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Risk Mitigation Strategies in the Tomato Supply Chain

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ABSTRACT

Tomatoes produced by smallholders in the summer season in Uzbekistan provide a significant part of the population's demand for tomato products. However, tomato production in smallholders is based on the principles of the free market economy and is operating at high risk. The paper aims to assess and reduce the level of risks associated with infrastructure, financial, natural and environmental, farm management and political changes among entities in the smallholder tomato supply chain. Uncertainties related to producer, buyer, infrastructure, finance, natural and environmental, management and political changes are taken into account in the assessment of risk levels. These threats were assessed using Fuzzy Linguistic Quantifier Order Weighted Aggregation (FLQOWA) model. The obtained results showed that the level of risk arising in production, cooperation, infrastructure and financial issues was high. At the same time, measures to reduce risk levels were taken in the study. According to the results, application "written contract" and "insurance" to collaborative relationships to reduce risk levels has been shown to reduce risks until 0.6 coefficients. The results obtained from this investigation will have a positive effect if policy makers use the applications to increase the economic cooperation between the subjects in STSC.

INTRODUCTION

In the tomato production chain, economic cooperation between smallholders and suppliers, processing, wholesale, and retail trade organizations has several advantages. In particular, as a result of the proper establishment of economic cooperation between entities, the high quality and quantity of agricultural products grown for consumption will be ensured, product supply interruptions will be reduced, the exact quantity of the offer will be created, and it will lead to an increase in export potential, stabilization of product prices, and guaranteed income of smallholders (Keramydas *et al.*, 2015). Therefore, one of the important issues is considering the promotion of economic relations between subjects (Pardaev *et al.*, 2022). Consequently, the strengthening of the agricultural supply chain will ensure stability in the country's food security (Mangla *et al.*, 2018).

These risks are the factors that harm the implementation of economic relations between entities in the tomato production chain. The level of risk in the field of agricultural production is higher than in other sectors of the economy (Ton *et al.*, 2018). Yusupov found that field of agricultural production is a complex biotechnological and socio-economic system and cited high-risk levels as a result of the strong connection of the production process with natural factors (Yusupov, 2019).

Komarek *et al.* (2020) argue that risk factors related to production, marketing, institutional, personal, and financial processes occur more in the production chain of agricultural products (Komarek *et al.*, 2020).

In particular, among agricultural products, seasonality, large volume, and perishability of fruit and vegetable products cause inconsistencies in cooperation between

entities (Behzadi *et al.*, 2018).

The purpose of this article is to find ways to stimulate economic relations between the entities of the tomato supply chain and to justify it scientifically. More specifically the study attempts to answer the following research question: What are the inconsistencies between entities in the tomato production chain? What are their degrees of influence on cooperation between entities? And What are the measures to reduce the impact of risks in the tomato supply chain?

METHODOLOGY

Economic-empirical analysis methods were used to mitigate the impact of risks in the implementation of the proposed goal. Based on this practice, a three-scenario experiment was conducted with the participation of representatives of "Supplier Organizations", "Smallholders", "Product Processing Enterprises", "Wholesale Trade Organizations" and "Retail Trade Organizations" in the main blocks of the tomato production chain, and the obtained data were collected. We used FLQOWA (Fuzzy Linguistic Quantifier Order Weighted Aggregation) model for analysis.

Risk Mitigation Strategies

The fact that the tomato production chain is a whole system that ensures the delivery of the product "from the field to the table" and a large number of participating entities make it somewhat difficult to take measures to mitigate the risks. Risk mitigation includes the following four steps (Figure 1).

Sources of risks in the tomato production chain have several forms depending on the type of farm. They are divided into the criteria of formation in each block

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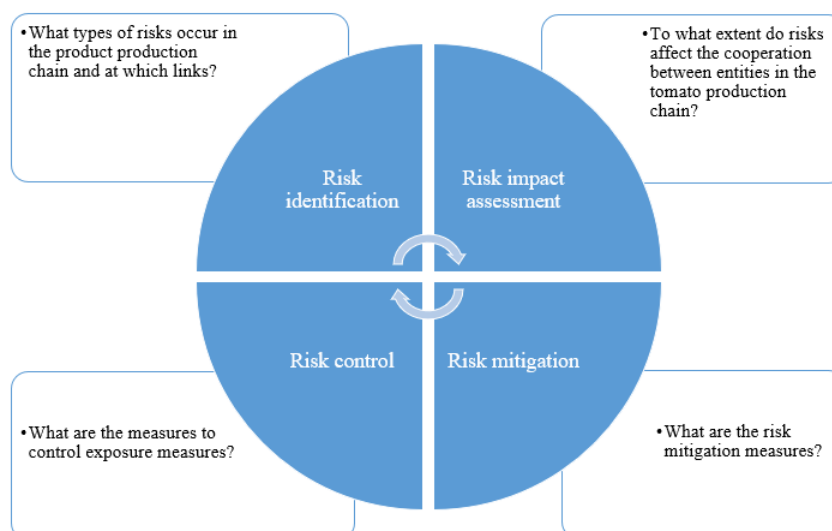


Figure 1: Risk mitigation steps affecting cooperation between entities in the tomato production chain.

of production according to its separate directions in Table 1. Risk areas related to production, cooperation, infrastructure, financial, natural and environmental, management, and political situations are formed between smallholders and subjects. In the Samarkand province of

Uzbekistan, cooperation between actors, financial issues, and infrastructure risk levels have been proven to be above average in the tomato production chain (Pardaev *et al.*, 2022).

To determine strategic directions for reducing and

Table 1: Sources of risk in the tomato supply chain and its impact in Samarkand, Uzbekistan.

The Main Directions	Sources of Risk	Points of Influence
Production	Low production volume; Low availability of modern production technology; Lack of technique; Existence of supply interruptions.	Trade, transport Production, price, product standard, product quality Product quality, productivity Product quality, productivity
Partnership	Uncertainty of the amount of demand; Inadequate information regarding product demand; Absence of a clear agreement on the purchase of the product.	Distribution, planning Production, harvesting Trust of the parties in each other
Infrastructure	Long distance and roughness of the road; Insufficient transportation for harvest; Incomplete formation of conditions in Dehkan markets.	Product quality and price Product quality and price Confidence in place of sale at Dehkan markets
Financial	Lack of financial support; Low diversification of investment; Difficulties in obtaining credit; Sudden price changes in the product market.	Production, product quality, raw materials Production, product quality Incentives for production, raw materials Farmers' decision-making
Nature and environment	Crop destruction by diseases; Lack of water for irrigation; Fluctuation of the precipitation.	Productivity, product quality, price Production.
Management	Decision-making in production; Quality control in production; Planning; Farmer's experience.	Production, harvesting, processing, sale Production, product quality, cooperation Production, price, cooperation, implementation Production, productivity, product quality, cooperation
Political	Political instability; Restrictions on trade.	Production, cooperation, implementation Production, cooperation, implementation, incentives for production

Source: author's collection by interview of representatives in the tomato supply chain.

eliminating risks in the product production chain, it is necessary to determine the directions of risks, sources of formation, and links of their influence on the system. Such practice means coordination of economic relations between entities in the system, determination of risk reduction strategy, and application of efficiency improvement measures.

From the theoretical point of view, there are opportunities to manage risks and reduce their impact on the production chain of agricultural products. We can see this in practice from foreign experiences. It has implemented several projects at the government level on risk mitigation in the member countries of the Organization for Economic Co-operation and Development (OECD, 2011). In particular, “application of insurance and contracts”, “partial reimbursement of costs” and “state intervention in product trade” as financial tools for mitigating risks. In this regard, the United States Agricultural Average Income Guarantee Program (ACRE), Canadian Agricultural Stabilization Program (AgriStability), Drought Response Program of Australia (DAFF), Mexico’s Small Farm Product Price Protection Program and examples of the European Union’s cooperation support programs for agricultural production chain actors (EAGF and EC, 2020). In addition, agricultural insurance introduced in several countries is leading to the mitigation of risk levels. Therefore, in mitigating the risk in the product production

chain, the producer, supply, processing, and trading enterprises and government organizations should take responsibility for the development and requires adaptation of technology, the use of effective management practices and financial instruments, investment in infrastructure, and public-private partnership.

Considering the above, several strategies for mitigating the effects of risks in the tomato production chain in Samarkand were studied and two of them were recommended to be applied in the supply chain (Table 2). The strategy of applying technological development and adaptation is one of the most effective and sustainable methods used in risk mitigation. The mechanism of implementation of this strategy is manifested mainly by the innovative results of scientific research in knowledge-based agriculture, technological development, and the application of digital technologies in the field. Improving the management system, increasing the experience of subjects in their activities in the production chain, and introducing an integrated tactical planning system in the field (Ahumada and Villalobos, 2011). As a result, the efficiency of the use of resources in the delivery of the product to consumption increases, a clear map of the opportunities for improving the quantity and quality of the product is revealed, and it leads to an increase in the income from the activity.

One of the most effective ways to mitigate risks in the

Table 2: Risk mitigation strategies in the agricultural production chain

Risk mitigation strategy directions	Implementation mechanism
Technological development and adaptation Improving management	Conduct research, develop recycling, introduce digitization, advance science and education Introduction of diversification practices in farms, accurate forecasting, planning, increase of practical experience
Financial instruments	Application of preferential loans, the introduction of insurance, investment in the sector, price support
Infrastructure improvement Application of political programs	Infrastructure improvement Institutional agreements, application of management norms, the conduct of state policy
Uniting entities toward one goal	Integration of farmers in the product production chain with other entities through the creation of advertisements

Source: Based on the author’s scientific research.

production chain is the use of financial instruments, which means the use of preferential loans and subsidies, the introduction of insurance, investment in infrastructure improvements, state support for product prices, and other financial support (Muratov *et al.*, 2022). It is important that risk management and regulation using this method can be carried out in a short period. However, the use of the financial instrument creates some difficulties for countries with economies in transition or with poor economies. The way infrastructure is improved will significantly reduce the risk levels in the system.

However, modern transport and communication, energy supply, storage, and processing infrastructure at all stages up to the delivery of the product to the consumer provide an opportunity to quickly, qualitatively, and cheaply

deliver the product to the consumer. Political programs ensure the integration of subjects, political support, and changes in legislation.

In the system, institutional arrangements, application of governance norms, and state intervention are considered important at the initial stage of development. In particular, it serves as a key strategy in ensuring the country’s food security and putting the system on the right pathway.

The integration of entities in the system towards one goal leads to a decrease in risk levels. As a mechanism for implementing this strategy, it is based on the introduction and improvement of contractual relations, and the creation of a formal agreement between suppliers, manufacturers, and buyers. In Uzbekistan, the strategies listed above are

being used to some extent in mitigating and eliminating the risks arising in the food supply chain. However, the use of these strategies in some areas requires scientific justification.

It is very difficult to correctly assess the situation and choose a strategic path with a specific 'address'. It requires a certain period and finance. Nevertheless, based on the theoretical concepts presented above, the strategies of "financial instruments" and "combining entities towards one goal" in mitigating risks are compatible with the

requirements of stabilization in the current period and the future.

Methods of data collection and analysis

A three-scenario experiment was conducted with the participation of representatives of "Supplier organizations", "Smallholders", "Product processing enterprises", "Wholesale" and "Retail" trade organizations in the main blocks of the tomato production chain (Figure 2).

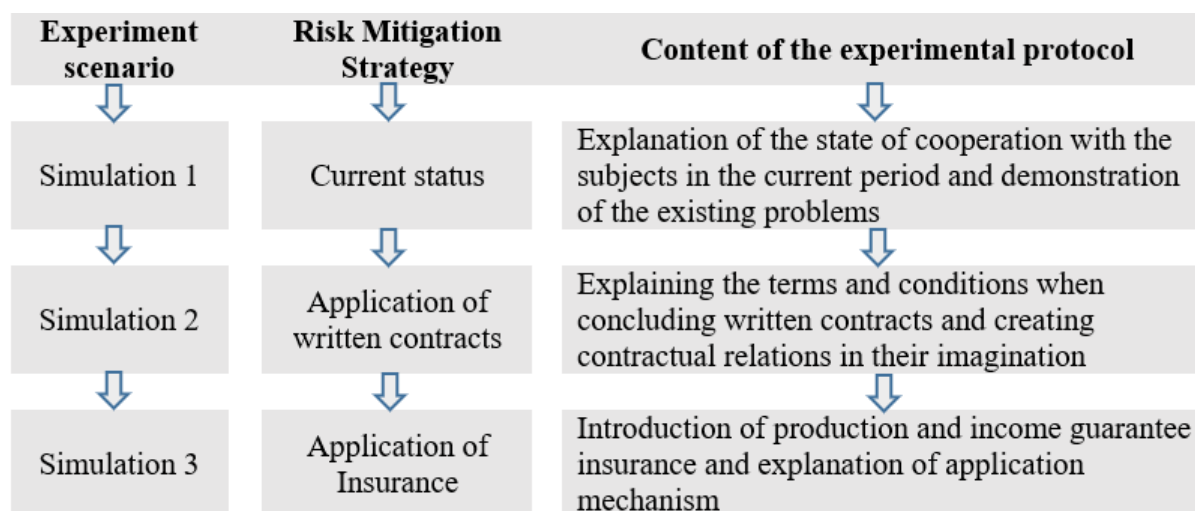


Figure 2: Experimental stage of studying the influence of guarantee factors in mitigating risks in the tomato production chain in the Samarkand region of Uzbekistan.

A total of 346 respondents were involved in the experiment. At each stage of the experiment, a separate scenario was implemented. The results obtained at each stage were separated and analyzed using the FLQOWA (Fuzzy Linguistic Quantifier Order Weighted Aggregation) model.

RESULTS

The application of risk mitigation strategies in the economic relations of entities in the tomato supply chain gave the following results (Figure 3).

Risk in Supplier Organizations

The level of importance of the establishment of economic cooperation relations between smallholders and supplier organizations is high. Agro-pharmacies, seed and technical supply organizations, *tomorqa* service LLC and customer organizations are considered to supply organizations that provide seeds/seedlings, fertilizers, equipment, pesticides, etc.

When assessing the cooperation between them, it was found that the risk level is 0.6 due to the low production of farmers and households, the low level of provision of modern production technology, and the presence of supply interruptions, 0.6 due to the uncertainty of demand and lack of clear agreements, and 0.8 due to the impact of infrastructure. The inclusion of collateral factors, such as written contracts and insurance, has been shown to reduce risk levels by a factor of 0.4 and 0.3, respectively.

Risk in Production

In the current situation, smallholders have a higher than average level of risk in cooperation with entities (supplier organizations, processing enterprises, wholesale and retail trade organizations) and financial issues in the tomato supply chain. It has been proven that the risk level has decreased to a 0.3 coefficient due to the establishment of contractual relations with the subjects and the use of insurance in the system.

Sources of Occurrence of Risk Levels:

a) Production process; b) Relationship with a partner; c) Infrastructure objects; d) Financial issues; e) Natural and environment; f) Management of the economy; g) Political changes.

Risk levels in the current state of the partnership

Risk levels when insurance was introduced

Risk levels when a written contract was introduced

Risk Levels in Product Processing Enterprises

At processing plants, tomatoes appear as a supplier and a buyer for producers at the same time. Processing enterprises have high opportunities for cooperation with smallholders. However, the risk levels were high due to the presence of production supply and financial issues in farmers and households. In particular, the level of risk in establishing cooperation with them has increased to 0.9 and the level of risk in connection with financial inconsistencies has increased to 0.6.

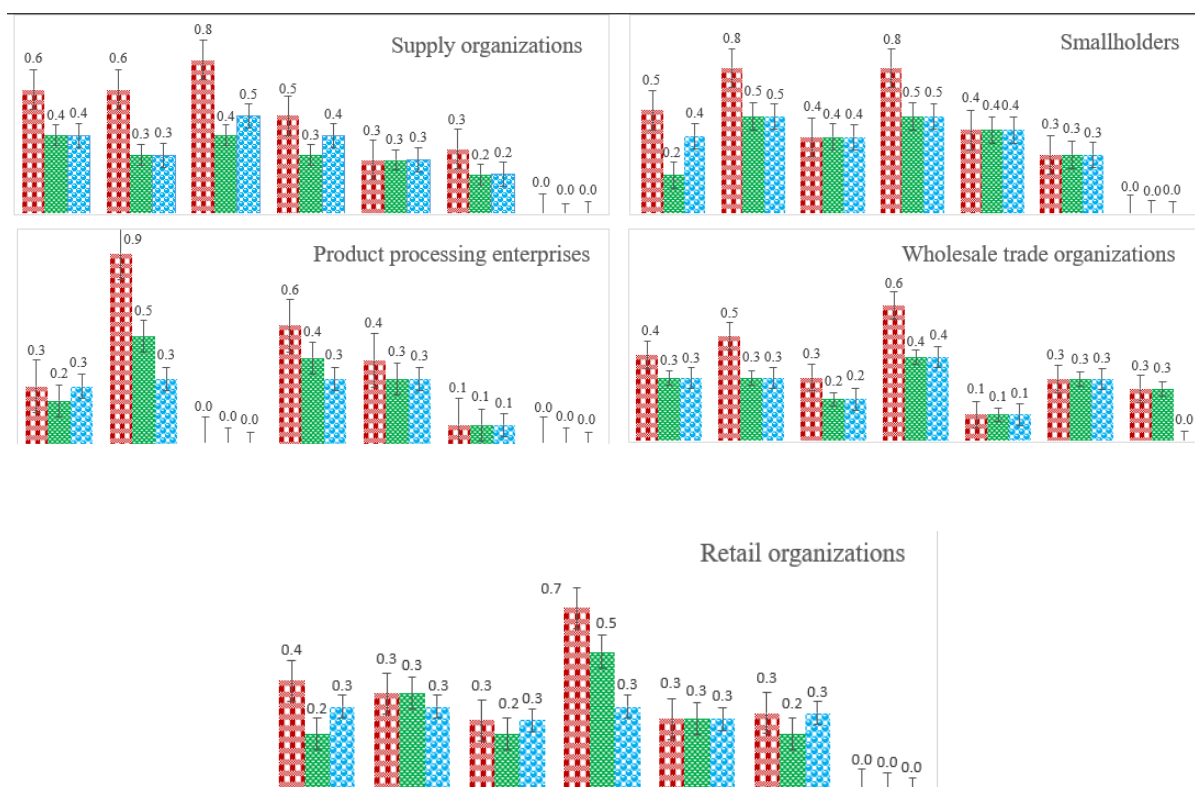


Figure 3: Assessing the impact of assurance factors on mitigating the level of risk among actors in the tomato supply chain.

These risk factors are above average, showing that the introduction of contracts in the system reduces the risk of partner relationships by a factor of 0.5 and the risk of financial inconsistency by a factor of 0.4, while the introduction of insurance reduces both by a factor of 0.3.

Risk Levels in Wholesale Trade Organizations

Due to the lack of financial support in wholesale trade organizations, low diversification of investment, and sharp changes in product market prices in different economic periods, the risk levels have increased to 0.6 coefficient in the current situation. It has been proven that both factors introduced in the system reduce the risk by a factor of 0.3.

Risk Levels in Retail Organizations

Retail trade organizations are considered the lower block in the tomato production chain and deal directly with consumers. Looking at the results, the level of other types of risks, except for financial inconsistencies, is significantly below average. Therefore, their chances of establishing formal economic relations with smallholders are higher. The strategies used in the experiment are demonstrated to reduce the risk levels. In particular, due to the introduction of cooperation agreements, risk levels decreased from 0.7 to 0.5 coefficients, and the introduction of insurance led to a decrease of 0.3 coefficients.

CONCLUSION

The following conclusions were drawn from the results of the research conducted on the management of risks affecting the economic cooperation between entities in the tomato production chain. The non-establishment of formal cooperation between entities in the system was directly influenced by the inconsistencies that occur in the "Production process", "Partner relations", "Infrastructure objects" and "Financial issues". A strategy studied to establish cooperative relations between entities and integrate farmers and households into a system of vertical integration, that is, the use of written contracts and insurance used to mitigate or eliminate the level of risks caused by inconsistencies, gave positive results. Therefore, to increase the economic integration between entities in the chain of production of agricultural products, it is appropriate to pay attention to the introduction of insurance as a factor guaranteeing contractual relations and cooperation in relevant cases.

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