

Article

Innovative Production and Innovative Agricultural Products in the Food Economy in the Context of Selected Lifestyle Elements of the Inhabitants of South-Eastern Poland: Case Study

Aleksandra Badora ^{1,*}  and Krzysztof Kud ² 

¹ Department of Agricultural and Environmental Chemistry, University of Life Sciences in Lublin, 15 Akademicka Street, 20-950 Lublin, Poland

² Department of Enterprise, Management and Ecoinnovation, The Faculty of Management, Rzeszów University of Technology, 12 Powstanców Warszawy Street, 35-959 Rzeszów, Poland; kkud@prz.edu.pl

* Correspondence: aleksandra.badora@up.lublin.pl

Abstract: Sustainable development in the agriculture of the future will lead to innovative production, providing the possibility of obtaining better quality agricultural products. In turn, these innovative agricultural products will fit into new social lifestyles. Therefore, in this study, the authors asked the following research questions: (i) How do respondents perceive innovative agricultural production and innovative products in the area of food economy?; (ii) what is the relationship between selected lifestyle elements and the perception of innovative agricultural production and products? The research tool was a survey questionnaire. The diagnostic study was conducted using the CAWI (Computer-Assisted Web Interview) technique. The study was partial and non-probabilistic in nature. Participation in the study was voluntary and anonymous, and completion of the form could be interrupted at any time. The target group were adults aged ≥ 18 years. They were residents of south-eastern Poland, from the Podkarpackie and Lublin provinces. The study was of a correlational nature, as it sought relationships between the elements studied, without the possibility of influencing the level of individual variables. A five-point Likert scale with a neutral value was used for the assessment. Spearman correlation analysis (r_s) was performed to find the relationship between the items. This type of correlation was chosen because the variables subjected to calculations were on an ordinal scale. The Kruskal–Wallis H test was also calculated to determine the effect of independent variables (lifestyle elements) on dependent variables (perception of innovative production and food products). The Mann–Whitney U test was utilized to calculate and identify differences between groups (sex and place of residence). Statistical significance was assessed at the level of $\alpha = 0.05$. To illustrate these differences more clearly, categorized graphs of the average ratings of the items studied were also drawn up. The research results indicate a different approach from men and women to the issues studied. The place of residence and the approach of the respondents from south-eastern Poland to the studied lifestyle elements influenced their perception of sustainable agricultural production and innovative features of agricultural products. The examined lifestyle elements demonstrated a varied impact on the perception of innovative production and innovative food products.

Keywords: innovative production and products in agriculture; sustainable lifestyle; south-eastern Poland; food economy



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1. Introduction

Sustainable development includes three types of capital: economic, social and natural. The food economy is of particular importance in shaping sustainable development. Food supplied to consumers is in a market subject to economic laws, and at the same time it is the foundation of the health of society. Among many developmental factors, particular importance is attributed to innovations. The key determinant of innovation is the premise

of differentiation of products/processes from their predecessors. In the agri-food sector, however, the approach to innovations may be different, which will be discussed later in the study.

Purchase decisions are the result of numerous determinants, among which are, among others, the axiological sphere, or that of preferences and everyday behavior. Depending on these complex factors, the biological foundation of the health of society is shaped. On the other hand, there are a number of factors influencing consumers and their purchase decisions.

The aim of this work was to identify the relationships between selected lifestyle elements and the perception of innovative production and food products. The implementation allows for deepening the state of knowledge regarding food consumers. The identification of the assumed relationships can be used to shape the desired consumer attitudes and, in the practical sphere, the results can be used by decision-makers to implement a strategy for ensuring the health of society.

Food is therefore a key market good, necessary to maintain life processes and, at the same time, the foundation of good health. The way people eat is an important factor in maintaining the health of society.

In this study, two main research questions and further supplementary questions were asked. The first main question referred to the perception of innovative production and food products. (i) How do respondents perceive innovative agricultural production and innovative products in the food economy? Since consumers often do not wonder where food comes from, this study attempted to identify the relationship between the perception of food production and food products. Therefore, the supplementary question was asked: (a) is there a relationship between the perception of innovative production and innovative food products? Since the perception of many phenomena depends on individual and environmental characteristics, an attempt was also made to determine differentiation in the perception of the phenomena studied, depending on the sex and place of residence of the respondents. In the case of place of residence, at the conceptualization stage it was assumed that differences may occur depending on whether respondents live in a village or a city. It was assumed that living in a village, closer to primary agricultural production, may change the perception of the phenomena studied. Therefore, the supplementary question was formulated as follows: (b) do sex and place of residence relate to the perception of innovative production and innovative food products

At the stage of conceptualization of the research, selected lifestyle elements were assumed as determinants of the perception of the studied phenomenon. Therefore, the second, main research question was formulated as follows: (ii) what is the relationship between selected lifestyle elements and the perception of innovative production and agricultural products?

Primary data obtained using a diagnostic survey were used. The research tool was a survey form, and the study was conducted using the CAWI technique (Computer-Assisted Web Interview). The perception of innovative food production and innovative food products among residents of southeastern Poland was studied, combining these features with elements of the respondents' lifestyle.

The article contains a literature review on the subject of innovation in the food economy. This part presents the evolution of the issues of innovation and production safety in the agri-food sector, as well as the issues related to challenges in food systems, and population preferences in choosing food products. The next part presents the methodology of the conducted research, followed by its results. The following part contains a discussion of the results obtained, with literature reports on this topic. The last part of the article consists of conclusions and implications, including the possibility of practical use of the research results.

2. Review of Literature

2.1. Challenges to Food Systems

Global food systems are challenged by the growth of the world's human population (Table 1), as well as geopolitical conflicts, crises and changing consumer preferences [1]. To meet these challenges, it is necessary to optimize food production, apply sustainable practices and develop technological advances. At the same time, it is necessary to ensure safety and public acceptance of food innovations [2,3].

Table 1. World population (projected data for 2030 and 2050) and agricultural area for individual continents—own study based on [4–7].

Name of the Continent	Population in 2015 and Forecasts for 2030, 2050			% Change to 2050, Year on Year 2015	Area of Continents Million km ² Total Land:	Agricultural Area Billion ha (Cropland + Permanent Meadows and Pastures)
	2015 mln	2030 mln	2050 mln			
World	7349	8501	9725	32	149.1	4.8
Asia	4393	4923	5267	2%	44.4	1.65
Africa	1186	1679	2478	109	30.3	1.15
South and Central America	634	721	784	24	20.5	0.75
Europe, including: EU	738	733	707	−4	10.5	0.40
North America	506	510	500	−1	4.2	0.18
Australia and Oceania	358	396	433	21	21.5	0.50
	39	47	57	46	8.5	0.35

The differences in the amount of agricultural land on individual continents have an impact on the different approaches in these regions to land and capital for investment. These components are abundant on continents such as Australia, North and South America, and therefore there is a continuous expansion of farms, mainly at the expense of other farms. In addition, progress in mechanization means that precision farming can be practiced everywhere, where there are farms of 5–10,000 ha, often managed by just a few people [8]. In contrast, in the underdeveloped countries of Asia, Africa, or South America, completely different trends are observed. There we often deal with the phenomenon of “extensification”, where the physical size of the farm expands without a concomitant increase in inputs or technology—a case in which poor yields prevail but are compensated for by an increase in the area of cultivated land. In addition, due to the growth of the human population, farms are divided, which leads to the fragmentation of land into small areas and uneconomic units, which often results in the phenomenon of marginalization [7–9].

The relationships between environmental, social and economic development constitute the essence of the concept of sustainable development [10–12]. It is therefore important to study the interactions between these three “pillars” [13]. Some authors [14] argue that currently promoted sustainable development strategies have three basic flaws: (i) they do not recognize the threats related to the growth of global overconsumption; (ii) they do not focus directly on the consumer; (iii) they do not take a holistic approach to these issues. Seasonal food consumption, for example, is promoted as one aspect of a sustainable diet and is often considered to be based on local food. However, it is important to remember that the social, environmental and economic benefits and constraints must be weighed against the context of providing fresh produce all year round [15,16]. Therefore, seasonal food marketing is becoming increasingly popular [17]. The expansion of global supply chains is reinforced by the prospect of year-round availability of seasonal, fresh food products and the competitive advantage of certain geographical areas in the production of specific food products [18]. Some authors [19] argue that it is important to appreciate the complexity of bioecological, functional, economic and social interactions, because they embody agricultural production systems. Support for diversified agricultural systems is therefore needed to increase productivity and promote socio-ecological transformation.

Moreover, food is increasingly discussed in the context of human behavior around food. Food shortage patterns and the development of alternative food industries are now

linked to other urban or rural policy areas and sectors, such as quality of life, health, and education [20].

The impact of the food system on the environment is multidimensional and leads to water consumption and climate change. However, there are very few studies that combine all these issues simultaneously and address the seasonality of local products [16]. Some authors [21], in their studies, have presented a set of attributes and performance indicators to compare the performance of the local food chain with the global one. These authors concluded that the global chain may have an advantage over the local, in terms of lower greenhouse gas emissions per kilogram of produce, and may be more efficient in terms of production costs, because farmers in the global chain have higher annual incomes. Other authors [22] reported that even a single change in the seasonal pattern of food production can have an impact on the environment through the type of fertilizer or pesticide used. Examining the use of agricultural chemicals, other authors [23] presented the results of a two-way fixed effects regression model that indicated that in the United States, the growth of local food systems was measured as the increase in the number of farms selling produce in the direct market. This trend was found to be strongly related to the decline in agricultural chemical expenditure in 1997. Moreover, the scale of this relationship steadily decreased throughout the country over the next 15 years. One possible explanation proposed by the authors is that, as the local food movement gained momentum after 1997, it attracted more and more producers and consumers, who did not necessarily rely on quasi-organic or low-input agricultural practices.

Some work [24] suggests that the concept of “food miles” plays an important political and ideological role in emphasizing the importance of carbon footprints in a sustainable food system [24–26]. In contrast, the term “local trap” has gained popularity because there is no convincing evidence that ‘local’ means sustainable or equitable. Some authors [27] have argued that the idea of the local trap assumes that a local food system will be inherently more socially equitable than a national or global one. Other authors [26] have noted the problem of associating the term ‘local food’ with quality or sustainability, or even with the term ‘traditional food’, since these products may be produced on local family farms.

Life cycle assessment is widely used to assess environmental impacts and identify more sustainable agricultural production options [28]. Environmental impact categories are assessed in terms of carbon footprint, water footprint, depletion of fossil fuels and minerals, acidification, eutrophication, and ecotoxicity resulting from pesticide use. However, few food product life cycle analyses explicitly examine seasonality. When product life cycles refer to “seasonality,” the term is associated with the “natural growing season” of the crop [29]. Other authors [30] concluded that the carbon footprint of carrot and tomato consumption was strongly influenced by a strict definition of seasonality that excluded both long-distance transportation and production in heated greenhouses. However, the high energy consumption required for lighting and heating to grow produce in greenhouses during the off-season may result in higher GHG emissions than those associated with transportation [29].

The definition of “local food” and its implications for sustainable consumption have long been explored in the literature. It cannot be assumed that local food will have a lower environmental impact than global food just because it was produced close to the consumer [10]. On the other hand, it is not possible to guarantee that global food is more sustainable than local food, considering only a smaller carbon footprint. As an alternative to the binary thinking—“local” and “global”—the terms “local seasonality” and “seasonality” have been proposed. This may allow for a more complex analysis, in which food entities can be oriented and linked locally and globally [10]. Other authors [31] conducted a study in which they proposed and discussed six characteristics of the food chain: geographical configuration, product identity, spatial distance, size of operation, management and technologies. These authors recommend that these characteristics be taken into account when measuring the “localness” or “globality” of food and supply chains and their implications for assessing sustainability (Table 2).

Table 2. Food chain characteristics, that influence the “localness” or “globality” of supply chains, and sustainable development [31].

Features	Impact on “Localness” and Implications for Sustainable Development	Impact on “Globality” and Implications for Sustainable Development
Geographical configuration	Better control of sustainability and “product life cycle”	Contrary to the case of “local”
Product identity	Implementation of local practices, ingredients and product features. Easier for consumers to compare with other products.	Contrary to the case of locality.
Spatial distance	Contrary to the case of “globality”	Large distance between producers and consumers and between input and output.
Size of operations,	Small scale of production, pressure on local resources, which limits demand for local products and slows down economic development.	Contrary to the case of “localness”.
Governance,	The relationships between farmers and intermediaries and processors, or direct relationships with consumers, are either relational (frequent and intensive interactions) or closed (when the buyer imposes standards on small farmers.	The relationship between retailers and processors is modular (they exchange goods based on given product specifications).
Technologies	They can support ‘localism’. A large competitive and investment effort, in order to create a so-called ‘survival niche’ on the market among global players.	They support “globalization” because there is a greater competitive advantage in the market, which implies allocating a larger pool of funds for technological innovations

Comparative sustainability assessment at the “local–global” level can, according to the above authors [31], promote more informed choices from producers and consumers, which should be based on multiple economic, social, ethical, health and environmental criteria, as well as on the effects of food behaviors. Comparative sustainability assessment can also be used to guide paths for relocalization or better integration of regional or national food systems. At the company level, it can be useful to examine best practices, reference points, critical points and errors to avoid in the food production process [32,33].

2.2. Innovation and Safety in Production

The relationship between climate change, agriculture, and global and local food security strategies seems to be increasingly complex and is constantly being transformed by changing political and economic factors [34]. Some authors [35] discuss the role of policy in promoting innovation to support local agri-food systems and their capacity to meet social needs. Here, the focus is on the analysis of food security, taking into account not only food availability, but also the three other dimensions of food security: access, stability and use [36]. Therefore, food innovation is “broadly defined” to encompass a range of types and phenomena: a new product or service, a new process technology, a new organizational structure, administrative systems, or new plans and programs [37]. Innovation also encompasses social networks of the actors involved in interconnected spheres in this respect. The research included in the article [35] reflects the links between agri-food production, climate change and innovation. These are introductory in nature, as they outline a two-way relationship that connects the evolution of food systems and long-term changes in temperature, and weather patterns. Innovation can play a significant role in transforming agri-food production to combat climate change. In this context, state policy is of great importance, as it can stimulate innovation to support local agri-food systems, and their capacity to meet social needs. Innovation can also be linked to climate change, agriculture and global–local initiatives, in order to ensure food security [38]. Innovation in the agricultural economy may have a different character than the classical understanding of innovation. The key element of these innovations is not only the search for the element

of novelty, but also the focus on the characteristics of the final product. An innovative food product should be safe and of full value [39,40].

On the other hand, an interesting alternative is the currently promoted theory of traditionalization, which consists in returning to the use of traditional methods, often even those from very distant times [41]. According to the above authors, innovation can be a return to better solutions from the past. Issues related to the use of traditional knowledge were also the subject of research by other authors [42]. New proposals related to the return to solutions from the past in food production and processing (respecting the laws of nature and based on natural biological processes), which already appear in theory, are usually eco-innovations also. Therefore, these three ideas (eco-innovations, traditions, wisdom), which are very closely related, together give a picture of the possible evolution of the food economy. Examples of eco-innovations in the food economy include biological methods of plant protection, new natural fertilizers, economic solutions in water management, and safe cultivation in order to maintain the necessary soil properties [42]. In turn, other authors [43] state that “innovations” that disrupt the current model of food production have been proposed to address the challenge of achieving the so-called “Great Food Transformation”. Obstacles on this path, causing disruptions to sustainable development, may include, for example, alternative food networks or short food supply chains, a return to local food. or “glocalism”, i.e., a focus on small-scale agriculture, an emphasis on biodiversity and the exploration of underutilized species, e.g., wild species [44], and the integration of social and ethical values into food supply chains.

Based on the results of case studies, some authors [22] concluded that using a definition of local seasonality should take into account the local link between production and consumption, e.g., production and consumption in the same climatic zone. Therefore, it is important to construct the transformation of social and ecological sustainability as a multidimensional concept that goes far beyond the dimensions of “local market” or “seasonal food”. A multidimensional perspective on this issue helps to avoid falling into the “local trap” and can be used to explore new food consumption practices that strengthen local economies [45]. This is especially important because a multidimensional understanding of sustainability has to compete with the growing discourse on economic regionalism, which focuses on local economic production without necessarily integrating ecological and social dimensions [45]. For example, a tomato that comes from a local, mass, large-scale production can be labeled “regional”. However, such a local label is not linked to sustainable consumption and/or production methods, nor even to respect for local seasonality [10].

According to some authors [46,47], urban agriculture is discussed as an alternative to a larger supply of local or regional, traditional products in urban areas. The development of this type of agriculture is growing worldwide, especially in projects inside and outside urban buildings, e.g., rooftop farms, rooftop greenhouses and plant factories. This is referred to as “Zero Land Farming” (Z-Farming) [46,47]. The most noticeable difference between urban agriculture (plant factories) and rural agriculture is the integration of urban agriculture with the urban economic system and urban ecosystems [48]. Other authors [49] analyzed the efficiency of urban plant factories compared to cultivation in traditional greenhouses and concluded that plant factories can offer many advantages, such as quality of production, but have high energy requirements due to the need for artificial lighting.

In turn, other studies [50] report that the food environment changes along an urban–suburban–rural gradient, which the authors of this study observed in three locations in North Vietnam. The findings of the above-mentioned authors have contributed to the current discussion on the critical role of the food environment in nutrition and the relationship between economic marginalization and access to food, as well as the role of food supply channels in the consumption of processed foods. In the studied peri-urban and rural areas, an additional source of agricultural products, produced and quickly delivered by the residents themselves, plays an important role in contributing to the improvement of the nutrition and health of the residents. Some of these products are sold in traditional food outlets in these areas. However, due to the process of urbanization and the development of

industrial zones, it is becoming increasingly difficult to provide food to urban residents, and to secure the livelihood of peri-urban farmers [51]. Therefore, local planning policies should take into account the maintenance of food supplies to urban areas, e.g., by designating agricultural zones [50].

Countries around the world face enormous challenges in achieving food security, despite significant progress in reducing hunger and malnutrition in recent decades [52]. The central role of the food environment in combating various forms of malnutrition has been highlighted in several recent international reports [52–54]. Food systems are essential to achieving the Sustainable Development Goals (SDGs) and particularly SDG2—zero hunger [55]. The food environment is defined as the physical, economic, political and socio-cultural interface where people interact with the broader food system to obtain, prepare and consume food [54–56]. The United Nations Decade of Action for Nutrition 2016–2025 identified “a safe and enabling environment for food at all ages” as one of the key areas for action, and Member States were called upon to increase research on the food environment [56]. This research has gained popularity in recent years in high-income countries in response to the high prevalence of overweight, obesity and noncommunicable diseases [57–59]. As low- and middle-income countries struggle with multiple undernutrition problems, characterized by the coexistence of undernutrition with overweight and obesity [60,61], the food environment is also gaining policy attention in such contexts [62].

To achieve climate neutrality by 2050, the European Union is promoting the Green Deal, which is based on the Farm to Fork and Biodiversity strategies [62]. The Farm to Fork strategy aims to create a more sustainable food system by introducing restrictions on the use of fertilizers and pesticides and by allocating at least 25% of EU agricultural land to organic farming by 2030 [56]. Food safety is an integral part of food security. The Rapid Alert System for Food and Feed and the Farm to Fork regulations also focus on ensuring high levels of food safety, animal health and welfare and plant health in Europe. Food safety is part of a sustainable food system, minimizing the risk of transmission of toxins or pathogens through the food system and minimizing the use of antibiotics, pesticides and other substances of concern [63,64]. It is therefore necessary to be proactive in the field of biological threats and, in the case of the food system, those that emerge throughout the food chain. Studies by some authors [65] have shown that there are alarming signals in this regard from users of baby food. It can be seen that consumers in this study are concerned about three categories of contaminants: (i) contaminants from agricultural practices, such as pesticides; (ii) contaminants from packaging, such as plastics; (iii) only in third place are microbiological threats, and these are those related to bacteria that cause low or moderate digestive disorders (Table 3).

Table 3. Respondents’ concerns about the origin of hazards in baby food [65].

Threats–Sources	Chemical (Fear Strength)	Microbiological (Fear Strength)
Agriculture	0.72 *	-
Packaging	0.56 *	-
Digestive bacteria	-	0.53 *
Environment	0.49	-
Pathogenic bacteria	-	0.47
Industrial processes	0.45	-
Parasites	-	0.32
Viruses	-	0.31
Unknown chemicals	0.29	-
Unknown pathogens	-	0.28
Fraud	0.23	-

*—Collective attitudes with a concern strength above 0.5 can be interpreted as an expression of significant and regular concern among respondents. Collective attitudes below 0.5 indicate that the absence of any concern, even sporadic, is more strongly confirmed than the presence of regular concern.

Further analysis of Table 3 shows that these dominant concerns are followed by more discrete ones: environmental contaminants, bacteria responsible for serious diseases, and contaminants from industrial processes. Other threats (parasites, viruses, unknown chemicals or pathogens and adulterants) are not as widely known among the global population of respondents [65].

2.3. The Preferences of the Population

It should be noted that, in the modern era, consumers show increasing preferences for traditional, local or organic food, and some authors indicate that this trend will develop further [38,40,66]. Nevertheless, traditional food producers are constantly forced to increase the safety of their products, and, in order to meet market demands, they are also struggling with pressure from large retailers. Therefore, they often implement innovations to emphasize the nutritional and health benefits of their products. However, a change in the approach to production may result in a change in traditionality, which in turn is met with resistance from consumers, especially in the traditional food sector [2,10,67–69].

Many socio-cognitive models interpret consumer choice as a problem-solving method determined by rational information processing (e.g., value-belief-norm theory and attitude-behavior-context theory) [70,71]. Consumption is therefore a social, cultural and economic process of choosing goods. A deeper understanding of this phenomenon leads to the view of consumption as a holistic process [72,73]. It is also important to emphasize that consumer willingness to pay is an important indicator of individual preferences, but it contains limited information about the customer [74]. In this respect, the transition to sustainability is characterized as a systemic change of interconnected intangible and tangible elements, rather than a change in consumer behavior alone [45]. Furthermore, the increasing distance between production and consumption raises increasing concerns among consumers [75,76], which is why there is a need to establish indicators for assessing the sustainability of food systems [25]. Among others, “food miles” are used as an indicator of environmental sustainability, i.e., a measure of how far food travels from production to consumption [77,78].

Some products are produced locally, but not necessarily with local ingredients. One of the most commonly used criteria for classifying products as local is the place of production [79]. The distinction between the concept of local food and local product can be crucial for the analysis of consumer preferences and their willingness to pay. Therefore, it is proposed to label a food product locally in terms of its production method, which can positively influence consumer evaluations [80]. Although labels strengthen trust in local products, they only refer to the geographical concept of locality. Some authors [81] have confirmed that the term “local food” also brings a special emotional perspective to the minds of consumers and the idea of building social interactions.

Knowledge, risk perception and concerns about food safety are the most commonly studied cognitive motivators among consumers [82]. It is widely believed that knowledge alone is not enough to change practice [83,84]. Consumers may also have difficulty translating knowledge into practice because, based on the belief that the risk is low, they look for “shortcuts” when handling food (e.g., performing procedures as quickly as possible) [82]. Nevertheless, knowledge is an important factor influencing food safety because it can motivate positive attitudes [83]. Risk perception is a cognitive decision-making process, usually involving two systems: (i) heuristic and intuitive, which occurs without cognitive effort; and (ii) a second system based on mental operations requiring cognitive effort, taking into account rules, mathematics or consumer needs [85]. Therefore, consumers’ risk perception will vary depending on any assessed risks, their knowledge of the subject and previous experiences. Some authors [70] have shown that trust, knowledge, subjective characteristics and socio-economic status are key factors influencing food safety risk perception. Consumers surveyed interpret the place of purchase/consumption in two main ways. The first concerns the characteristics of consumers in a given location. For example, higher food

safety standards were attributed to markets and shops visited by consumers from higher social classes [71].

The second approach concerns consumers' cognitive characteristics in terms of control. This shows that the place of purchase/consumption is important, but indirectly dependent on socio-economic and cognitive factors and risk/situation. It can therefore be concluded that cognitive characteristics and aspects may influence beliefs about food safety in BRICS countries (Brazil, Russia, India, China, South Africa). Among the observed motivating factors, it is worth noting that income, education level, food safety concerns and risk perception are most strongly associated with changing food safety behaviors in these countries [86]. These countries are at different stages of development, which directly affects their policies and population.

In addition, policies aimed at improving access to education, income and social equity may be essential to improve the perception of food safety among the general public. This is fundamental in middle-income countries, such as BRICS, which still suffer from social inequalities. In turn, cognitive aspects can be shaped by risk analysis policies and linked to investments in assertive and easy-to-understand communication [86]. Food safety risks may also increase as a result of changes in food and agricultural systems. However, new technologies in different areas of the food chain should be further reinforced among all actors and stakeholders [63,87], as this leads to innovations, which in turn ensure consumer cooperation within the food chain [88–90].

In our research, we fill the research gap related to the perception of innovative products by the surveyed respondents as a consequence of innovative production, and we assume that consumers' assessment may be of great importance in the context of their lifestyle, sex and place of residence. There are still few studies that, like ours, combine behavioral and axiological pillars with the perception of European and global trends in the food economy.

3. Materials and Methods

The subject of this study was broadly understood as food consumers aged ≥ 18 years. The spatial scope of the study included south-eastern Poland: the Podkarpackie and Lublin voivodeships. The study area is presented in Figure 1.



Figure 1. The study area marked on the map of Poland's divisions, according to NUTS 2 [91].

When characterizing the regions selected for research, it should be remembered that there is a significant number of small farms, producing mainly or exclusively for self-

supply or for related households [92]. However, the reasons for such non-commercial production are changing. It is no longer only an activity related to supplementing the low income of the rural population (especially the households of retirees). Currently, there are increasingly environmental, health or hobby reasons for this activity. The percentage of farms conducting only plant production in these voivodeships has also increased at the expense of farms with mixed production (plant and animal), while the percentage of farms conducting only animal production has remained the same, which confirms the processes of specialization in Polish agricultural production observed for years [93]. The main factors influencing the transformation of Polish agriculture include the introduction of instruments of the Common Agricultural Policy of the European Union [94], changes in the eating habits of society [95], or switching to other methods of agricultural cultivation and animal breeding [96]. Regional differences in the size of farms also persist. The south-eastern voivodeships, which include both voivodeships selected for the study, are still characterized by a fragmented farm structure [92,93].

All the factors and phenomena described above could have influenced the preferences and responses of the respondents surveyed in this work.

The research was conducted in September and October 2023, using a diagnostic survey method, and the research tool was a survey form. The CAWI (Computer-Assisted Web Interview) technique was used to conduct the surveys among respondents. The research was non-probabilistic. The link to the survey was provided to several dozen people from various environments and business entities, cooperating with the authors of this publication. These people invited other friends of theirs, and a link was posted on social media. Respondents were informed that the survey was voluntary, anonymous and could be interrupted by them at any time. First, a question was presented verifying the place of residence in one of the two surveyed voivodeships. A total of 825 surveys were collected, of which 732 were selected, reliably completed, and met the conditions of the research.

The survey form contained the items presented in Table 4. The items were divided into three parts. The first part referred to issues identifying lifestyle elements. The second group of items referred to the perception of innovative food production, and the third group concerned the perception of innovative food products. All items were in the form of statements. Respondents were asked to assess to what extent these statements reflected their opinion. A five-point, bipolar scale with a neutral middle value was used for the assessment [97]. The values on the scale were coded as follows: 1—definitely not; 2—rather not; 3—neither yes nor no; 4—rather yes; 5—definitely yes.

The Cronbach's Alpha reliability test gave a result of 0.71361, which is a satisfactory level [98,99]. This is the most popular method of analyzing the reliability of applied psychometric tests.

The collected material was subjected to calculations using MS Excel and Statistica programs. An analysis of the structure of ratings of individual items was performed. In order to initially identify structures in the collected data, cluster analysis was performed. This allows the grouping of the items studied in such a way that the degree of connection between objects belonging to the same group is the greatest, and that with objects from other groups the lowest. A cluster analysis of geometric distance in multidimensional space was conducted using Ward's method [98]. Spearman correlation analysis (r_s) was performed to find the relationships between items. This type of correlation was chosen, because the variables subjected to calculations were on an ordinal scale and, in such a case it is not recommended to calculate Pearson correlation. In the dataset, there were tied ranks, so an appropriate formula was used to take into account this fact. The Kruskal–Wallis H test was also calculated to determine the influence of independent variables (lifestyle elements) on dependent variables (perception of innovative production and food products). The Mann–Whitney U test was calculated to identify differences between groups (sex and place of residence). Statistical significance was assessed at the level of $\alpha = 0.05$ [100]. In order to graphically illustrate, the differences calculated for the Mann–Whitney U test,

graphs of average ratings of items categorized according to differentiating features (sex, place of residence) were drawn up [98].

Table 4. List of studied items.

No.	Items
I—Lifestyle Items	
1	An important foundation of the scale of values is man
2	An important foundation of the scale of values is nature
3	An important foundation of the scale of values is God
4	The important thing is that reality is relative and has no fundamental value foundation
5	An important element of lifestyle is caring for the climate and the natural environment
6	An important element of the lifestyle is dedication to the homeland and society
7	An important element of lifestyle is the desire to increase the amount of free time
8	An important element of lifestyle is the development of one's own interests and pleasures
9	An important element of lifestyle is regular waste sorting
10	An important part of lifestyle is accumulating money
11	An important part of lifestyle is using reusable products
II—Items related to innovative production	
12	Innovative production is ecological plant cultivation and animal breeding
13	Innovative production is production without genetically modified organisms (GMOs)
14	Innovative production is production using GMOs
15	Innovative production involves the use of bioactive plant protection products and fertilizers
16	Innovative production is the use of traditional technologies that limit the use of chemicals in food production processes
17	Innovative production is the use of advanced technologies (including chemical and bioengineering) that increase production efficiency
18	Innovative production is the production of a large number of alternative plants in the area of plant cultivation
19	Innovative production means diversifying the crop structure
III—Items about innovative agricultural products	
20	Innovative food should have a long shelf life
21	Innovative food should be highly processed and ready to eat
22	Innovative food should have attractive packaging
23	Innovative food should be cheap
24	Innovative food should contain ingredients (including synthetic ones) that increase taste and visual appeal
25	Innovative food should contain genetically modified elements
26	Innovative food should contain additives that increase nutritional value (functional food)
27	Innovative food should be safe for health and of full value
28	Innovative food should be produced using traditional methods
29	Innovative food is organic food

The results of the research and calculations are presented in the tables and figures in the next chapter.

4. Results

The study was conducted on a group of 732 respondents. They were adults. The median age was: Mdn = 22 years, quartile 25—Q1 = 20 years, and quartile 75—Q3 = 41 years, while the interquartile range—IQR = 21. Among all respondents, 67% were women and 33% were men. Referring to the place of residence divided into urban and rural areas, 48% were urban residents and 52% were rural residents. Both among urban and rural residents, the proportions between the sexes were the same as in the general sample, i.e., 67% were women, while 33% were men.

4.1. Initial Data Exploration

First, cluster analysis was performed. This allows for grouping data in such a way that the degree of connection between the studied objects and objects belonging to the same group is as high as possible, and that with objects from other groups as low as possible [95]. The analysis performed allowed for the detection of data structures, which were interpreted in the further part of the work. The results of cluster analysis are presented in Figure 2. On this graph, the cut-off points of the dendrogram at the point of increasing the distance of connection, relative to the connection stage ($y = 200$), are marked with a red line. As a result, two large clusters were distinguished. The belonging of items to clusters, together with the average and standard deviation, are presented in Table 5.

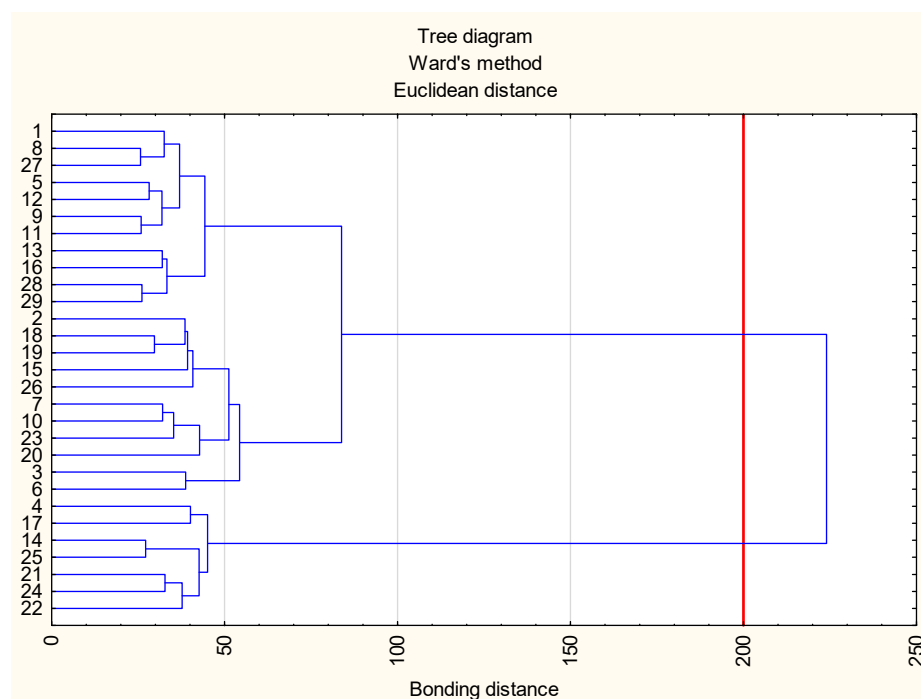


Figure 2. Cluster analysis diagram. The names of the items are given in Table 4.

Within the first cluster, two smaller branches of the dendrogram are visible. The first one included items 1, 8, 27, 5, 12, 9, 11, 13, 16, 28, 29 (Table 4). It can be said that these were pro-ecological formulations, for example, care for the climate, waste segregation, use of reusable products, but also ecological food production, production without GMOs, use of traditional production technologies, etc. The average ratings of these items were higher than 3, and it should be remembered that the value 3 corresponds to a neutral position on the scale used in this study. The ratings of seven of these items exceeded the value 4, which corresponds to the position 'rather yes'. It can therefore be stated that the respondents positively assessed the items included in this cluster. The second branch of the first cluster included items 2, 18, 19, 15, 26, 7, 10, 23, 20, 3, 6 (Table 4). These were items related to food production technology, providing high-quality products, accumulating money, searching

for free time, but also dedication to the homeland. The average ratings in this branch of clusters were greater than 3 but did not exceed the value of 4. This signifies moderately positive ratings for the listed items.

Table 5. Means and standard deviation of individual items grouped in the order resulting from cluster analysis.

Items ¹	M	SD	Belonging to the Cluster	Items ¹	M	SD	Belonging to the Cluster
1	4.14	0.954	1	26	3.29	1.155	1
8	4.25	0.795	1	7	3.81	0.980	1
27	4.54	0.747	1	10	3.91	1.003	1
5	3.87	0.923	1	23	3.79	0.965	1
12	4.05	0.954	1	20	3.44	1.181	1
9	4.07	1.004	1	3	3.64	1.271	1
11	4.11	0.896	1	6	3.18	1.107	1
13	3.82	1.106	1	4	2.76	1.065	2
16	3.87	0.983	1	17	2.73	1.140	2
28	3.89	1.011	1	14	2.19	1.099	2
29	4.05	0.944	1	25	2.08	1.025	2
2	3.5	1.058	1	21	2.4	1.142	2
18	3.23	0.953	1	24	2.49	1.136	2
19	3.61	0.937	1	22	2.58	1.174	2
15	3.18	1.057	1				

¹—The names of the items are given in Table 4; M—Medium; SD—Standard Deviation.

The second cluster included items 4, 17, 14, 25, 21, 24, 22, relating to relativism, chemicalization of food production, use of GMOs, products containing chemical additives and GMOs, attractiveness of food packaging, etc. It is worth emphasizing that the average ratings of all items in this cluster were lower than 3, which signified a negative opinion.

The highest standard deviations, indicating a large diversification of assessments, were noted for the item referring to God as the foundation of the scale of values (item 3), as well as the long shelf life of a food product (item 20) and attractive packaging (item 22). On the other hand, the smallest standard deviations were found in the branch grouping pro-ecological items. These items referred to the safety and nutritional value of food (item 27), the high value of developing one's own interests and pleasures (item 8) and the use of reusable products (item 11).

Based on cluster analysis, it is possible to indicate some of the items that were negatively assessed by respondents, forming cluster 2, and some of the items that were positively assessed, taken from cluster 1.

The detailed structure of the assessment of individual items is presented in Figures 3–5. Figure 3 presents the structure of item assessments concerning selected elements of the respondents' lifestyle. The first four items concerned the foundation of the axiological sphere, and items 5 to 11 referred to the respondents' behavior. The highest assessments were obtained for the thesis that the foundation of the scale of values is man (item 1), with total support amounting to 82.7%. This item had the lowest level of negative assessments (7.4%). On the other hand, item 4, indicating the relativity of the scale of values, had the highest level of negative assessments (40.6%) and, at the same time, the lowest level of positive assessments (23.9%).

Among the items related to the respondents' behavior, the pursuit of pleasure and self-development (item 8) was rated the highest (88.1% of yes indications). The use of reusable products (item 11), regular waste sorting (item 9) and concern for the climate (item 5) were also rated highly. The ratings for item 6, referring to dedication to the homeland and society, were interesting. In this case, 42.6% of the respondents assessed this thesis positively, but at the same time 29.2% had a neutral attitude. This may indicate a not

very high level of social involvement. It can therefore be stated that, among the lifestyle elements, the focus on one's own needs and a pro-ecological attitude dominated.

Figure 4 presents the structure of item ratings related to the perception of innovative food production. The data presented in this figure show that respondents particularly appreciated ecological food production (item 12) and traditional technologies limiting the use of chemicals in production (item 16). Such preferences could be related to the attitudes discussed above, while statistical confirmation of these relationships will be the subject of the next subsection. Particular attention should be paid to the negative ratings given to item 14. A total of 63.4% of respondents negatively assessed the use of GMOs in food production. On the other hand, with regard to increasing production efficiency through high chemicalization of production (item 17), respondents also expressed negative opinions (42.5% of negative ratings). In this case, the large percentage of neutral ratings (31.6%) is worth noting. The reasons for this attitude require further research, as it may indicate a lack of knowledge or indifference regarding this topic. Similarly, a high level of neutral assessments concerned the use of bioactive plant protection products and fertilizers (item 15), balanced crop structure (item 19) and, above all, a large share of alternative plants in the cultivation area (item 18). In the case of item 18, 44.1% of respondents assessed the issue in a neutral way. It is likely that the respondents did not have sufficient knowledge about alternative plants.

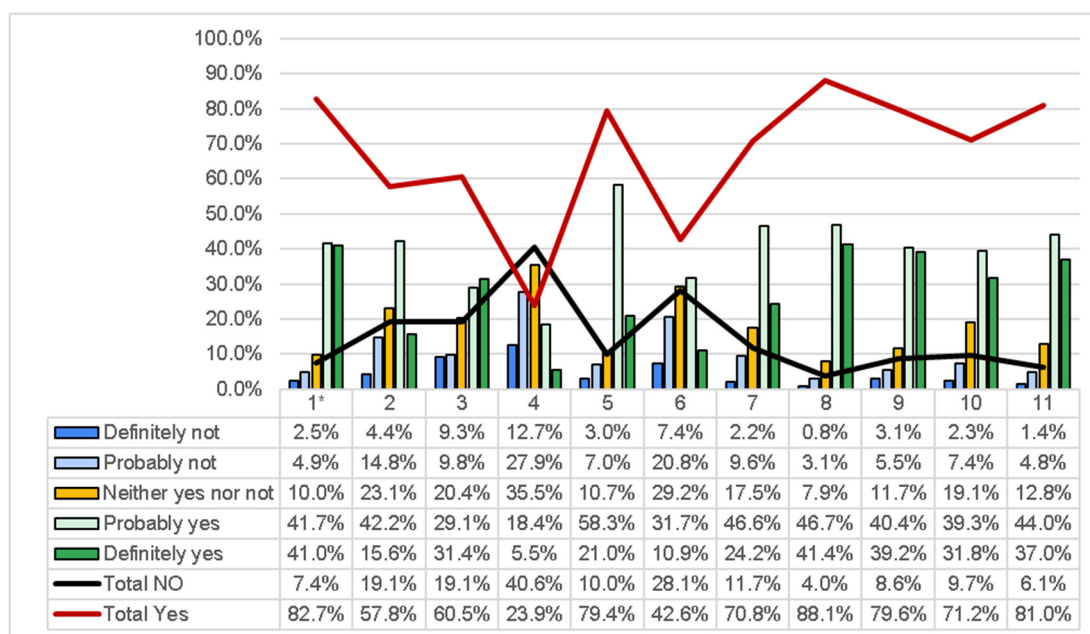


Figure 3. Analysis graph of the structure of item ratings regarding the respondents' lifestyle elements.
*—The names of the items are given in Table 4.

Based on the results presented in Figure 4, it can be stated that the respondents appreciated organic food production, traditional technologies and, at the same time, expressed concerns regarding the use of GMOs and the chemicalization of food production. Therefore, innovative food production technologies were understood by the respondents as a return to natural and traditional production systems.

Figure 5 presents the evaluation of items concerning innovative food products. The highest percentage of positive evaluations was obtained by item 27, according to which innovative food is safe and of full value (92.1%). At the same time, this item received the lowest percentage of negative evaluations (2.7%). The second most positive evaluations concerned the statement that it is organic food (item 29). Respondents also drew attention to the low price of the products (item 23).

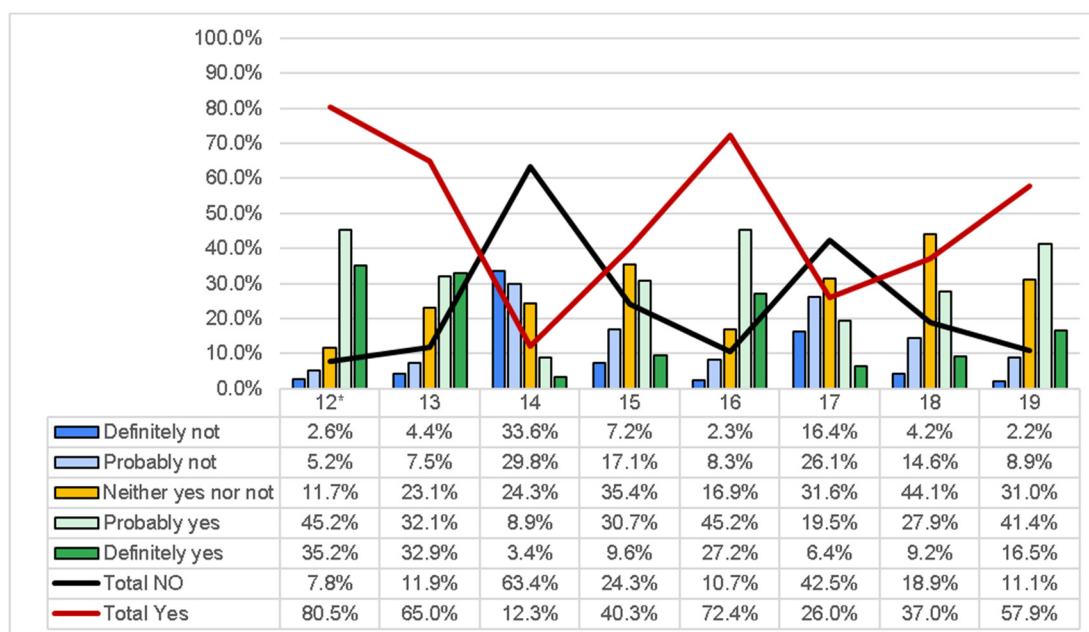


Figure 4. Chart of the analysis of the structure of item ratings regarding respondents' expectations regarding innovative food production. *—The names of the items are given in Table 4.

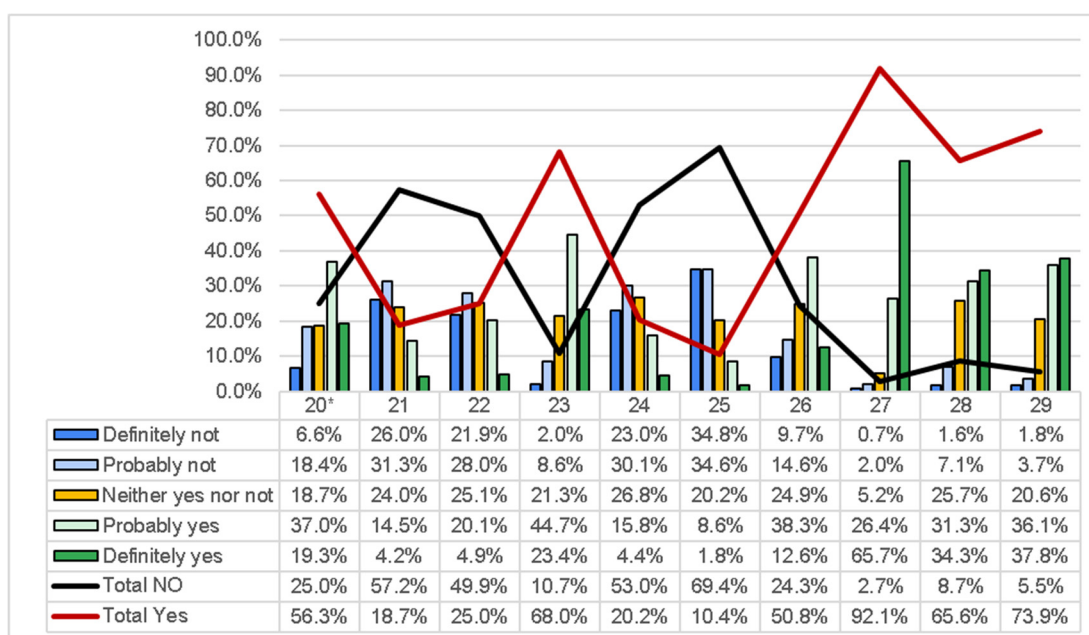


Figure 5. Chart of the analysis of the structure of item ratings regarding respondents' expectations towards innovative food products. *—The names of the items are given in Table 4.

It is worth emphasizing which features, according to respondents, are undesirable in the characteristics of innovative food. The data presented in Figure 5 show that, first of all, such food does not contain GMO elements (item 25) and is not highly processed and ready to eat (item 21). Most respondents also stated that innovative food should not contain synthetic ingredients that increase taste, visual appeal, etc. (item 24).

The data presented show that the respondents understood food production and food products in a coherent way. They understood the relationship between food production technologies and the quality of food products. They paid the greatest attention to the safety and nutritional value of food, but also expected low prices.

4.2. Relationships Between Lifestyle Elements and the Perception of Innovative Food Production and Innovative Food Products

At the stage of conceptualization of the research, it was assumed that lifestyle elements are determinants of the perception of innovative features of production and food products. In order to search for relationships, Spearman correlation analysis (r_s) was conducted, assuming items from 1 to 11 as determinants, and items from 12 to 29 as explained variables. The results of the calculations are presented in Table 6. The values of statistically significant r_s coefficients are written in red font, while the background of the numbers indicates the strength of correlation determined according to the scale given at the bottom of the table [101].

Table 6. Spearman correlation coefficients (r_s) between lifestyle elements and expectations regarding innovative food production and innovative food products.

Items ¹	1	2	3	4	5	6	7	8	9	10	11
12	0.207	0.170	0.106	−0.101	0.361	−0.029	0.115	0.234	0.258	0.101	0.269
13	0.186	0.093	0.217	−0.117	0.228	0.139	0.083	0.159	0.222	0.083	0.243
14	−0.113	−0.013	−0.233	0.085	−0.115	−0.099	−0.012	−0.057	−0.178	0.016	−0.166
15	0.067	0.085	0.002	−0.009	0.023	−0.041	0.013	0.077	0.021	−0.004	0.085
16	0.118	0.056	0.226	−0.128	0.183	0.069	0.086	0.133	0.162	0.096	0.193
17	−0.039	0.067	−0.150	0.097	−0.075	−0.053	0.013	0.047	−0.094	0.045	−0.051
18	0.040	0.108	−0.024	0.039	0.080	0.033	0.063	0.119	0.056	0.086	0.092
19	0.059	0.122	0.051	−0.005	0.119	0.063	0.084	0.093	0.168	0.093	0.155
20	0.056	−0.013	0.090	−0.019	−0.022	0.073	0.089	0.045	−0.035	0.127	0.004
21	−0.113	−0.054	−0.057	0.081	−0.116	0.062	0.027	−0.089	−0.146	−0.006	−0.208
22	−0.085	−0.022	0.013	0.042	−0.006	0.059	0.080	0.022	−0.060	0.062	−0.071
23	0.125	−0.017	0.079	−0.042	0.042	0.053	0.154	0.156	0.026	0.210	0.111
24	−0.114	−0.020	−0.125	0.143	−0.148	0.004	0.015	−0.036	−0.157	0.047	−0.167
25	−0.158	−0.042	−0.218	0.146	−0.172	−0.122	−0.060	−0.125	−0.203	0.018	−0.225
26	−0.020	0.118	−0.099	0.015	0.008	−0.061	0.109	0.100	−0.010	0.118	0.062
27	0.217	0.121	0.075	−0.143	0.182	0.016	0.141	0.251	0.198	0.097	0.286
28	0.149	0.023	0.304	−0.107	0.134	0.184	0.066	0.079	0.112	0.087	0.158
29	0.200	0.106	0.220	−0.126	0.273	0.070	0.061	0.092	0.207	0.077	0.228
² Very weak correlation	Weak dependence		Moderate dependence		Strong dependence		very strong dependence		statistically significant coefficients		
0.0–0.2	0.2–0.4		0.4–0.6		0.6–0.8		0.8–1.0		$p < 0.05$		

¹—The names of the items are given in Table 4. ²—Strength of correlation

The results of the analysis presented in Table 6 indicate that not all items considered as determinants showed a relationship with the explained variables, i.e., the perception of innovative production and food products. The ratings for items 2 and 4, referring to the foundation of the axiological sphere, showed a very weak correlation with the perception of innovative production and food products. Similarly, sacrifice for the homeland (item 6) and the desire to increase the amount of free time (item 7) were very weakly correlated with the explained variables. Since the absolute values of the calculated correlation coefficients r_s did not exceed the value of 0.4, the focus was on the interpretation of correlations in the range of $|r_s|$ from 0.2 to 0.4 (weak relationship). For these cases, the Kruskal–Wallis H test, considered as a nonparametric version of the analysis of variance [99,100], was calculated. In these calculations, the determinants were considered as independent variables, and the explained variables were treated as dependent variables. The results of these calculations are presented in Table 7. For better interpretation, the table also includes the values of Spearman correlation coefficients.

Table 7. Results of the analysis of the relationships between lifestyle elements and the perception of innovative production and food products.

Items ¹	Kruskal-Wallis H Test	Spearman's Correlation ²	Items ¹	Kruskal-Wallis H Test	Spearman's Correlation ²
Item 1			Item 9		
12	H (4, N = 732) = 32.5412 <i>p</i> = 0.0000	0.2074 *	12	H (4, N = 732) = 49.8501 <i>p</i> = 0.0000	0.2584 *
27	H (4, N = 732) = 37.1258 <i>p</i> = 0.0000	0.2173 *	13	H (4, N = 732) = 38.4113 <i>p</i> = 0.0000	0.2223 *
Item 3			25	H (4, N = 732) = 31.1311 <i>p</i> = 0.0000	−0.2034 *
13	H (4, N = 732) = 36.8762 <i>p</i> = 0.0000	0.2170 *	29	H (4, N = 732) = 31.7123 <i>p</i> = 0.0000	0.2067 *
14	H (4, N = 732) = 47.7332 <i>p</i> = 0.0000	−0.2333 *	Item 10		
16	H (4, N = 732) = 39.3801 <i>p</i> = 0.0000	0.2257 *	23	H (4, N = 732) = 37.9004 <i>p</i> = 0.0000	0.2105 *
25	H (4, N = 732) = 44.0414 <i>p</i> = 0.0000	−0.2180 *	Item 11		
28	H (4, N = 732) = 70.2461 <i>p</i> = 0.0000	0.3041 *	12	H (4, N = 732) = 54.6627 <i>p</i> = 0.0000	0.2692 *
29	H (4, N = 732) = 36.0232 <i>p</i> = 0.0000	0.2197 *	13	H (4, N = 732) = 51.1049 <i>p</i> = 0.0000	0.2425 *
Item 5			21	H (4, N = 732) = 36.2865 <i>p</i> = 0.0000	−0.2079 *
12	H (4, N = 732) = 95.8976 <i>p</i> = 0.0000	0.3614 *	25	H (4, N = 732) = 37.7463 <i>p</i> = 0.0000	−0.2245 *
13	H (4, N = 732) = 39.7142 <i>p</i> = 0.0000	0.2280 *	27	H (4, N = 732) = 63.4638 <i>p</i> = 0.0000	0.2858 *
29	H (4, N = 732) = 58.8908 <i>p</i> = 0.0000	0.2732 *	29	H (4, N = 732) = 40.1926 <i>p</i> = 0.0000	0.2277 *
Item 8					
12	H (4, N = 732) = 51.5445 <i>p</i> = 0.0000	0.2340 *			
27	H (4, N = 732) = 61.8986 <i>p</i> = 0.0000	0.2506 *			

¹—The names of the items are given in Table 4. ²—Spearman correlation coefficients with *r_s* > 0.2 (see Table 6).

*—Statistically significant coefficients (*p* < 0.05).

The data in Table 7 show that the relationships between all pairs of variables selected for calculations were statistically significant. People who treated humans as the foundation of the scale of values appreciated ecological plant cultivation and animal breeding, as well as the nutritional value and safety of consumed food. On the other hand, people who considered God as the foundation of the scale of values expected food to be produced using traditional technologies, limiting chemicalization and without the use of GMOs. Food products expected by these respondents are, therefore, ecological or produced using traditional methods, and do not contain GMOs.

Respondents who were guided by climate concern in their lifestyle expected organic plant and animal cultivation and production without the use of GMOs and appreciated organic food.

The development of one's own interests and pleasures influenced higher evaluations of organic farming and animal breeding as well as the expectation of safe and nutritious food.

Respondents who regularly sorted waste perceived organic plant and animal farming as types of innovative food production, as well as production without the use of GMOs.

These respondents considered organic food and food without GMO additives as innovative food products.

Respondents who wanted to save money expected low prices for innovative food products.

The use of reusable products, in relation to food production, was associated with the perception of innovative ecological production and production without the use of GMOs. In relation to food products' safety and high nutritional value, lack of GMO additives was expected. It was expected that, if this food was not highly processed and ready to use, it was defined as organic food.

Based on the data presented in Table 7, it can be stated that specific lifestyle elements determine the perception of innovative food production and innovative food products. In principle, the expected characteristics of food production refer to technologies ensuring food safety and high nutritional value. On the other hand, the perception of food products is consistent with the perception of their production technology. The expected characteristics of innovative food are related to ensuring consumer safety and nutritional values. For the surveyed group, the most important features were not appearance, convenience of use or enriching substances. The respondents considered the ecological origin of food as important.

4.3. Factors Differentiating the Perception of Food Production and Products

In search of factors determining the perception of innovative production and innovative food products, the Mann–Whitney U test was also calculated. In this case, differences were sought between the assessments of individual items depending on the respondent's sex and place of residence. The H0 hypothesis regarding the lack of differences between groups was tested. In the case of rejection of the H0 hypothesis, the alternative HA hypothesis was accepted, according to which there are statistically significant differences between groups. For these items, graphs of means were made, categorized according to the grouping factor (Figure 6).

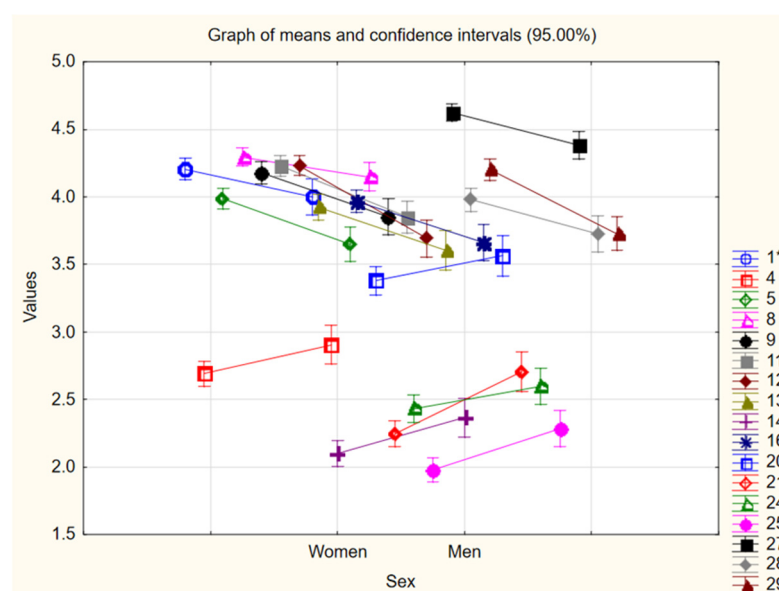


Figure 6. Graph of mean item ratings categorized by sex of respondents for whom the Mann–Whitney U test was statistically significant. *—The names of the items are given in Table 4.

Table 8 presents the results of the Mann–Whitney U test calculations by sex. The data presented in this table show that the assessment of many items differed depending on sex.

Table 8. Results of the analysis of the Mann–Whitney U test; differences between the ratings of individual items due to the respondents' sex.

Items ¹	Women (n = 491)		Men (n = 241)		Z	p
	Mdn	IQR	Mdn	IQR		
I—Lifestyle Items						
1	4.0	1.0	4.0	1.0	2.041	0.0413 *
2	4.0	1.0	4.0	1.0	0.751	0.4528
3	4.0	2.0	4.0	2.0	1.608	0.1079
4	3.0	1.0	3.0	2.0	−2.392	0.0168 *
5	4.0	0.0	4.0	1.0	4.618	0.0000 *
6	3.0	2.0	3.0	2.0	−1.712	0.0869
7	4.0	2.0	4.0	1.0	0.561	0.5750
8	4.0	1.0	4.0	1.0	2.247	0.0247 *
9	4.0	1.0	4.0	2.0	4.346	0.0000 *
10	4.0	2.0	4.0	2.0	−0.077	0.9384
11	4.0	1.0	4.0	1.0	5.644	0.0000 *
II—Items related to innovative production						
12	4.0	1.0	4.0	1.0	6.939	0.0000 *
13	4.0	2.0	4.0	2.0	3.665	0.0002 *
14	2.0	2.0	2.0	2.0	−3.005	0.0027 *
15	3.0	1.0	3.0	2.0	1.491	0.1360
16	4.0	1.0	4.0	1.0	3.778	0.0002 *
17	3.0	1.0	3.0	2.0	−1.421	0.1552
18	3.0	1.0	3.0	1.0	−1.211	0.2257
19	4.0	1.0	4.0	1.0	0.032	0.9741
III—Items about innovative agricultural products						
20	4.0	2.0	4.0	1.0	−2.175	0.0296 *
21	2.0	2.0	3.0	1.0	−5.186	0.0000 *
22	3.0	2.0	2.0	1.0	0.043	0.9659
23	4.0	1.0	4.0	1.0	1.308	0.1909
24	2.0	2.0	3.0	1.0	−2.080	0.0375 *
25	2.0	2.0	2.0	2.0	−3.918	0.0001 *
26	4.0	1.0	3.0	2.0	0.655	0.5126
27	5.0	1.0	5.0	1.0	4.510	0.0000 *
28	4.0	2.0	4.0	2.0	3.022	0.0025 *
29	4.0	1.0	4.0	1.0	6.529	0.0000 *

¹—The names of the items are given in Table 4. (Mdn)—Median; (IQR)—Interquartile range; (Z)—U test value for samples N > 20. *—Statistically significant coefficients ($p < 0.05$).

Among lifestyle elements, within the perception of the scale of values, differences between the sexes concerned the human as the foundation of the scale of values, and relativism (items 1 and 4). The data presented in Figure 6 show that women rated the human as the foundation of the scale of values higher, while men rated the relativity of this scale higher. Among the items referring to the behavioral elements of lifestyle, all differences came down to higher ratings given by women. This indicates a higher involvement of women in such activities as caring for the climate, regular waste sorting, or using reusable products, etc.

Among the items concerning the perception of innovative food production, women, compared to men, rated ecological food production (item 12), the use of traditional technologies that limit the use of chemicals in production (item 16) and production without GMOs (item 13) more highly. Women expressed greater opposition to the use of GMOs in food production (item 14). Such results may indicate that women are more convinced about pro-ecological food production systems.

The differences noted in relation to the perception of innovative food products concerned, among others, long shelf life (item 20), high degree of processing and preparation for consumption (item 21), and high taste and visual attractiveness of the products (item 24).

These items were rated higher by men. On the other hand, items 27, 28 and 29, referring to food safety and its nutritional value, traditional production technologies and ecological origin, were rated higher by women. Item 25, concerning the content of GMO additives in food, was rated the lowest by all respondents while, in the division by sex, women expressed a higher level of disapproval.

The analysis of differences in the assessment of individual items depending on the place of residence (urban/rural) is presented in Table 9. Figure 7 presents a graph of the average item assessments, categorized according to the respondents' place of residence.

Table 9. Results of the analysis of the Mann–Whitney U test; differences between the ratings of individual items according to the respondents' place of residence.

Items ¹	City (n = 351)		Village (n = 381)		Z	p
	Mdn	IQR	Mdn	IQR		
I—Lifestyle Items						
1	4.0	1.0	4.0	1.0	−2.307	0.0211 *
2	4.0	1.0	4.0	1.0	0.356	0.7216
3	4.0	2.0	4.0	2.0	−2.472	0.0134 *
4	3.0	1.0	3.0	1.0	1.124	0.2608
5	4.0	0.0	4.0	0.0	−0.529	0.5966
6	3.0	2.0	3.0	1.0	−3.065	0.0022 *
7	4.0	2.0	4.0	1.0	0.403	0.6868
8	4.0	1.0	4.0	1.0	−1.136	0.2559
9	4.0	1.0	4.0	1.0	−1.366	0.1720
10	4.0	2.0	4.0	1.0	−3.069	0.0022 *
11	4.0	1.0	4.0	1.0	−0.815	0.4151
II—Items related to innovative production						
12	4.0	1.0	4.0	1.0	−0.028	0.9776
13	4.0	2.0	4.0	2.0	−2.194	0.0282 *
14	2.0	2.0	2.0	2.0	1.580	0.1142
15	3.0	2.0	3.0	1.0	−0.189	0.8504
16	4.0	1.0	4.0	2.0	−1.990	0.0466 *
17	3.0	2.0	3.0	1.0	1.090	0.2757
18	3.0	1.0	3.0	1.0	−0.588	0.5564
19	4.0	1.0	4.0	1.0	−1.278	0.2014
III—Items about innovative agricultural products						
20	4.0	2.0	4.0	1.0	−1.420	0.1557
21	2.0	1.0	2.0	2.0	1.687	0.0916
22	2.0	1.0	3.0	2.0	−1.029	0.3035
23	4.0	1.0	4.0	2.0	−2.406	0.0161 *
24	2.0	1.0	2.0	1.0	0.537	0.5914
25	2.0	2.0	2.0	2.0	2.639	0.0083 *
26	3.0	2.0	4.0	1.0	−0.508	0.6115
27	5.0	1.0	5.0	1.0	−1.211	0.2259
28	4.0	2.0	4.0	2.0	−3.632	0.0003 *
29	4.0	2.0	4.0	1.0	−1.284	0.1991

¹—The names of the items are given in Table 4. (Mdn)—Median; (IQR)—Interquartile range; (Z)—U test value for samples N > 20. *—statistically significant coefficients ($p < 0.05$)

Within the items related to lifestyle elements, the assessments of four of them differed depending on the respondents' place of residence. Two of these concerned the foundation of the scale of values in the form of man (item 1) or God (item 3). The others were sacrifice for the homeland (item 6) and the importance of accumulating money in life (item 10). In all these cases, the assessments of rural residents were higher than the assessments of urban residents. The remaining lifestyle elements did not show any differences, depending on the respondents' place of residence. This may mean that the lifestyle of the surveyed urban and rural residents did not show any significant differences.

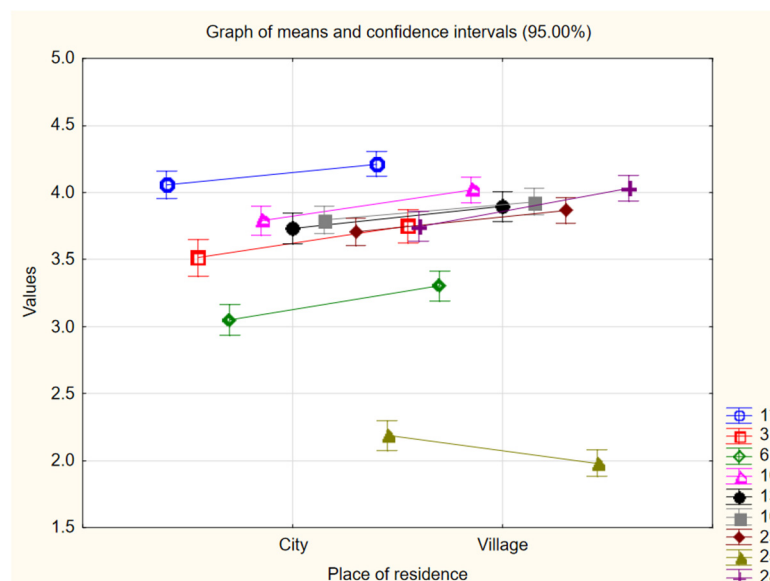


Figure 7. Graph of mean item ratings categorized by sex of respondents for whom the Mann–Whitney U test was statistically significant. *—The names of the items are given in Table 4.

In relation to the perception of innovative food production, the differences in ratings between rural and urban residents concerned items 13 and 16. Both production without GMOs (item 13) and the use of traditional technologies (item 16) were rated higher by rural residents. In relation to the perception of innovative food, items 23 (innovative food is cheap) and item 28 (produced using traditional methods) were rated higher by rural residents. On the other hand, the content of GMO additives in food met with slightly less opposition among urban residents.

The differences in perception of food production and food products, presented above, may be due to the closer connection of rural people with the food production process. Villagers, even if they are not farmers, may appreciate traditional production technologies because of their place of residence.

Among the factors analyzed in this chapter that differentiate the perception of innovative food production and innovative food products, place of residence does not seem to play as big a role as the sex of the respondents. The differences in perception of the issues studied depending on the sex of the respondents indicate the higher sensitivity of women compared to men, in relation to food safety and its ecological origin. All respondents, regardless of sex and place of residence, negatively perceived innovations in the form of using genetically modified organisms in food production. It turned out that, in relation to this factor, there were differences determined by sex and place of residence.

5. Discussion

5.1. Safety of Production and Agricultural Products

The research presented in this article shows us that the answer to the first research question is affirmative. There is a relationship between the perception of the production characteristics and characteristics of agricultural products by the surveyed respondents. This study is consistent with the research of other authors [38], who explain that the food system is a component of the broader economic, social and environmental context. Food security is a state in which all people have physical and financial access at all times to adequate, safe and nutritious food. Such food meets their dietary needs and food choices for a healthy life [102]. Other authors [103] state that excessive use of chemicals, whether for plant and animal nutrition, soil fertilization or weed and pest control, is contrary to sustainable agriculture. This is consistent with the opinions of the respondents from this study. It was found that respondents appreciated organic food production, and innovative

food production technologies were understood by them as a return to natural and traditional production systems [38,40,66,104]. At the same time, our respondents expressed concerns about the use of GMOs and the chemicalization of food production [2,105,106]. The respondents from our study associated innovative production methods with features of safe and wholesome food, as well as organic food, and definitely assessed negatively the undesirable features of innovative food. According to them, such food should not contain GMO elements and cannot be highly processed and ready to eat. The respondents also stated that innovative food should not contain synthetic ingredients to increase taste and visual attractiveness. In addition, the respondents surveyed in this study expected low prices for the food in question.

Moreover, the alternative hypothesis was confirmed in this study, as sex in particular, but also, to a lesser extent, place of residence, influenced the differentiation in the respondents' judgments, because in our research sex was of fundamental importance in the assessment of the features of innovative production by the respondents we surveyed. Women, in comparison to men, rated higher ecological food production and the use of traditional technologies that limit the use of chemicals in production, and expressed greater opposition to the use of GMOs in food production. In the assessment of the features of innovative agricultural products, women focused mainly on the safety and nutritional value and the ecological origin of the products, while men were more open to the taste and visual attractiveness of the products, their long shelf life, or even, to some extent, acceptance of processed and ready-to-eat food. According to research by some authors [64,107], the growing social awareness of the problems posed by the current industrialized food system has led to an increase in support for the creative market and for economically, socially and ecologically sustainable food production systems, as well as to an increase in the demand for changes in agricultural policy and legal regulations.

In our study, place of residence too, although to a lesser extent than sex, differentiated respondents' perception of the characteristics of production and of agricultural products. Both production without GMOs and the use of traditional technologies were rated higher by rural residents. However, innovative food should be, in their opinion, cheap and produced using traditional methods. On the other hand, the content of GMO additives in food was met with slightly less opposition among city dwellers. In some research [108], it was found that the lifestyle of households is the main driver of climate change. These authors examined in particular the role of information about health benefits in the making of pro-ecological decisions by households. On the other hand, in other research [50,64,107], the authors found that traditional open and street markets remain the most important sales points for respondents from poor suburban districts of Vietnam. It was also found that, contrary to popular belief, suburban and rural areas, not urban areas, were the main consumers of processed foods in this country, and that these areas had, on average, higher consumption of ultra-processed foods than urban areas. The low price of processed foods and the presence of processed foods even in traditional grocery stores located closest to rural households offer potential explanations for these findings. The results of studies by other authors [65] show that consumers' concerns about microbiological risks are lower than those about chemical risks, and that is why French consumers have greater confidence in home-grown food compared to food produced industrially. In our study, consumers also preferred traditional farming methods and traditional products without chemical agents, but many of their responses remained neutral on these issues, which could be due to various factors, including a lack of knowledge about the various types of contamination risks [65] or understanding of traditional techniques [41–43,86] producing products in different ways, e.g., in the context of local production methods [63,86], and at the same time, they were indifferent to the sustainable crop structure or the share of alternative crops in the crop structure.

5.2. Consumer Preferences in Choosing and Evaluating Agricultural Production and Products

Our research allows us to answer the second research question in the affirmative to some extent. This is because some elements of the value scale and behavioral behaviors of the respondents we studied were related to their perception of the features of innovative production and innovative agricultural products. The sex of the respondents played a significant role here, as did their place of residence.

Our research showed that rural residents considered the axiological sphere (man and God, sacrifice for the homeland and accumulating money) to be more important, and these elements were related to their perception of innovative features of production and agricultural products. On the other hand, the perception of behavioral lifestyle elements (separating waste, using reusable items, caring for the climate) by the surveyed urban and rural residents did not differ substantially and were similarly related to preferences regarding the features of production and agricultural products. Case studies by other authors [86] show that the impact of globalization on food systems can be properly understood, among other things, by understanding current local environmental problems and determinants of health. This can also be understood through long-term monitoring of the area to understand the sustainability of local food systems in the context of globalization [65]. A different approach to similar issues is taken by some authors [15], who argue that globalization is transforming food systems worldwide and that few geographical areas are spared from nutritional, dietary and epidemiological changes. These authors have preserved aspects of traditional food systems in the regions investigated, although they remain subject to different patterns of influence, which are modeled by various factors, including history, cultural practices, distance and availability, and the integration of globalized ultra-processed foods, which have different impacts on human health.

Our research indicates women's higher involvement in activities such as climate care, regular waste sorting, and the use of reusable products, and also shows, that women definitely believe that the human being is the foundation of the axiological scale of values. Men have a more relative approach in this respect. In [109], the authors found that one of the aspects that is often omitted in the research is the different response of men and women to physical exercise and the presence of nutrients in nutrition, and that the choice of food is different for both sexes and is strongly dependent on different hormonal age in women [110,111].

This study showed that the perception of the features of innovative production and innovative agricultural products could be influenced by the lifestyle preferred by respondents, understood as certain axiological and behavioral features contained in their attitudes. Concern for the climate, waste segregation, and the use of reusable products were clearly associated with the preference for traditional production [40–43,66] and GMO-free [9], as well as with expectations of high-quality agricultural products. In this context, such lifestyle elements as accumulating money and seeking pleasure and searching for free time were also accepted, in the context of the safety and nutritional value of agricultural products. On the other hand, the axiological foundations of lifestyle, such as God or dedication to the homeland, had a varied and insignificant effect on the perception of the features of production and agricultural products.

According to our research, the priority of food production must be the restoration and protection of ecosystems and sustainable food systems. This requires a forward-looking, rational management strategy and fundamental changes in patterns. It also requires changes in economic practices, development practices and product and production characteristics. Other authors share this view [64,107]. In turn, other authors [15] ask about the sustainability of local food systems and show in their research how respondents react to the phenomenon of globalization.

6. Conclusions, Limitations, Implications and Future Research

This research allowed us to answer the research questions in the affirmative and reject the null hypothesis in favor of the alternative hypothesis. The alternative hypothesis as-

sumes that there are differences in the approach to the perception of innovative production and innovative products, in the context of lifestyle elements, depending on the gender and place of residence of the respondents. The following statements can therefore be derived:

1. Most respondents had a negative attitude towards innovations in the form of the use of genetically modified organisms in food production, with significant differences in the perception of this phenomenon depending on gender and place of residence
2. Respondents understood innovative food production technologies as a return to natural and traditional production systems, and their pro-ecological attitudes were related to caring for the climate, waste segregation and the development of their own interests and needs.
3. Respondents understood the relationship between food production technologies and the quality of food products and attached the greatest importance to the safety and nutritional value of food, but they also expected low prices for these products.
4. Axiological and behavioral elements of the respondents' lifestyle determined their perception of innovative food production and innovative food products, and they also expected safe and valuable product features and an ecological origin.
5. Sex significantly differentiated the approach of the surveyed respondents to the studied lifestyle elements and the perception of the features of innovative production and its relationship with the perception of the features of innovative agricultural products. Women were characterized by greater sensitivity, compared to men, in relation to food safety and its ecological origin.
6. Villagers focused more on traditional cultivation technologies than city dwellers and understood the production of healthy, wholesome and safe food in this way. Additionally, axiological foundations were important to them, but no significant differences were observed between city and village dwellers in their approach to behavioral elements of lifestyle.
7. The results obtained indicate a deficit of knowledge among the respondents regarding the chemicalization of agricultural production, the use of bioactive plant protection products and fertilizers, the balanced structure of crops and above all, the large share of alternative plants in the cultivated area; therefore further research and broad education in this area are recommended.

In light of the conducted case study, several general suggestions can be formulated:

- (i) Since the respondents identified safety and high nutritional value of food with products from organic farming, this sector of the food economy should be continued and developed.
- (ii) Educational activities are necessary to increase the level of social awareness regarding safe chemicalization of agricultural production, the use of bioactive agents, and sustainable structure of cultivation using alternative plants.
- (iii) The recognition by the respondents of man as the foundation of the axiological scale indicates anthropocentric attitudes. The focus on meeting one's own needs and concern for the natural environment indicate that the previous social contract based on providing large amounts of cheap food has now become outdated. Food must be produced with respect for the natural environment, must be safe and of full value, and delivered at a reasonable price.

This study has shown us some limitations which were highlighted in the respondents' answers. In the future, attention should be paid to what 'local', 'traditional', and 'ecological' mean, because it seems that the respondents understood these words interchangeably. It would also be necessary to specify the contaminants present in food as chemical and biological, because the respondents only paid attention to the former. In future studies, it would also be necessary to emphasize and specify more precisely what agricultural practices mean (explain the use of mineral or organic fertilizers; define bioactive agents, and their impact on agricultural crops; describe the names of alternative plants and the benefits of a diversified crop structure). The financial status of the respondents is probably also of great importance, in the context of their statements about low prices of high-quality agricultural products, which should also be examined in the future.

The strength of our research is that it opens up paths for further interesting research and fits into trends visible all over the world. The research also highlighted the important role of women in this area.

The above studies have implications for decision-makers in terms of broad education on various traditional approaches to innovations in the food economy, and in taking into account the role of women in promoting pro-ecological attitudes, as well as the role of the countryside in promoting a return to traditional crops and technologies.

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