit beyond the required cutoff. The Goodness of matched Index (GFI) of 0.963 and the Relative Mean Root (RMR) value of 0.075 showed that the model matched the data rather well. In addition, other indices including NFI Delta1 (0.897), RFI rho1 (0.918), IFI Delta2 (0.986), TLI rho2 (0.973), and CFI (0.956) provide further information on the model's fit.

5. DISCUSSION

The aim of this research study is to explore the relationship between the dynamics of the actors and information in the organic supply chain. To achieve the objectives two questions have been developed. 1) What is the relationship between the dynamics of the actors and the organic supply chain? 2) How does information influence the performance of the organic supply chain? There were 389 responses and data were collected from all over the country. To analyze data AMOS sequential equation modelling was conducted. From the analysis, it was found that both the hypotheses were accepted. Therefore, academically it is revealed that there is a positive relationship between the dynamics of the actors and the organic supply chain. It is also found that information influences the performance of the organic supply chain. The study provided important findings that the dynamics of the actors and information significantly influence the performance of the organic supply chain. The performance of the organic supply chain is improved by farmers who actively participate in the supply chain, wholesalers who work closely with producers, merchants who advertise organic products, and customers who support & demand organic products. This conclusion is consistent with the larger body of literature on supply chain management, which emphasizes the significance of actor engagement and collaboration for attaining efficiency and sustainability in supply chains, particularly in the context of organic agriculture.

6. CONCLUSION

It is found that the study has successfully answered the research questions and achieved the designated research objectives by fulfilling the hypotheses. Many research implications for the stakeholders are identified with the idea that dynamics and information are significant forces in the supply chain for organic agriculture. Several research limitations were clarified. In the end, recommendations for future research are suggested in order to emphasize the understanding of the influence of dynamics of the actors and information on the organic supply chain to enhance the growth of organic business.

The lack of information and data fragmentation about the effects of dynamics and information on the supply chain of organic agricultural goods constitute a major constraint in this study. It might be difficult to have access to thorough, current, and trustworthy data on supply chain dynamics, the use of information, and related performance metrics. Additionally, the data could not be consistent and homogeneous across different sources, which would weaken the analysis's validity. Moreover, estimated sample size of intermediaries and retailers are small compare to the sample size of farmer and consumer.

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