

# **Solutions for consumer trust in short food supply chains in Vietnam: Block chain technology**

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## **Abstract:**

*The purpose of the research paper is to explore the key factors affecting consumer trust in short food supply chain products (SFSCs) applied Blockchain technology. The study was conducted by synthesizing theoretical issues related to SFSCs, Blockchain technology, and consumer trust, and investigating how the relationship between the application of Blockchain to SFSCs affects user trust in Vietnam. From there, the authors proposed a research model consisting of Trust – a dependent variable and 6 independent variables including (1) Transparency, (2) Product Quality Management, (3) Authenticity, (4) Traceability, (5) Sustainability, and (6) Security. Through the process of surveying the group of people who have been using SFSCs products, the authors have obtained 299 valid answers (out of 350 votes), through both online and in-person forms, from which the author team has a basis to perform data processing steps through SPSS 25 software. The processing results show that the factor "Product Quality Management" has the strongest impact on the dependent variable "Trust". Based on that result, the authors propose some solutions to contribute to promoting customer trust in SFSCs and expanding the scale of this chain in Vietnam.*

**Key Word:** *Blockchain, consumer trust, short food supply chains, solutions.*

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Date of Submission: 11-02-2023

Date of Acceptance: 23-02-2023

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## **I. Introduction**

Currently, short food supply chains (SFSCs) are no longer an unfamiliar concept, especially for developed countries such as Europe or the United States. This issue has become a hot topic of interest for scholars, research institutions, and policymakers around the world. Combined with Blockchain technology, this supply chain will contribute to improving consumer confidence with the benefits it brings.

Vietnam's agriculture has always been highly appreciated, but there are still many limitations that make this supply chain not replicated in the country. Not only that, in Vietnam, until now, there has not been a complete research paper on consumer trust in SFSCs applying Blockchain technology.

Realizing that, the authors conducted the study "Solutions for consumer trust in short food supply chains in Vietnam: Blockchain technology". The study aims to synthesize issues related to SFSCs, Blockchain technology, and consumer trust, thereby finding the biggest influence on consumer trust, and proposing some solutions to replicate the model and improve consumer trust in SFSCs with Blockchain applications in Vietnam.

## **II. Material And Methods**

### **1. Concept**

#### **1.1. SFSCs**

The concept of "Short Food Supply Chains (SFSCs)" was introduced by Marsden in 2000, then supplemented and perfected in 2003 by Renting. Short food supply chain is a term that describes how food is distributed, including many activities related to food production, distribution, and consumption such as agricultural product stores, cooperatives, purchasing groups, etc. According to EU Regulation No. 1305/2013, SFSCs are defined as supply chains with a minimum number of economic relationships between manufacturers, commitment to develop the local economy and create social and geographical ties in the supply chain, including producers and consumers.

SFSCs are characterized by short geographical distances between producers and consumers, a small number of intermediaries (often none or only one), and a direct connection between consumers and producers (Marden, 2000; Bui Viet Hung, 2020). In addition, the products in SFSCs also have characteristics associated with cultural identity, so consumers can make judgments about the value of food based on their knowledge, experiences, or opinions (Renting et al., 2003). Theoretically, there are currently three main types of SFSCs, namely: i) Direct selling individuals; ii) Direct sales through groups such as farmers, farms, and cooperatives to

sell their products directly; iii) Partnerships between consumers and producers are achieved through agreements between consumers and producers (Galli and Brunori, 2013).

### **1.2. Blockchain**

Through the process of synthesizing and selecting some of the most popular views and concepts about blockchain on the Internet and by researchers such as Jian Zhang (2019), the authors have drawn the following definition: *Blockchain is a decentralized database based on an extremely complex encrypted system. Blockchain is used to store information in blocks that allow data to be transmitted securely and blocks to be expanded over time.*

Features of Blockchain technology:

- Immutability: All transactions made on the Blockchain cannot be tampered with, removed, added, or inserted data. The reason is that the data is encrypted and linked by the blockchain. When a block is modified, the data in the block becomes invalid, resulting in the entire chain being corrupted, with no use value.

- Security: Distribution of information and data and complete security is a key feature of blockchain. Only the owner of the private key can access the data in the Blockchain.

- Transparency: Anyone can track blockchain data as it moves from one address to another. It can also be decentralized so that others can access a piece of information on the blockchain.

- Smart contracts: These are digital contracts embedded in If-This-Then-That (IFTTT) code and executed without a third party. No one can stop or destroy this contract.

- Decentralization: Blockchain operates independently based on a consensus algorithm mechanism and is not controlled by a third party.

- Distributability: Blocks contain the same data, but are distributed in different locations. So, even if the data is lost or corrupted, it can still be recovered because it is still on the blockchain.

### **1.3. Beliefs**

Behavioral economics considers trust to be a subjective term for which there is currently no uniform definition (Merkle et al., 2004). However, from the perspectives of previous researchers as well as through the synthesis process. In conjunction with the discussion, the team derived the concept: Consumer trust in the food supply chain (FSC) is the reliability of how beneficial or harmful that food affects the health of consumers, formed through the experiences of customers when they consumed food in the past, or they trust the words, actions, or trusting attitudes of others about that food item. On the other hand, consumers' confidence in FSC is also reflected in the willingness of businesses in the economy to buy, pay for and consume food items.

## **2. The relationship between "blockchain application to short food supply chains (SFSCs)" to consumer trust**

Kshetri's research (2017) points to factors that help Blockchain technology improve, enhancing consumer confidence including immutability, security, transparency, product visibility, and providing an environment that requires fewer intermediaries. In particular, the author especially emphasizes the security factor that has the most obvious impact on the trust of users when participating in the food supply chain with Blockchain applications because it contributes to ensuring the information security of partners, customers, and owners.

On the other hand, Taehyun Ko et al. (2018) have confirmed that companies are now looking for ways to bring Blockchain technology into the supply chain with the two main purposes of making transactions fast, minimizing costs incurred, and ensuring product quality. As a result, consumers will have more confidence in the food supply chain in general and SFSCs in particular, and the future of Blockchain technology in this supply chain.

In 2019, Jian Zhang's research suggested that the main factors that influence consumer confidence in the food supply chain are transparency, traceability, and product quality management. In addition, the results of the research paper confirm that with the application of Blockchain technology to the supply chain, traceability is improved while contributing to helping stakeholders have more confidence in the product.

The most recent research is Dr. Pankaj's (2022) study on "Improving food supply chain efficiency and productivity with the development of Blockchain". According to Pankaj (2022), there are 4 factors that he thinks are the big results that Blockchain brings, and also the main factors that directly affect consumer confidence when participating in the supply chain in general and SFSCs in particular with the support of Blockchain technology:

- (1) Transparency: is the clarity, completeness of the information and the ease in which consumers can access and share such information.

- (2) Product traceability: the ability to track information from the final product to the original place of production, and review each stage in processing and distribution.

(3) Authenticity: the accuracy of information related to the product.

(4) Sustainability: can be understood in two respects. Firstly, sustainability in the food supply chain is generally the fact that the products of the chain can be produced in environmentally friendly methods. Second, the data in the Blockchain is stored forever.

In addition to foreign research papers, this issue is gradually gaining attention in Vietnam. However, the research papers do not mention the impact of applying Blockchain technology to SFSCs on consumer confidence, but only analyze foreign SFSCs and propose solutions to suit the context in Vietnam. And one of them is the research paper of Associate Pro. Ph.D. Nguyen An Ha (2021), the author has given a positive view on the application of advanced technology (Blockchain, IoT, ...) to the food production process in SFSCs to strengthen consumer confidence in the chain's products, helping to promote and expand the development of SFSCs in Vietnam in the period to 2030.

### 3. Research models and hypotheses

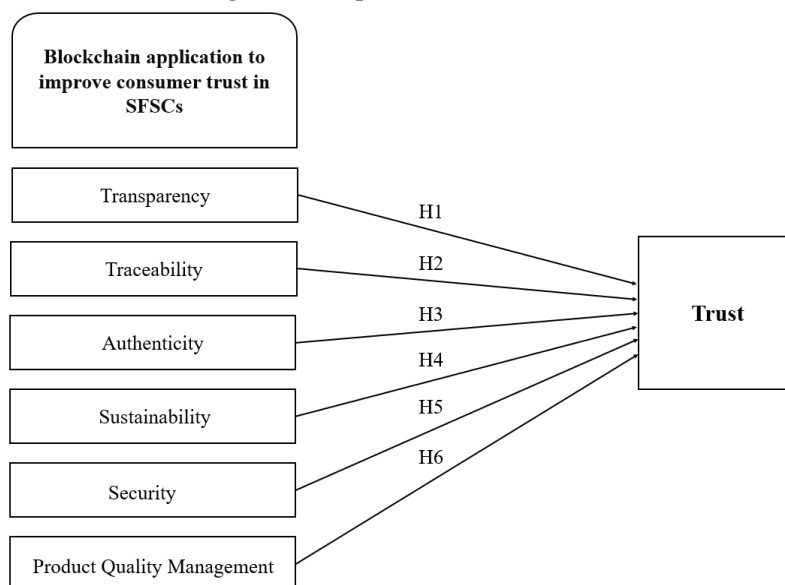
#### 3.1. Research model

The relationship between blockchain and improving consumer confidence in SFSCs is new and there has not been a formal study on the issue at home or abroad. Most of the previously relatively relevant studies that identified the main drivers of consumer confidence in the supply chain when adopting Blockchain have similarities to Pankaj's (2022) model. For example, Tse et al. (2017) conducted a study in Singapore related to this model, arguing that blockchain has built and enhanced user trust by enabling information sharing and checking the authenticity, reliability, and immutability of data. Therefore, the authors took this model as a premise to develop and proposed a research model for the research paper.

In addition, with the growing concern of consumers about product quality and security against the risks of theft and counterfeiting, plagiarizing product-related information, and personal information of customers in today's context (Jeremy Wilson and Brandon Sullivan, 2016) some studies looking at factors affecting consumer trust have added "Product Quality Management" such as the study of Borah et al. (2020): "Supply chain management in agriculture using Blockchain and IoT"; and added "safety and security" factors such as the study "Blockchain technology and its relationship with sustainable supply chain management" by Saberi et al. (2018). In addition, in the article "Developing a short agricultural and food supply chain in Vietnam in a new context" of the Vietnam Academy of Social Sciences 2021, it is also mentioned that one of the main goals and roles that SFSCs bring is to ensure the safety and security of product information with participants (such as origin, production process,...) and product quality (composition, storage, packaging,...).

In summary, in order to have the most overview of the impacts of blockchain application in SFSCs on consumer trust in the context of Vietnam, the authors added two components "Security", and "Product Quality Management" to the research model, as follows:

**Figure 1: Proposed research model**



#### 3.2. Research hypothesis

H1: Transparency when applying Blockchain to SFSCs has a positive impact on consumer trust.

H2: Product traceability when applying Blockchain to SFSCs has a positive impact on consumer trust.

- H3: The authenticity of applying Blockchain to SFSCs has a positive impact on consumer confidence.
- H4: The sustainability of applying Blockchain to SFSCs has a positive impact on consumer confidence.
- H5: The security of applying Blockchain to SFSCs has a positive impact on consumer confidence.
- H6: Product quality management when applying Blockchain to SFSCs has a positive impact on consumer confidence.

#### **4. Research Methodology**

**Study Design:** Quantitative design with the survey.

**Study Location:** The study was conducted in Hanoi, the capital city of Vietnam.

**Study Duration:** November 2022 to December 2022.

**Sample size:** 350 people.

#### **Procedure methodology**

Qualitative research helps to provide the most accurate measurements and selects the factors affecting Vietnamese consumers' trust in the research model, as well as making necessary adjustments. In-depth interviews were conducted with 4 experts who are working in the field of food supply or doing research in the above field. Interviews are conducted face-to-face or online at school, at home, or through suitable online platforms such as Teams, Google Meet, etc. to ensure comfort and privacy. Each interview lasted from 45 - 90 minutes on issues related to measuring consumer confidence, and the influence of factors in the model on trust.

Basically, the qualitative research results show that the factors in the proposed model have an impact on consumer confidence. The results of the in-depth interview also help to adjust the questionnaire to suit the interviewee.

In this study, all scales were built on the basis of previous studies and adjusted to suit Vietnamese consumers after qualitative research. The scale of Transparency, Security, Traceability, and Trust is built based on the research of Jaehun Joo & Yuming Han (2021). The Sustainability scale and the Authenticity scale are built based on the research of Anna et al (2020). The Product quality management scale is built based on the research of Parasuraman et al. (1991) and Cronin & Taylor (1992). The scale is built in the form of Likert 5 levels, where 1 is completely disagree, 5 is completely agree.

After the scale has been calibrated, the questionnaire was given directly and indirectly (via Google Forms) to consumers. The research team selected the survey area as consumers living and working in Vietnam with different genders, ages, levels of education, and spending for food levels. The authors collected the survey sample from November 2022 to December 2023 and obtained 350 responses, but after checking and removing the incorrect, unreasonable, or never participated in the SFSCs, Blockchain. There are only 299 valid counters (used SFSCs and known about Blockchain) for research.

#### **Statistical analysis**

Data was analyzed using SPSS version 25 (SPSS Inc., Chicago, IL).

**Table 1:** Participants' characteristics

<b>Variables</b>	<b>Categories</b>	<b>Frequency</b>	<b>Percent</b>
Gender	Female	199	66.6%
	Male	100	33.4%
Age	Below 18	11	3.7%
	18-25	176	58.9%
	26-35	47	15.7%
	36-45	41	13.7%
	Above 45	24	8.0%
Level of education	High school	26	8.7%

	Undergraduate	21	7.0%
	Bachelor's degree	201	67.2%
	Post-graduation	51	17.1%
Spending for food level	Below 5 millions VND	87	29.1%
	5 - <10 millions VND	90	30.1%
	10 - < 15 millions VND	58	19.4%
	15 - < 20 millions VND	31	10.4%
	Above 20 millions VND	33	11.0%
Food purchase frequency	1 per week	48	16.1%
	2 per week	60	20.1%
	3 per week	64	21.4%
	More than 3 per week	127	42.5%

*Source: Results of data analysis*

The results in Table 2 show that all variables have Cronbach's Alpha > 0.8 and Corrected Item-Total Correlation > 0.5, so the variables meet the requirements of reliability and are used for EFA subsequent analysis.

**Table 2: Reliability Statistics**

Variable	Number of items	Cronbach's Alpha	Corrected Item-Total Correlation
Transparency (TRANS)	5	0.833	0.595
Product Quality Management (QUALI)	7	0.882	0.595
Authenticity (AUTH)	3	0.892	0.779
Traceability (TRACE)	4	0.854	0.669
Sustainability (SUS)	2	0.973	0.948
Security (SEC)	6	0.896	0.623
Trust (TRUST)	8	0.912	0.589

*Source: Results of data analysis*

### III. Result

Results of exploratory factor analysis (EFA) for 27 independent observed variables, after 2 runs of EFA to retain observed variables that have symbolic significance for the parent factor, the authors retained 24 independent observed variables representing 5 independent multiplier groups. With the KMO coefficient = 0.917 and the significance level (Sig. = .000) of Bartlett's test, it is confirmed that the data used is appropriate in this study. The coefficient of total variance extracted is 68.113% > 50%, and all factors have Eigenvalue (eigenvalue) > 1, which shows that 5 factors used in the model can explain 68.113% variation of the data. Accordingly, after running Exploratory Factor Analysis, the variables AUTH1, AUTH2, AUTH3, TRACE1,

TRACE2, TRACE3, and TRACE4 belong to the same group of extracted factors 1. Since the initial variables belong to different research factors, To distinguish it from other extracted factors, the team named this factor AUTH.TRACE - "Traceability and Authenticity".

Factor analysis of the dependent variable "Trust" of customers shows that the KMO coefficient = 0.917 and the significance level (Sig. = .000) of Bartlett's test shows that these variables are correlated with each other and are completely consistent with each other. suitable for factor analysis. With the coefficient of variance extracted at 62.258% and the Eigenvalues index (eigenvalues) reaching 4.981. Therefore, 8 observed variables of the dependent variable have extracted 1 factor with the total extracted variance reaching 62.258%.

As a result, we have concluded 5 components:

1. AUTH.TRACE Component "Traceability and authenticity"
2. QUALI Component "Product Quality Management"
3. TRANS Component "Transparency"
4. SEC Component "Security"
5. SUS Component "Sustainability"

**Table 3:** Factor rotation matrix table

Factor	1	2	3	4	5
TRACE2	,754				
TRACE1	,710				
TRACE3	,703				
TRACE4	,665				
AUTH3	,619				
AUTH1	,587				
AUTH2	,577				
QUALI6		,756			
QUALI5		,741			
QUALI2		,713			
QUALI4		,675			
QUALI3		,666			
QUALI1		,528			
TRANS2			,753		
TRANS1			,722		
TRANS4			,674		
TRANS3			,643		
TRANS5			,623		
SEC1				,831	
SEC2				,827	
SEC3				,784	
SEC4				,642	
SUS1					,856

Source: Results of data analysis

After removing the unsuitable variables, the remaining 24 relevant observed variables will be kept for further use in the analysis as a basis, ensuring the quality of the scales before testing the hypotheses in the next section.

We can see that after exploratory factor analysis EFA, observed variables with the same properties have been merged into new parent factors, thereby leading to the original hypotheses that are no longer valid for research. The authors would like to restate the hypothesis to fit the new model including new parent factors:

H1: Transparency when applying Blockchain to SFSCs has a positive impact on consumer trust.

H2: Traceability and authenticity when applying Blockchain to SFSCs have a positive impact on consumer trust.

H3: Sustainability when applying Blockchain to SFSCs has a positive impact on consumer confidence.

H4: Security when applying Blockchain to SFSCs has a positive impact on consumer confidence.

H5: Product quality management when applying Blockchain to SFSCs has a positive impact on consumer confidence.

Pearson test helps us to examine the correlation of independent variables TRANS, QUALI, AUTH.TRACE, SUS, SEC, TRUST, and dependent variable TRUST. The results show that all Sig values. = .000 (< 0.05), so there is a linear relationship between the dependent variables and the independent variables. The Pearson correlation coefficients are all greater than 0.4, showing that the independent variable has a strong impact on the dependent variable, especially the quality control independent variable has the strongest impact with the correlation coefficient Pearson = 0.768 and the independent variable SUS has the highest correlation coefficient. less impact than other variables with a correlation coefficient of Pearson = 0.512.

Besides, the Pearson correlation coefficient matrix also gives us an early prediction of whether there is multicollinearity between the independent variables or not. If the correlation coefficient Pearson > 0.5, we have grounds to raise doubts about the occurrence of multicollinearity between pairs of independent variables such as AUTH.TRACE with TRANS, SEC with QUALI. However, this is not an exact conclusion, and the authors will clarify this issue in the next step of the model.

Table 3: Regression analysis result

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	Collinearity	
	B	Std. Error				Tolerance	VIF
Constant	-.062	.151		-.413	.680		
AUTH.TRACE	.222	.052	.214	4.248	.000	.408	1.450
QUALI	.451	.050	.425	9.002	.000	.464	1.154
TRANS	.159	.048	.151	3.355	.001	.509	1.963
SEC	.147	.038	.168	3.845	.000	.541	1.848
SUS	.123	.039	.126	.659	.000	.644	1.552
Adjusted R <sup>2</sup> = 0.692							
Durbin - Watson = 2.001							
F (ANOVA) = 134.764							
Sig. from ANOVA: 0.000							

Source: Results of data analysis

From Table 3, ANOVA results show that the model's F-statistic = 134.764 and Sig value of the F test is equal to .000 (<0.05), so the multiple linear regression model is suitable for the data set or the independent variables have a linear relationship with the dependent variable and the model can be used. The model with an adjusted R<sup>2</sup> coefficient of 69.7% (>50%) shows that the independent variables included in the regression analysis affect 69.7% of the variation of the dependent variable, and the remaining 31.3% is due to the dependent variable. out-of-model variables and random error. Besides, the Durbin - Watson index (DW) = 2.01 belongs to the interval [1;3], so there is no first-order serial correlation between the error parts. It is possible to identify the data collected as well.

From the regression results, we see that all 5 variables have statistical significance at 5% level (Sig. < 0.05) namely AUTH.TRACE, QUALI, TRANS, SEC, and SUS. The variance exaggeration factor (VIF) of the variables is all < 2, so it can be concluded that there is no multicollinearity in the model.

The unnormalized regression has the form:

$$\text{TRUST} = -0.62 + 0.222\text{AUTH.TRACE} + 0.451\text{QUALI} + 0.159\text{TRANS} + 0.147\text{SEC} + 0.123\text{SUS} + \epsilon$$

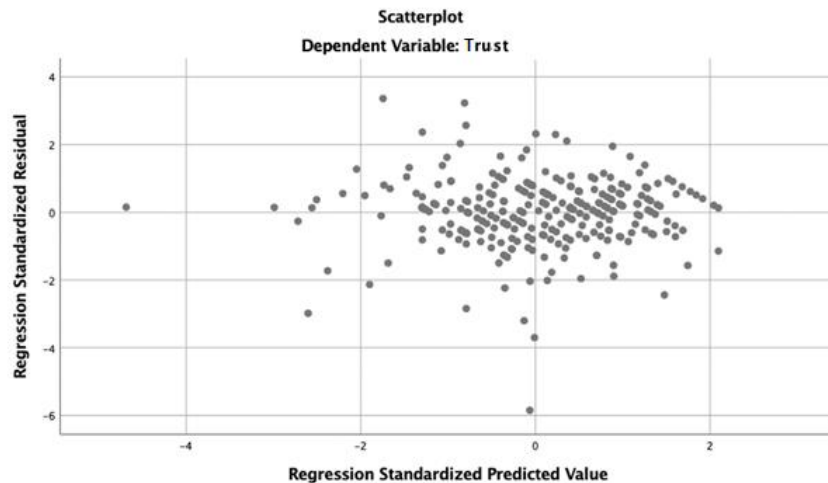
$\epsilon$

The normalized regression has the form:

$$\text{TRUST} = 0.214\text{AUTH.TRACE} + 0.425\text{QUALI} + 0.151\text{TRANS} + 0.168\text{SEC} + 0.126\text{SUS} + \epsilon$$

In detecting violations of linear regression assumptions, the scatter plot (Figure no 2) shows that the dot is concentrated to zero and tends to form a straight line, thus assuming a linear relationship between the independent variable and the dependent variable is not violated.

**Figure 2: Scatterplot**



*Source: Results of data analysis*

#### **IV. Discussion**

The processing results are completely consistent when placed in the context of Vietnam. Because according to our state's regulations from a number of documents such as Consolidated document No. 01/VBHN-BNNPTNT dated May 18, 2018, of the Ministry of Agriculture and Rural Development: Circular on traceability (TRACE), recall and handle unsafe agro-forestry products; The Prime Minister's Decision No. 100/QD-TTg dated January 19, 2019, approving the Scheme on implementation, application, and management of the traceability system has clearly recognized the authenticity and accuracy of the information in the system. Traceability is a must for every establishment in the food industry. As for international organizations such as the current FDA regulations, the majority of the food industry must establish and maintain the accuracy of each process and product origin. Therefore, it can be seen that building the accuracy of the information in traceability is the first and essential step to help our country's goods be distributed domestically as well as exported to international markets. The difficult economy in terms of food quality and safety. Therefore, in order to provide the most general solutions and inferences in the context of Vietnam, the authors propose to combine the two factors "authenticity" and "traceability" in the model. The figure of Pankaj (2022) in a group named "Traceability and authenticity" shows mutual support when it comes to the process of traceability information of food and testing the quality of food. accuracy of that information.

The data processing results show that the factor "Product quality management" has the strongest impact on product consumer confidence of the SFSCs chain (Standardized Beta coefficient is 0.425), the remaining 4 factors. have the corresponding decreasing influence as follows: "Traceability and authenticity"; "Security"; "Transparency" and finally "Sustainability". This is the basis for the research team to pay attention when proposing to develop the model in Vietnam.

#### **V. Conclusion**

From the results of data analysis, the authors propose some solutions for 3 main subjects that directly affect the development of short food supply chains (SFSCs), that is the State; enterprises, and manufacturers; and finally are customers



### **For the State**

*First*, the state should standardize the form and content of cards, stamps, labels or formats through appropriate processes and put in place policies to raise the standards of existing food safety certifications (e.g. VietGAP), and the state should have organizations, departments closely control and supervise the inspection process and provide food safety certificates.

*Second*, the state should focus on investing capital and training high-quality human resources in technology to be able to apply technology to operate SFSCs. On the other hand, the state should also implement cultural festivals to stimulate demand for products in SFSCs. Authorities at all levels should organize training sessions for community-based tourism areas, and establish innovative start-up centers for SFSCs with technology applications and community tourism development in each region in the coming time.

### **For enterprises and manufacturers**

#### *One, product quality management*

Enterprises need to plan training, and periodically organize professional training classes for those directly involved in the production process to ensure product quality. In addition, managers in each enterprise also need to closely control the process of processing and packaging products because this is an important stage in the food production process. In particular, to enhance the competitive position with domestic and foreign participants in the short food supply chain, businesses should invest and promote the application of modern technology such as integrating Blockchain into the production process to support, manage and improve the quality and value of their products compared to other entities.

#### *Two, traceability and authenticity*

Enterprises need to step up the construction of traceability systems and establish codes of planting areas and farming areas. Typically, the implementation of QR codes on product packages and labels. This not only helps businesses connect with domestic consumers but even abroad. From there, businesses will partly improve consumer confidence in SFSCs that apply Blockchain technology.

#### *Third, security*

Businesses need to really focus on implementing their data security solutions by applying Blockchain technology well to the supply chain, because once the information has been entered into the system, it will not be editable and if this is the case, the system will save and display the corrected information. In addition, businesses can improve security systems with common measures such as improving firewalls to prevent malicious access, splitting the internal network of the business if something goes wrong, only one subnet branch is affected, or using information security solutions from professional companies.

#### *Four, transparency*

Each Vietnamese enterprise needs to set its own regulations for the organization including principles and standards for those involved in the production process, and enter product information into the system to understand and comply. For example, in the code of business ethics, it is necessary to mention some basic things such as: Always being honest in all actions; Take responsibility for your actions.

#### *Five, sustainability*

Enterprises need to apply digital transformation well and mobilize the help of experts to maintain management in production, ensuring continuous processes. For environmental issues, enterprises should build environmentally friendly organic production lines using natural raw materials, less preservative chemicals, and high pesticide residues. Businesses should also study combining production with other businesses. As the product output of one enterprise can be processed to become the input material of another enterprise to contribute to reducing the negative impact of production activities and bringing disciplinary measures to violators.

### **For consumers**

Consumers need to actively disseminate knowledge for themselves about food supply chains, information security issues, traceability of products through packaging, etc. to avoid being scammed and causing unnecessary damage. In addition, people should also be supportive and open to the development of the SFSCs model; understand the challenges and government policies to scale up SFSCs using advanced technology.

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