

Efficient value chain as a factor for reducing losses and ensuring food security

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Abstract. The authors consider the situation in the field of losses formation in the production and circulation of fresh fruits and vegetables in the context of the effective value chain formation. Relevant aspects of research in this area were the importance of fresh fruits and vegetables in the formation of a healthy lifestyle, the lengthening and complication of supply chains associated with the expansion of sales markets and the presence of significant losses in this area. Features of fruit and vegetable production and commodity properties of fruits and vegetables, quality and safety requirements determine the need to build effective communication along a single chain, including the stages associated with the implementation of technological processes, the organization of product sales, and the stage of consumption. It is established that at each stage there are risks of food losses. The main conclusions of the authors include the presence of an integrated approach, mandatory consideration of the specifics of the product group under consideration, and compliance with the requirements of current international standards in the field of fresh fruits and vegetables circulation. The proposals include such areas as technological solutions for waste processing, use of the principles of charity and reverse logistics at the sale stage, and principles of responsibility for consumers.

1 Introduction

The problem of loss and spoilage of food products, a topical and complex problem, has acquired a global character and social and ethical expression. A problem that is relevant to all participants in the value chain is of wide interest and is actively discussed at the level of the global community.

Today, the world's population is 7.5 billion people, more than 815 million of them are underfed, and 3.1 million children die of hunger every year. At the same time, a third of all food produced in the world is lost or thrown away every year – about 1.3 billion tons per year, and, as emphasized in [1], food is lost or wasted throughout the supply chain, including due to many inefficiencies, emphasizes Marie Mourad [2]. The relevance of research in this area is directly related to issues of food security, since losses significantly reduce the amount of food intended for human consumption.

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General characteristics of the problem at the global level, the conceptual framework of food loss, basic concepts and statistics across regions are convincingly presented in the proceedings of the FAO/WHO [3], food losses and organic waste in the consumer market of Russia – in the study of experts of the Moscow School of Management "Skolkovo" [4]. At the same time, the authors note that it is of scientific and practical interest to study the causes and factors of food losses, loss of quality and reduction of food value in the context of individual product groups in order to develop a mechanism for their reduction at each stage of the value chain. It is important to adapt the main provisions of the FAO/WHO technology platform for losses to the Russian reality. Thus, the objective of research, the main provisions of which are reflected in this article, is to study the situation in the field of food losses and spoilage in the production and circulation of fresh fruits and vegetables and to develop proposals for the formation of an effective value chain as a factor in reducing losses and ensuring food security.

2 Methods

In order to achieve this goal, bibliographic, system, logical, analysis and synthesis methods were used as theoretical ones, while methods of publication research and expert evaluations were used as applied ones.

3 Results and Discussion

A healthy lifestyle in the modern world is directly related to the consumption of sufficient amounts of fresh fruits and vegetables, which are necessary for a balanced diet and are an essential source of vitamins, carbohydrates, and organic acids [5], and low consumption of fruits and berries is one of the ten main risk factors contributing to the explained mortality [6].

The peculiarities of the considered group of goods are their species and varietal diversity, organoleptic properties, technological properties (keeping quality, damageability, sensitivity to various factors, commercial processing, etc.), production, for example, traditional or organic, using genetic engineering, etc. Fresh fruits and vegetables are subject to compliance with safety standards and regulations, phytosanitary requirements, implementation of the principles of traceability and labeling. It should be noted that retail chains set requirements for the quality of fruits and vegetables in terms of compliance with quality standards and product characteristics with pomological, botanical and ampelographic varieties, in terms of calibration and quantization, deliveries, etc.

The importance of reducing losses in order to ensure adequate nutrition [7] is evidenced by the fact that fruits and vegetables account for the highest quantitative food losses and food waste. In the total world loss, damage and waste by commodity groups, more than 60% are root crops, fruits and vegetables [4], a similar situation is observed in the whole crop production in consideration of the quantitative losses in the context of key sectors of the food industry (for comparison, in the meat industry 30-35%).

The value chain for the product group "fresh fruits, vegetables", as a full cycle of activity [8], includes several stages, from the primary production of products (cultivation, harvesting), post-harvest stage, storage, transportation and storage at the stages of commodity movement, commodity processing, distribution and retail sales of products up to their consumption. Aspects of research issues are the lengthening and complication of supply chains, which is associated with the expansion of markets for fresh fruits and vegetables, the expansion of the range of products sold through the supply of exotic fruits. And at each stage, considering these aspects, there are risks of food losses, which are

presented in the Table 1, indicating that this phenomenon is not accidental and is an integral element of the value chain.

Table 1. Losses in crop production at the stages of the value chain

Value chain stages	Potato	Vegetables	Berries	Fruits
Growing and harvesting	15-25	5-20	18-25	10-20
Transportation	0.5-15	5-10	5-15	2-5
Conditioning and processing	5-10	10-20	1-5	10-30
Storage	10-20	10-20	5-20	5-10
At sale points	5-7	10	10-20	10

Thus, the total losses reach more than 50% and they are formed at each stage of the value chain. It is shown in [9] that developing countries lose 40% of their food during post-harvest operations, while in developed countries 40% of food waste is generated at the retail and consumer stages. Researchers emphasize that imperfect, often not well planned, logistics leads to significant product losses at all stages of product movement from manufacturer to consumer [2]. In the group of fresh fruits and vegetables losses dominate also at the stage of sale. High "appearance quality standards" of supermarkets and hypermarkets for fresh food lead to food waste. Products are rejected by supermarkets at the farm gate due to strict quality standards regarding the weight, size, shape and appearance of the crops [1]. At the same time, it should be noted that the FFV international standards for fresh fruits and vegetables provide gradations depending on quality, which trade enterprises, including in Russia, almost completely ignore.

The main types of losses for fresh fruits and vegetables are the following: natural weight loss, quality reduction, and formation of waste and defects. In the specialized literature, the types of fruits and vegetables losses, their causes, internal and external factors that affect the duration of storage of vegetables and fruits, and the results of storage are scientifically justified and fully presented.

For fresh fruits and vegetables, it is relevant to consider the category of "food waste" – the part of food losses that occurs due to the disposal or alternative (non-food) use of nutritious and safe food products intended for human consumption at all stages of the food chain.

According to the authors, two reasons for the formation of fruit and vegetable waste should be considered. Processing factories are the main source of fruit and vegetable waste. This is an objective factor, since it is associated with morphological and anatomical features that do not allow using all parts of the raw material for food. For example, 30-40% of the total weight of potatoes is made up of potato peelings and cuttings, which is 2 million tons on a national scale, which are sent to waste deposit. At the same time, the experience of countries such as Belgium shows that all waste can be concentrated at processors, since 90% of potatoes are processed into the final food product in the country, and consumers and public catering organizations purchase potato semi-finished products. In Russia, according to [10] data, the utilization rate of fruit and vegetable raw materials is 0.79, which means that on average 21% of raw materials will inevitably go to the waste group. With proper management of food waste, several solutions can be implemented, according to the authors of the article [9], which helps to reduce their number.

The problem of food waste at the stage of consumption at the household level is also relevant, as evidenced by numerous studies, primarily by foreign authors, who estimate that losses at the consumer level are 35 percent [11], while most of the waste in households is accounted for fruits and vegetables and reaches 39 % [6]. A number of studies describe in detail the measures that consumers can take to reduce their food waste [9], but not all of them are acceptable to the Russian consumer. However, the authors note that the project

"Consumers in a sustainable food supply chain" (COSUS), completed in 2014-2017. (the study was attended by six research partners from five countries: Denmark, Germany, Norway, Sweden, and the United States and the Netherlands) [12] can be a basic framework for the methodology of conducting a study of Russian consumer behavior in the context of waste reduction at the consumption stage.

4 Conclusions

1. The study of the value chain for the group "fresh fruits and vegetables" is a relevant direction, as it allows to understand the reasons for the difficulties that prevent the value chain from achieving certain economic indicators and identify ways to sustainable changes [13]. A holistic view on the production, marketing and consumption of fresh fruits and vegetables, involving a wide range of disciplines, revealed a number of features of the formation of the food chain in the group under consideration.

2. It is established that the product group "fresh fruit and vegetable products" is characterized by the formation of not only quantitative, but also qualitative losses associated with a decrease in quality characteristics, including nutritional value; specifics of fruits and vegetables cause the formation of food waste.

It is revealed that at the level of production, transportation and storage of fresh fruits and vegetables, the formed theoretical base and practical experience of the world community and individual regions and countries, including Russia, make it possible to make decisions, including innovative ones, concerning the reduction of losses and spoilage of fresh fruits and vegetables and establish an effective link along a single chain "production – procurement – storage - sale - consumption of products".

3. Retail trade has a significant impact on waste generation and contributes significantly to losses generation. Retail trade does not fully use the provisions of international standards regarding quality gradations of fresh fruits and vegetables, which, along with donating surplus food to emergency food organizations, collecting unprocessed products on farms, and marketing or processing of "ugly" products [14], could constitute a new direction of "charitable logistics". Reverse logistics for the "fresh fruits and vegetables" product group needs to be improved.

4. Further development is required based on advanced experience in the implementation of innovative solutions in the field of processing of food waste of fruits and vegetables.

5. It has been established that the devaluation of fresh fruits and vegetables can be triggered at all levels and by all participants in the value chain, including consumers. Even when manufacturers and trade use technological innovations, they can only be successful if they are accepted by consumers. At the same time, consumers are directly and indirectly responsible at the stage of consumption, including for the formation of a significant part of food waste.

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