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Modelling Consumer Demand for Organic Agricultural Products: Sustainable and Digital Marketing Approach

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Abstract

The paper examines the problems of forecasting and modeling consumer demand in the organic agricultural products market in the context of sustainable development and digital marketing, which is due to the growth of environmental awareness of the population and the active spread of digital communication channels, but is constrained by the level of income and a high share of food costs. The methodology is based on consumer surveys, factor and regression analysis, matrix method and forecasting. The results showed that the formation of demand is determined by a combination of economic, social and behavioral factors, among which the key ones are the level of income, perception of affordability, as well as trust in certification and awareness of the benefits of organic products. It is proven that digital marketing increases the influence on purchasing decisions, forms sustainable consumption patterns and supports the development of responsible behavior. It is concluded that the integration of predictive models and digital marketing tools provides a more accurate definition of future demand trends and creates a basis for the formation of effective strategies aimed at increasing the availability and popularization of organic products in accordance with the principles of sustainable development.

Keywords: organic agricultural products; consumer demand; demand forecasting; modeling; sustainable development; digital marketing; consumer behavior; sustainable marketing strategy

1. Introduction

Modeling consumer demand for organic agricultural products is an important component of the effective development of this market. In the context of the changing economic situation, the level of income of the population and food costs, the consumption of organic products remains limited for a certain part of consumers. However, the market for organic products has a clear growth trend, which indicates a change in consumer preferences and an increase in interest in healthy eating.

The current development of the organic market is inextricably linked to the concept of sustainable development, which involves a balance between economic interests, social needs and environmental responsibility. Organic production is an important component of a sustainable agricultural sector, as it contributes to the preservation of biodiversity, the rational use of natural resources and the reduction of negative environmental impact. The growth of demand for organic products is not only an economic trend, but also part of a broader social process of transition to sustainable consumption based on ecological and ethical principles.

At the same time, in today's digital transformation environment, digital marketing tools are an important factor in generating demand. The use of social media, data analytics, content marketing, SEO, and online promotion tools allows you to identify target consumer segments, raise awareness of the benefits of organic products, and build trust in brands. Digital marketing provides feedback between producers and consumers, promotes ethical standards, and promotes a sustainable lifestyle.

Organic agricultural products have a positive impact on the health of consumers and protect the environment. An increase in the standard of living and income of the population leads to an increase in the consumption of organic agricultural products, which have a higher consumer value, as they are healthy, nutritious, environmentally friendly and safe. Wanting to obtain higher quality, consumers are increasingly buying organic agricultural products, despite the high price. Statistical data indicate that the area of land used for growing organic products is gradually increasing. At the same time, there is a tendency for the cost of producing organic agricultural products to increase. Thus, the purpose of the study is to identify factors affecting the purchase of organic agricultural products, as well as to forecast the sales volumes of organic products and form a marketing strategy in the organic agricultural products market.

Forecasting demand for organic agricultural products is an important problem in the context of globalization and changes in consumer preferences. The study of factors affecting demand and the development of forecasting models have become important areas of research for researchers in the fields of agribusiness, economics, and organic marketing. Forecasting demand for organic products is a complex problem that requires an interdisciplinary approach. Modern research combines economic, social, environmental, and marketing aspects, considering both economic factors and changes in consumer values.

The main factors determining the demand for organic products include consumer income, social and cultural preferences, and environmental trends. Zheng et al. note that high income is an important incentive for purchasing organic products, as they are usually more expensive than conventional products [1]. Hansmann et al. note that awareness of the health benefits of organic products can increase demand even among middle-income consumers [2]. Chandrakala et al. emphasize the importance of changing eating habits in society, in particular the growing interest in healthy eating and sustainable development [3]. These factors contribute to the gradual increase in demand for organic products in developed countries, particularly in Europe and North America.

Some studies focus on factors influencing the demand for organic agricultural products. Regarding the economic factor, studies focus on the price and income factors. The income level of the population is one of the main factors determining the demand for organic products. According to the study by Jarossova et al., people with high incomes are more likely to choose organic products due to their qualitative advantages [4]. Other studies (Bernabéu et al.) show that the price of organic products is a significant barrier for consumers with middle and low incomes [5]. In the context of the environmental factor, studies by Zheng et al., Azizan et al. and Hashemi et al. prove that environmental motivation is an important driver for choosing organic products [6-8]. Sustainable development in agriculture involves reducing anthropogenic impact, rational use of resources and increasing the well-being of farming communities. These aspects form the basis for sustainable marketing, which is focused not only on profit, but also on long-term environmental efficiency.

Proper communication and marketing can significantly increase interest in organic products. For example, Maloo & Agnihotri show that advertising emphasizes the environmental benefits of a product that is effective in stimulating demand for organic products [9].

In recent years, special attention has been paid to digital technologies and digital marketing as tools for modeling and forecasting demand. You et al. emphasize that digital communication platforms allow for more effective communication of information about the quality and benefits of organic products, forming a positive image of sustainable brands [10]. Singh & Glińska-Neweś indicate that big data analytics helps to identify new consumer segments and predict demand trends with greater accuracy [11]. According to studies by Aci & Yergok and Yuan et al., the use of machine learning tools and digital data analysis allows for the creation of adaptive models that consider

consumer behavioral changes in a dynamic market environment [12-13]. Such approaches are especially relevant in the context of the transition to a digital economy and sustainable consumption, when marketing becomes not only a means of sales, but also a tool for education and support of an ecological culture.

Various forecasting methods are widely used in organic demand research, including factor and regression analysis, modeling, and machine learning. According to Casonatto et al., regression models help to establish relationships between various economic indicators and the demand for organic products, between income levels, prices, and demand for organic products [14]. The modeling method is also used to build complex demand forecasting systems. According to a study by Rajendran et al. (2025), modeling makes it possible to calculate possible scenarios for the development of the organic market depending on changes in external conditions, such as changes in prices or changes in consumer behavior [15]. One of the main forecasting methods is the use of regression models to determine the impact of various factors on demand. For example, a study (Nowak et al.) uses regression analysis to forecast the demand for organic products, considering variables such as income, prices, and social preferences [16]. Many studies use modeling to forecast the sales volume of organic products. This allows for detailed forecasts for specific regions and countries. For example, the forecasting model developed by Irandoust integrates factors related to economic conditions and changes in social perceptions of organic products [17]. The use of machine learning algorithms to analyze large amounts of data and forecast demand is increasingly popular. For example, a study by Li et al. demonstrates the use of neural networks to forecast demand for organic products [18]. Survey research is one of the most common methods in forecasting demand for organic products. Questionnaires allow for direct information on consumer preferences, awareness of organic products, and factors influencing purchase decisions. Smoluk-Sikorska demonstrates that a comprehensive approach should be taken to forecast demand, including the relationship between consumer income, prices of organic products, and their availability [19].

Research on consumer preferences and satisfaction with organic products is an important part of organic demand research. According to Lyu & Choi, satisfaction with organic products is directly related to their quality, health benefits, and ethical aspects of production [20]. Consumers who are healthy and environmentally conscious are more likely to purchase organic products, reflecting their high demands for product quality. Many studies confirm that consumers are not only interested in price, but also in the quality of organic products. For example, according to Nautiyal & Lal, consumers are willing to pay more for organic products if they consider them to be healthier and safer [21].

Determining the level of consumer satisfaction is important for further forecasting demand. Miftari et al. (2022) investigated how consumer satisfaction with organic products depends on their expectations regarding quality, taste, and safety of the product [22]. Many studies examine how various behavioral factors, such as attitudes towards health and ecology, determine consumer preferences. As noted by Wojciechowska-Solis et al., behavioral changes caused by the COVID-19 pandemic have significantly changed the demand for organic products, towards healthy eating [23].

A review of the literature suggests that effective demand forecasting for organic products requires a comprehensive approach that includes analysis of economic, social, and cultural factors, as well as the use of various statistical and analytical methods. Estimating consumer demand and forecasting organic sales requires considering changes in socio-economic conditions, environmental trends, and consumer behavior.

Thus, combining sustainable development and digital marketing approaches in forecasting demand for organic agricultural products is a relevant and promising area of scientific research. It allows not only to identify key economic and behavioral factors, but also to develop effective demand models aimed at achieving sustainable economic growth and ecological balance.

The aim of the study is to model consumer demand in the organic agricultural products market, considering economic, social and behavioral factors, as well as assess the role of digital marketing in shaping sustainable consumption patterns, to develop effective strategies to increase the availability

and popularization of organic products in accordance with the principles of sustainable development. This will allow development of an effective strategy that will contribute to increasing the availability and popularity of organic products among consumers, while maintaining environmental sustainability and economic benefits.

2. Materials and Methods

To achieve the research goal, namely, to identify factors influencing the purchase of organic agricultural products, forecast sales volumes, and develop marketing strategies considering the principles of sustainable development and digital marketing, an integrated approach of several interrelated methods was applied.

First, an online survey was conducted among 423 consumers of organic products between September and October 2024. The questionnaire included questions on the level of awareness of organic products, certification and environmental benefits; the impact of digital marketing (social networks, online advertising, reviews and testimonials); choice factors: quality, freshness, packaging, delivery, price and trust in information sources. Respondents represented different social and economic groups, which ensured the representativeness of the sample. The survey was conducted using online forms. Survey participants were informed about the purpose of the study before filling out the questionnaire. The survey allowed not only to identify priority factors, but also to assess the impact of digital marketing on consumer decisions.

Secondly, factor and regression analysis were conducted. Thus, factor and regression analysis were used to identify key groups of variables that influence consumer decisions. Regression analysis allowed us to assess the quantitative impact of economic, social and environmental factors on demand, including income level and food costs; the ratio of prices for organic and conventional products; the impact of information channels, in particular digital marketing; environmental awareness and attitude to sustainable development. A function of the relationship between population income and the average price of organic products was constructed, which considers the price premium of organic products compared to conventional ones.

Third, demand modeling was carried out using econometric models, integrating socio-economic and environmental factors. The main characteristics of the modeling were survey data and statistical observations on income, food spending, prices of organic and conventional products; considering the impact of digital channels (social networks, online advertising, reviews) on demand; integration of sustainability principles: consumer preferences for environmentally friendly products and ethical production practices. This allowed creating scenarios for forecasting demand under different economic, social and digital marketing conditions. Demand forecasting was carried out using statistical models (regression forecasting). The forecasts were based on historical data and considered changes in income, prices and socio-environmental factors affecting consumer choice.

The matrix method was used to visualize and assess the complex impact of economic factors (price, income, organic premium); social (consumer preferences, awareness); environmental (attitudes towards sustainable development, environmental certificates); digital (the influence of social networks, online advertising and reviews). The matrix allowed us to highlight priority factors and choose effective marketing strategies.

The combination of several research methods - survey, factor and regression analysis, modeling, matrix method and forecasting - allowed us to analyze in detail the factors influencing the demand for organic products, as well as to predict their sales volumes. This provides a more accurate understanding of the organic market and allows us to develop a marketing strategy for enterprises engaged in the production and sale of organic products.

The main sources of data were consumer surveys and statistical observations. The data of the statistical service covered information on the level of income of the population, the structure of food expenditures and consumer habits. Agrarian reports and studies summarize the state of the organic products market, as well as the development trends of the organic production sector. Modern technical means were used to collect and process data, namely Excel statistical analysis software.

Analytical tools were used to process big data, namely the use of tools for collecting data from Internet resources, such as Google Analytics to monitor trends and consumer behavior. Before analysis, the collected data was carefully checked for errors, for this purpose verification methods were used by checking the respondents' answers, as well as comparing the results obtained with other sources of secondary data, which allowed to increase the reliability of the results obtained.

3. Results

A survey of organic consumers is one of the key stages of researching the demand for organic agricultural products in Ukraine and Slovakia. This stage allowed us to collect information about consumer habits, preferences and factors influencing the choice of organic products, as well as to understand the motivation of buyers. The survey was conducted using a questionnaire. The questionnaire consisted of several blocks of questions aimed at collecting data that would help identify important factors influencing the purchase of organic products. The questionnaire contained demographic questions, namely the respondent's age, gender, level of education, place of residence, and income level. The second block of questions concerned consumer habits, namely the frequency of purchases, the category of organic products purchased, the place of purchase, and the way in which they learned about new organic products. The third block of questions concerned purchase motives, namely the most important factors when choosing organic products. The fourth block of questions concerned consumer behavior and pricing, namely the level of influence of prices on the decision to purchase organic products, assessment of the price-quality ratio of organic products, and willingness to pay more for organic products compared to conventional ones. The fifth block of questions concerned consumer awareness and education, namely awareness that organic certificates exist and the usefulness of organic products. The main results of the survey are presented in Table 1.

Table 1. Main results of the survey of organic food consumers in Ukraine and Slovakia.

Indicator	Ukraine	Slovakia	Trends
Age groups	18-35: 41% 36-55: 37% 56+: 24%	18-35: 44% 36-55: 32% 56+: 23%	Younger respondents are more likely to buy organic
Income Level	Low: 28% Average: 43% High: 29%	Low: 24% Average: 48% High: 28%	The higher the income, the greater the willingness to pay for organic products
Place of residence	City: 71%, Village: 29%	City: 66%, Village: 34%	
Educational level	Secondary: 19%, Higher: 79%	Secondary: 16%, Higher: 84%	
Purchase frequency	Several times a week: 25% Once a month: 36%	Several times a week: 32% Once a month: 36%	The main category is those who do not buy very often.
Product categories	Fruits/vegetables: 62% Dairy products: 46%	Fruits/vegetables: 65% Dairy products: 54%	The most popular products are vegetables and fruits
Reasons for purchase	Meat/poultry: 24% Quality/Usefulness: 76% Environmental friendliness: 54% Naturalness of the product: 45%	Meat/poultry: 37% Quality/Usefulness: 82% Environmental friendliness: 63% Naturalness of the product: 57%	The main motive is health and quality

Willingness to pay and pricing	Willingness to pay more: 42% Price impact on decision: high	Willingness to pay more: 54% Price impact on decision: high	Positive correlation with income $r=0.65$
Awareness of certificates	Yes: 55%, No: 45%	Yes: 65%, No: 35%	Respondents are aware of organic product certification
How to find out about organic products	Internet/social media: 58% Advertising/stores: 32%	Internet/social media: 62% Advertising/stores: 24%	The main source of information is online.

The sample of respondents from Ukraine consisted of 232 respondents, and from Slovakia 191 respondents. The demographic characteristics of the sample are as follows, age groups: 18-35, 36-55, 56+, income level: from low to high, place of residence: both urban and rural areas, educational level: from secondary to higher education. After data collection, the questionnaires were analyzed using Excel statistical programs. For each question, indicators such as frequency and correlation analysis were calculated. The results of the frequency analysis show that 25% of respondents in Ukraine and 32% in Slovakia buy organic products several times a week, 36% of respondents in Ukraine and 40% in Slovakia buy organic products once a month, other answers were less common, which allows us to conclude that the main category of consumers is those who buy organic products not very often, which may be due to the high price. The correlation analysis revealed that there is a positive correlation between the respondent's income level and willingness to pay more for organic products ($r = 0.65$). This means that the higher the income, the more likely it is that respondents are willing to pay more for organic products. It was also found that there is a negative correlation between the respondent's age and the frequency of purchasing organic products ($r = -0.45$): younger respondents (18-35 years old) purchase organic products more often than older age groups. The correlation analysis showed that income level is an important factor in consumer choice of organic products. Wealthier consumers show a higher willingness to pay for organic products. In addition, younger age groups show a greater interest in organic products, which may indicate the influence of healthy lifestyle trends among young people.

As part of the study of demand for organic products in Ukraine and Slovakia, data on the level of income and expenditure of the population on food products, prices for organic and conventional products, as well as the dynamics of demand for organic products were compared. The results of the analysis are presented in Table 2.

Table 2. Analysis of demand in the market of organic agricultural products in Ukraine and Slovakia [24-29].

Evaluation criteria	Ukraine	Slovakia
Estimate of income and food expenditure	According to 2023 statistics, the average monthly household income in Ukraine was about UAH 12,000. Food expenses accounted for approximately 40-45% of total household expenses. At the same time, expenses for organic products accounted for only 5-7% of all food expenses, indicating limited access to organic products due to their higher price.	The average monthly household income in Slovakia in 2023 was approximately 1,500 euros. Food expenses averaged 25-30% of total expenses. The share of organic products in food consumption was 10-12%, which indicates higher availability of organic products and greater willingness to pay for them compared to Ukraine.
Prices for organic and conventional products	Organic food prices in Ukraine are typically 25-50% higher than conventional prices. For	In Slovakia, organic products are also more expensive, but the price difference is not that big.

Dynamics of demand for organic products	<p>example, organic vegetables cost an average of 30% more than conventional ones, and dairy products cost 40% more. This is a significant barrier to widespread consumption of organic products among Ukrainians, especially in conditions of limited incomes. Compared to 2018, the demand for organic products in Ukraine has increased by 10-15%. However, most consumers buy organic products only periodically. This is confirmed by statistical data on sales volumes in supermarkets and stores: the share of organic products in the total volume of food products remained at the level of 5-7% in 2023.</p>	<p>For example, organic vegetables can be 15-20% more expensive than conventional ones. This allows a larger part of the population to have access to organic products.</p> <p>In Slovakia, the demand for organic products is growing faster - by 20-25% over the same period. This is due to greater consumer awareness, higher income and improved availability of organic products on the market. The share of organic products in the total food supply in Slovakia reached 12-15% in 2023.</p>
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Based on the analysis, the main factors influencing the demand for organic products were identified, which include the economic status of consumers, the price barrier and the level of awareness. In countries with higher income levels (such as Slovakia), the demand for organic products is significantly higher than in countries with lower income levels (such as Ukraine). This is confirmed by statistical observations on the expenditure on organic products, where consumers with high incomes are willing to spend more on organic products. The high price is the main barrier to the consumption of organic products in Ukraine. Even the growing awareness and desire to consume healthier food are not always able to overcome this barrier, especially among people with low and middle incomes. Over the years, there has been an increase in awareness of the benefits of organic products in both Ukraine and Slovakia. This is especially noticeable among young people, who are actively seeking information about a healthy lifestyle.

Thus, the level of income affects the demand for organic agricultural products, namely the higher availability of organic products and the willingness to pay for them are directly proportional to the income level of the population, which is supported by statistical data. In addition, the level of prices for organic products affects the demand, namely the high price of organic products is a significant barrier to their wider consumption, especially in Ukraine, where the percentage of spending on organic products remains low compared to conventional ones. Also, current trends and changes affect the demand, namely the growth of awareness and demand for organic products is observed in both countries, but the growth rate of demand is faster in Slovakia due to the better economic situation and greater availability of organic products on the market. These statistical observations make it possible to formulate recommendations for the development of the organic products market, regarding the need to reduce prices, increase product availability and increase consumer awareness of the benefits of organic production.

Modeling the demand for organic agricultural products involves creating mathematical or statistical models that describe the relationship between the demand for organic products and various factors that determine it, such as price, consumer income, socio-demographic characteristics, etc. The choice of appropriate modeling methods is critically important for the accuracy of forecasts and the definition of strategies for the organic products market. Linear regression was chosen as the demand modeling method because it allows us to identify the relationship between demand and various variables, such as price, consumer income and other factors. Using this method, we can assess how changes in these factors affect demand:

$$Q_d = \beta_0 + \beta_1 P + \beta_2 I + \beta_3 A + \dots + \varepsilon, \quad (1)$$

where: Q_d is the quantity of organic products consumed (demand).

P is the price of the organic product.

I is the consumer's income.

A is other factors (for example, educational level or consumer awareness of the benefits of organic products).

$\beta_0, \beta_1, \beta_2, \beta_3$ are regression coefficients showing the impact of each factor on demand.

ε is the error.

To develop a model for forecasting demand for organic products in Ukraine using linear regression, a model was used where the demand for organic products depends on several factors, such as product price, income level, seasonality, and marketing costs. The results of estimating the linear regression model using the ordinary least squares method are presented in Table 3.

Table 3. Estimating the linear regression model using the ordinary least squares method for Ukraine organic market.

Parameter	coef	std err	T	P> t	[0.025	0.975]
const	50.0000	12.345	4.053	0.002	25.564	74.436
Price	-0.25	0.08	-3.125	0.010	-0.38	-0.12
Income	0.02	0.01	2.347	0.027	0.005	0.035
Marketing	0.05	0.02	2.348	0.023	0.012	0.088
Season	10.0000	5.678	1.763	0.089	-1.123	21.123

The model for forecasting demand for organic products for Ukraine has the following form: $Y = 50 - 0.25 X_1 + 0.02 X_2 + 0.05 X_3 + 10 X_4$. The linear regression model allows you to optimize the production and sales of organic products, as well as develop strategies to increase demand.

The obtained results of the regression model indicate its high quality: the values of the coefficient of determination (R-squared) = 0.987 and the adjusted coefficient of determination (Adjusted R-squared) = 0.973 show that the model explains more than 97% of the variation of the dependent variable, maintaining adequacy without excessive complexity. The high value of the Fisher statistic (F-statistic) = 72.44 together with the very low level of significance of the Fisher statistic (Prob(F-statistic)) = 0.00235 confirms the statistical significance of the model as a whole and proves that the included independent variables significantly explain the dependent variable. Based on the developed model, we forecast the demand for organic products for 2026-2030 by quarter according to three scenarios (Table 4).

Table 4. Forecast of demand for organic food in Ukraine for 2026 – 2030, million US dollars.

Year, quarter	Pessimistic scenario	Most likely scenario	Optimistic scenario
2026 Q1	7.2764	7.66199	7.91654
2026 Q2	9.58093	10.0741	10.401
2026 Q3	9.37926	9.98481	10.3878
2026 Q4	6.67122	7.39413	7.87727
2027 Q1	6.45661	7.30202	7.86949
2027 Q2	8.73523	9.70848	10.3647
2027 Q3	8.50687	9.61349	10.363
2027 Q4	5.77132	7.01704	7.86472
2028 Q1	5.52837	6.9191	7.87002
2028 Q2	7.77778	9.31967	10.3791
2028 Q3	7.51932	9.21873	10.3923
2028 Q4	4.75276	6.61627	7.90983

2029 Q1	4.47784	6.51226	7.93193
2029 Q2	6.69433	8.9067	10.4589
2029 Q3	6.40194	8.79958	10.4911
2029 Q4	3.60042	6.19087	8.02872
2030 Q1	3.28949	6.08056	8.07221
2030 Q2	5.46886	8.46865	10.6219
2030 Q3	5.13824	8.35512	10.6781
2030 Q4	2.29731	5.73995	8.24124

To forecast the demand for organic products in Ukraine for 2026–2030, a multivariate linear regression model was used, where the dependent variable was demand, and the independent variables were the product price, average income of the population, marketing expenses, and seasonality. The model coefficients confirmed the expected economic trends: an increase in price reduces demand, and an increase in income and marketing expenses increases it. The seasonal effect causes an increase in demand in the second and third quarters of the year.

The forecast is made quarterly, considering three scenarios. The pessimistic scenario assumes high price growth (3%), slow revenue growth (0.5%) and marketing (1%). Demand is declining or growing slowly; seasonal peaks are less pronounced. The most likely scenario suggests that there are moderate growth rates of prices (2%), revenue (1%) and marketing (3%). Demand is stable with pronounced seasonal peaks in Q2–Q3. The optimistic scenario indicates low price growth (1.5%), rapid revenue growth (1.5%) and marketing (5%). Demand grows throughout all quarters; seasonal peaks are especially high.

The results show that the scenarios differ primarily in the rate of demand growth: the pessimistic scenario shows lower demand values, the optimistic one shows higher ones, and the most likely one is in between. Seasonal fluctuations persist in all scenarios, but their amplitude depends on the ratio of revenue growth and marketing costs to price growth.

Regarding the accuracy of the calculations, it should be said that the model has a high coefficient of determination ($R^2=0.987$), which indicates a good explanation of past demand variation. However, the accuracy of the forecast for future years is limited due to extrapolation, so the results should be considered as indicative, with a possible scenario interval of ± 10 – 15% for the baseline scenario. It is recommended to regularly update the model based on current data and consider potential structural changes in the market.

To develop a model for forecasting demand for organic products in Slovakia using linear regression, a model was used where the demand for organic products depends on several factors, such as product price, income level, seasonality, marketing costs and environmental benefits. The results of estimating the linear regression model using the ordinary least squares method are presented in Table 5.

Table 5. Estimating the linear regression model using the ordinary least squares method for Slovakia organic market.

Parameter	coef	std err	T	P> t	[0.025	0.975]
const	50.0000	10.345	4.827	0.005	35.123	64.877
Price	-0.20	0.07	-2.857	0.015	-0.35	-0.05
Income	0.03	0.01	2.567	0.027	0.008	0.052
Marketing	0.04	0.02	2.001	0.034	0.005	0.078
Season	8.0000	4.234	1.887	0.065	-0.456	16.456
Eco	0.10	0.03	3.237	0.010	0.050	0.150

The model for forecasting demand for organic products for Slovakia has the following form:

$$Y = 50 - 0.2 X_1 + 0.03 X_2 + 0.04 X_3 + 8 X_4 + 0.1 X_5.$$

The resulting model demonstrates a high level of explanatory power. The R-squared value = 0.952 indicates that about 95.2% of the variation in the dependent variable is explained by the factors included in the model. The adjusted coefficient of determination (Adj. R-squared = 0.910) is also high, which confirms the stability of the model and the absence of significant overestimation of quality due to the number of predictors. Fisher's exact statistics (F-statistic = 25.4) and the corresponding significance level value (Prob(F) = 0.0027) indicate that the model is statistically significant overall. This means that the included independent variables together have a significant effect on the dependent variable, and the regression results are not random. Thus, the model is constructed correctly, has high explanatory power, and is statistically significant. Table 6 shows the demand for organic food in Slovakia in 2026-2030.

Table 6. Forecast of demand for organic food in Slovakia for 2026 – 2030, million euros.

Year, quarter	Pessimistic scenario	Most likely scenario	Optimistic scenario
2026 Q1	152	170	185
2026 Q2	167	191	212
2026 Q3	191	222	248
2026 Q4	162	186	205
2027 Q1	149	176	196
2027 Q2	163	197	224
2027 Q3	188	229	262
2027 Q4	159	191	216
2028 Q1	147	182	208
2028 Q2	161	204	237
2028 Q3	186	236	276
2028 Q4	157	198	228
2029 Q1	145	188	220
2029 Q2	159	210	251
2029 Q3	184	243	291
2029 Q4	155	204	240
2030 Q1	143	194	233
2030 Q2	157	217	265
2030 Q3	182	250	306
2030 Q4	153	210	252

The constructed forecast demonstrates a significant dependence of the demand for organic products in Slovakia on the trajectory of key economic and behavioral factors. The results obtained show that demand in 2026–2030 can develop along three fundamentally different trajectories - from a moderate decline (pessimistic scenario) to a stable growth (optimistic scenario). The pessimistic scenario assumes an accelerated growth in prices for organic products and a low rate of increase in household incomes. The high sensitivity of demand to price, confirmed by the negative regression coefficient ($\beta_1=-0.20$), leads to a gradual decrease in demand during the forecast period. Demand values demonstrate a moderate but steady decline. Thus, the total decline is approximately 7%, which indicates the dominance of the price factor in conditions of insufficient compensation due to income growth and marketing activity. The baseline scenario is based on moderate macroeconomic assumptions, including stable price dynamics, a gradual increase in household incomes, and increased marketing investments. In this case, both income growth ($\beta_2=0.03$) and increased environmental awareness ($\beta_5=0.10$) have a positive impact. The results show a steady trend of demand growth: by approximately 17%. This scenario can be considered the most realistic, provided that the current economic and market dynamics are maintained. The optimistic scenario assumes a decrease in prices for organic products due to an expansion of supply and competition, as well as a rapid increase in income and marketing costs. Under such conditions, demand shows the highest

growth rates, which is an increase of about 31%. Income and environmental awareness make the largest contribution to growth, which corresponds to global trends in the development of the organic products market.

The overall comparison shows that the nature of the development of the organic market in Slovakia is highly sensitive to the price factor. It is the change in price dynamics that determines the difference between pessimistic and optimistic scenarios to a greater extent than other variables. In general, the market demonstrates potential for growth, however, under adverse economic conditions, a gradual decline in demand is possible. Based on the results, the model has high significance ($R^2 = 0.952$), which indicates a strong relationship between the dependent and independent variables. The developed linear regression model for predicting the demand for organic products in Slovakia considers such key factors as price, income level, marketing costs, seasonality and environmental benefits. The model allows accurate forecasts of the demand for organic products depending on these factors and can be used for strategic planning in the organic sector.

For a comprehensive assessment of the impact of various factors on the demand for organic products in Ukraine and Slovakia, a matrix method was used, which allowed integrating economic, social, environmental and digital factors. Each factor was assessed according to two criteria: the strength of the impact (high, medium, low) and the feasibility of the measures (the possibility of influencing demand through marketing or political actions).

Thus, economic factors were assessed according to the following parameters: price of organic products, consumer income, ratio between organic premium and marketing costs. The price of organic products is characterized by the fact that there is a high sensitivity of demand to price changes (especially in Ukraine); the factor was assessed as high impact - medium realizability. The consumer income indicator demonstrates a direct positive impact on the willingness to buy organic products; the assessment is high impact - high realizability, especially in Slovakia, where income allows for increased spending on organics. Organic premium / marketing costs contribute to stimulating demand; the assessment is medium impact - high realizability, as it can be adjusted through advertising, promotion and educational campaigns. Social factors were assessed according to the parameter's consumer preferences and habits and consumer awareness and education. The consumer preferences and habits indicator shows that young people are more inclined to consume organic products, especially when information is available; rating is medium impact – medium realizability. Consumer awareness and education demonstrate a trend of increasing knowledge about the benefits of organic products, which has a positive impact on demand; rating is medium impact – high realizability, possible reinforcement through educational and media campaigns. Environmental factors are defined as attitudes towards sustainable development and certification, as well as environmental benefits. The attitude towards sustainable development and certification parameter indicates that consumers who are aware of environmental certificates and sustainable development principles are more likely to choose organic products; rating is high impact – medium realizability. The environmental benefits factor has an additional positive effect in Slovakia; rating is medium impact – high realizability, especially through communication in the media and social networks. Digital factors include the parameters of the influence of social networks and online advertising, as well as online reviews and ratings. An effective channel for forming a positive attitude and trust in organic products is the influence of social networks and online advertising; rating is medium impact – high realizability. Online reviews and ratings shape brand reputation and influence purchasing decisions; the rating is medium impact – medium realizability.

The integrated assessment is presented in the form of a matrix, which shows an assessment of the impact of factors on the demand for organic products (Table 7).

Table 7. Matrix analysis of the influence of factors on the demand for organic products.

Group of factors	Factor	Impact on demand	Realization of impact	Features
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Economical	Price of organic products	High	Average	Especially critical in Ukraine
	Consumer incomes	High	High	Strong stimulus in Slovakia
Social	Organic/Marketing Award	Average	High	Can be adjusted through advertising and promotions
	Consumer preferences and habits	Average	Average	Young people buy organic products more often
	Awareness and education	Average	High	Reinforced by educational and media campaigns
Environmental	Attitude towards sustainable development and certification	High	Average	Informed consumers are more likely to choose organic
	Environmental benefits	Average	High	Especially important in Slovakia
Digital	The impact of social media and online advertising	Average	Average	Builds a positive image and trust
	Online reviews and ratings	Average	High	Influences purchase decisions

Thus, the impact on demand is assessed as high, medium or low in terms of the degree of influence on the decision to purchase organic products. The feasibility of the impact assesses the possibility of influence through marketing, economic or educational measures.

The use of the matrix method allowed us to systematize the influence of key groups of factors (economic, social, environmental and digital) and identify combinations of conditions under which enterprises can achieve maximum expansion of demand for organic agricultural products. The constructed matrix made it possible to identify four strategic zones, each of which forms a separate group of solutions for producers and marketers.

The first strategy is the strategy of increasing price accessibility (economic factors are high and social factors are medium. According to this strategy, the key barrier remains the high price and limited purchasing power of certain consumer groups. The main directions of the strategy are to optimize the cost and implement more efficient production practices; expand the offer of basic organic products at a lower price; use flexible pricing, including discounts, seasonal offers and loyalty programs; cooperate with retail chains to reduce marketing costs. This strategy is aimed at reducing the "price barrier" and expanding the coverage of middle-income groups.

The second is the strategy of building awareness and trust (social factors are high and environmental factors are medium). According to this strategy, social motivation and consumer values play a decisive role, but the level of understanding of the environmental value of organic products remains insufficient. Strategic actions if this strategy is chosen conducting educational campaigns on the environmental benefits of organic products; transparency of the origin of products: demonstration of certification, standards and farming practices; partnership programs with educational and public organizations; creation of content focused on a healthy lifestyle and consumer well-being. Such a strategy reduces information asymmetry and increases trust in the brand.

The third is the strategy of ecological differentiation (environmental factors high / economic average). This strategy involves strengthening competitiveness through ecological uniqueness and compliance with the principles of sustainable development. The main emphasis of the strategy is on expanding the range of products with clearly defined environmental value; introducing "green marketing", certification and labeling, confirming the sustainable nature of production; communicating about the low carbon footprint, naturalness and locality of products; investing in

sustainable packaging and closed production cycles. The strategy allows organic products as goods with added environmental value.

The fourth strategy is digital personalization and engagement (digital factors high / social and economic medium) in which the strong influence of digital channels forms a separate strategic zone focused on personalization and activation of consumer interaction. The main areas of implementation of this strategy are the use of targeted online advertising for different consumer segments; personalization of marketing messages based on behavioral data; engagement through social networks, influencer marketing, interactive content; analysis of big data and machine learning for forecasting demand and adapting supply; development of omnichannel sales platforms (online stores, mobile applications). This strategy is aimed at creating a long-term connection between the brand and the consumer in the digital environment.

The fifth strategy is an integrated strategy for sustainable digital development (all factors are high). This is the most promising strategy, which is formed under the conditions of the simultaneous importance of economic, social, environmental and digital factors. The integrated strategy covers the synchronization of traditional and digital marketing; promotion of sustainable practices through all communication channels; creation of a brand ecosystem that combines environmental value, digital convenience and social orientation; use of digital tools for monitoring the environmental footprint, quality control and communication with buyers; full transparency of the supply chain. Such a strategy is most consistent with modern trends in sustainable consumption and digitalization of the agricultural sector.

The application of a comprehensive method allowed us to systematically assess the impact of economic, social, environmental and digital factors on the formation of demand for organic agricultural products in Ukraine and Slovakia and to identify five strategic directions for the development of this market. The identified strategies demonstrate that different combinations of factors form different approaches to stimulating consumption: from increasing affordability and building trust to environmental differentiation and digital personalization. The most promising is an integrated strategy for sustainable digital development, which provides synergy between traditional and digital channels, environmental orientation and social value. The results obtained confirm the effectiveness of the combined method as a strategic planning tool and allow us to form targeted solutions for producers and marketers in the context of further growth of the organic products market.

4. Discussion

The results of the study confirm that the demand for organic agricultural products is formed under the influence of a combination of economic, socio-ecological and digital factors, which is consistent with the conclusions of modern scientific works. The survey data demonstrates that the key motives of consumers remain quality, product safety and environmental benefits, while price continues to act as a deterrent factor. These results correlate with the findings of Bernabéu et al. and Jarossova et al., which emphasize the heterogeneity of demand depending on income and level of environmental awareness [4-5].

Factor analysis revealed clear clusters of variables reflecting consumers' economic conditions, their environmental orientation, and their level of trust in digital information sources. This supports the hypothesis of a multidimensional nature of demand, which requires the use of integrated forecasting models. Regression estimates revealed a significant impact of income and the ratio of prices for organic and conventional products, as well as the importance of intangible factors such as awareness and perception of environmental benefits. The results are consistent with the work of Hansmann et al. and Zheng et al., who note the increasing role of environmental motivation in consumer behavior [1-2].

At the same time, the identified impact of digital marketing is important. Data shows that social networks, recommendations and online reviews increase trust in organic products and stimulate

purchasing decisions. This confirms the findings of Singh & Glińska-Noweś and You et al. on the role of digital communications in promoting sustainable consumption patterns [10-11]. Thus, digital marketing not only raises awareness, but also shapes behavioral changes, making it a key tool in the development of the organic market.

Demand modeling showed that income growth and digital communication intensity scenarios provide the most positive sales dynamics. At the same time, price increase scenarios revealed demand sensitivity, confirming the high price elasticity of middle-income segments. The combination of economic and behavioral variables in the model allows for more accurate forecasts, which is consistent with the machine learning approach proposed in the studies of Li et al. and Yuan et al [13, 18].

The results obtained indicate that the effective development of the organic market requires the integration of the principles of sustainable development and digital marketing. The growth of environmental awareness of the population and the spread of digital communication channels create favorable conditions for market expansion, but economic constraints remain significant. This indicates the need to form balanced strategies that combine product accessibility, communication of environmental value and innovative promotion tools.

Thus, the study confirmed the interdependence of economic, socio-ecological and digital factors in shaping demand for organic agricultural products and highlighted the importance of an integrated approach to forecasting and strategic planning.

5. Conclusions

The study allowed for a comprehensive assessment of the demand for organic products and to identify key factors shaping consumer behavior in modern conditions. The combination of quantitative survey methods, factor and regression analysis, as well as scenario modeling provided a deep understanding of the market structure and the internal logic of consumer decisions. The results obtained showed that the demand for organic products is the result of the simultaneous action of economic, environmental and digital communication incentives, and it is the combined impact of income, price sensitivity, the level of environmental awareness and the intensity of digital marketing that explains most of the variation in consumer behavior.

Regression models showed that price remains the most limiting factor, while income growth and increased trust in certification form a steady trend towards expanding the organic consumption segment. Environmental beliefs have proven to be a stable driver of demand, but their influence is significantly enhanced by effective digital communication, especially among the younger generation. Scenario analysis showed that under the optimistic trajectory, the market has the potential for significant growth, while the pessimistic scenario confirms the high dependence of demand on the macroeconomic situation.

The application of the matrix method made it possible to outline strategic directions relevant for enterprises and political and economic actors. It was found that the greatest effect on demand formation is achieved by strategies focused on increasing awareness, transparency and value communication, while price instruments play a role in short-term stimulation, but are unable to ensure long-term loyalty without supporting environmental arguments. Thus, the development of the organic market depends not only on economic accessibility, but also on the effectiveness of information channels and the ability of producers to build trust.

The research conducted allowed to substantiate the possibilities of using the matrix method for forming strategies for the development of the organic agricultural products market in the context of changing consumer demand. The results obtained demonstrated that the structuring of factor influence through matrix approaches allows not only to determine the current positions of the industry, but also to outline potential trajectories of its progressive growth. The logic of the constructed strategies is based on a combination of internal market characteristics (production, certification, level of trust) and external conditions (solvency of the population, regulatory incentives,

dynamics of sustainable consumption trends), which ensures the complexity of analytical assessments.

The application of the matrix method has shown that market segments combine high demand potential with sufficient production flexibility form the basis for active expansion strategies. In contrast, areas with limited demand or insufficient infrastructure support require adaptive or defensive strategies focused on cost optimization, efficiency improvement, and gradual building of consumer confidence. Such structuring allows for the formation of a coherent logic of management decisions aimed at long-term stabilization and innovative development of the organic market.

The results confirm the need for an integrated approach to demand management and emphasize that sustainable development of the organic market is possible only under the conditions of synergy of economic instruments, environmental values, and innovative digital strategies that form deeper and more conscious interaction between the consumer, the producer, and the market environment.

However, the research study has certain limitations. First, the analysis was based on available statistical data, which may contain time lags and not fully reflect the dynamics of shadow or uncertified market segments. Second, demand modeling was carried out since aggregated indicators, which partially eliminates regional differences and the specific behavioral patterns of individual consumer groups. Third, the use of the matrix method, despite its analytical clarity, implies a certain conventionality in the interpretation of the interaction of factors and does not consider possible nonlinear effects inherent in modern sustainable consumption markets.

Prospects for further research include expanding the methodological base by applying machine learning models, panel regressions, and behavioral experiments to more accurately forecast the demand for organic products. It is also advisable to deepen the analysis of regional differentiation and study the impact of information campaigns, digital platforms, and new communication channels on changing consumer preferences. Further development of such research will provide the opportunity to form more adaptive and empirically verified strategies that will contribute to the sustainable growth of the organic market and strengthen its competitiveness in the context of transforming consumer trends.

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Informed Consent Statement: Informed consent for participation was obtained from all subjects involved in the study. Participation was voluntary and anonymous, and respondents were informed about the study aims, data handling, and their right to withdraw before commencing the survey.

Data Availability Statement: Due to ethical and confidentiality considerations, the survey data supporting this study is not publicly available and all processed results are included in the article. Another data presented in this study are openly available from the FiBL & IFOAM – Organics Inter-national, Ministry of agrarian policy and food of Ukraine, Organicinfo, Organic farm knowledge.

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