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THE IMPACT OF THE STATE OF THE ECOSYSTEM ON THE QUALITY OF PRODUCED ORGANIC PRODUCTS IN A SUSTAINABLE DEVELOPMENT

Olena Nifatova [1], Tetiana Lutska [2], Valeriia Shcherbak [3], Liudmyla Ganushchak-Yefimenko [4], Nina Krakhmalova [5], Iryna Goncharenko [6], Mariana Shkoda [7]

[1]Kyiv National University of Technologies and Design, Kyiv, Ukraine, E-mail address: helen.bykhova@gmail.com

[2]National University of Food Technologies, Kyiv, Ukraine, E-mail address: valerievna_@ukr.net

[3]Kyiv National University of Technologies and Design, Kyiv, Ukraine, E-mail address: valery_shcherbak@i.ua

[4]Kyiv National University of Technologies and Design, Kyiv, Ukraine, E-mail address: glm5@ukr.net

[5]Kyiv National University of Technologies and Design, Kyiv, Ukraine, E-mail address: knina2006@ukr.net

[6]Kyiv National University of Technologies and Design, Kyiv, Ukraine, E-mail address: goncharenko.im@knutd.com.ua

[7]Kyiv National University of Technologies and Design, Kyiv, Ukraine, E-mail address: mlomova@ukr.net

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Abstract
The modern economic paradigm of implementation and consumption of agricultural organic products, based on the theoretical concepts of food security of each country, is a kind of "marker of cultural identity" of modern society. In today's world, more and more people want to lead a healthy lifestyle and consume organic products. In this regard, the impact of the state of the ecosystem on the production of organic agricultural products in the context of sustainable development is high. The system of assessing the state of the ecosystem by four components: atmosphere, water resources, soil, waste pollution and green plantations is proposed. A model for assessing the impact of the state of the ecosystem on the quality of organic production is proposed based on data from 24 regions of Ukraine.

Keywords: *ecology, ecosystem, organic product, sustainable development.*
JEL Codes: *O13; Q01; Q15; Q18.*

Introduction

An ecosystem is a dynamic planetary ecosystem that is constantly changing under the influence of various processes (Callicott, 1997; Costanza et al., 1997). As a result of long-term evolution, the ecosystem has developed the ability to self-regulate and neutralize negative processes (Costanza, 2020; Dinerstein et al., 2019). However, under the influence of anthropogenic factors, the planetary ecosystem is forced to adapt to economic, military, recreational, and cultural human activities (Cairns, 1997; Jabbour et al., 2017). Human activities introduce physical, chemical, and biological changes to the natural environment (Delgado et al., 2020). There are 5 types of human intervention in ecological processes: simplification of the ecosystem and disruption of biological cycles; concentration of dissipated energy in the form of thermal pollution; growth of toxic waste from chemical production; introduction of new species into the ecosystem; and occurrence of genetic changes in plant and animal organisms (Adhikari, 2021). All types of anthropogenic interventions are divided into two groups according to the type of impact. The first group has a purposeful character, i.e., it is carried out consciously by humans to achieve specific goals. The second group includes spontaneous or involuntary anthropogenic impacts (Chopra, 2021). Anthropogenic impacts are divided into positive and negative (negative) according to their environmental consequences. Positive impacts include reproduction of natural resources, restoration of groundwater reserves, protective afforestation, and land reclamation in mining areas (Chorran et al., 2021; Shcherbak et al., 2021). Negative (negative) human impacts on the ecosystem include deforestation of large areas, depletion of fresh groundwater reserves, salinization and desertification of land, dramatic reduction in numbers and species of animals and plants (Menzel et al., 2010). The results of such negative impacts are: increased consumption of natural resources while reducing them; increase in the population of the planet; degradation of the main components of the biosphere, reducing the ability of nature to regenerate itself (Turner et al., 2007; Pinto et al., 2014; Shcherbak et al, 2020); climate change and depletion of the Earth's ozone layer; reduction of biodiversity (Axelsson et al., 2017; Sakizadeh, 2020); increased environmental damage from natural and man-made disasters; lack of coordination in the global community to solve environmental problems (Johnston et al., 2005; Neoh et al., 2016).

The creation of new agricultural technologies contributes to the intensive pollution of the planet with chemicals of different origin, threatening the genetic security of the environment. The use of organic agricultural production is necessary to improve the health of the population. The world agri-food market has responded to this by a significant increase in demand for organic products in developed countries and continues to this day (OECD, 2020; The World of Organic Agriculture, 2020). Currently the greatest demand for organic products is provided by developed countries (USA, Germany, France, etc.), and in the formation of supply, along with Australia, USA and EU countries, an increasing role played by developing countries: Argentina, Brazil, China and Uruguay. The largest area of organic farmland among the countries of the world has Australia (more than 35 million hectares). Ukraine is also one of the leading countries in the area of organic agricultural land (OECD, 2020). The leader in the number of organic producers is India (more than 1 million producers). Agriculture in Ukraine has sufficient potential for the development of the organic sector (Zaburanna et al., 2020): agricultural trade turnover between Ukraine and the EU increased in 2020 compared to last year by 23% (OECD, 2020). Therefore, the study of the impact of the state of the ecosystem on the quality of organic products produced is relevant. In accordance with this conclusion, the purpose of the article is to conduct a study of the impact of the state of the ecosystem on the production of organic agricultural products.

Materials and methods

Assessment of potential environmental damage to the ecosystem.

Possible environmental damage from the negative anthropogenic impact is determined by the main environmental threats: emissions of harmful substances into the atmosphere; emissions of harmful substances into water bodies; degradation and pollution of soils, reduction of green spaces.

Assessment of potential environmental damage from the emissions of harmful substances into the atmosphere

The potential environmental damage from air emissions (Gambhir et al., 2019) is calculated using the following equation (1):

$$E_a = E^a_{per_r} \times \sum_{k=1}^{k} M^a_{nk_{st}} \times K^a_{e_r} \quad (1)$$

where $E^a_{per_r}$– index of specific damage to the atmospheric air, caused by the emission of a unit of reduced mass of pollutants in the *r-th* region (reference value);

$M^a_{nk_{st}}$– reduced mass of pollutant emissions from the stationary emission sources not emitted into the atmospheric air from the *k-th* object as a result of the

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implementation of the *i-th* field of environmental protection activities in the *r-th* region;

K - number of objects (enterprises, productions) or number of installations for capturing and neutralization of harmful substances from exhaust gases, as well as other environmental protection measures, which resulted in prevention (elimination, reduction) of pollutants to enter into the atmospheric air;

$K^{a}_{e_r}$– coefficient of ecological situation and environmental importance of atmospheric air state in the regions of Ukraine (reference value).

Assessment of potential environmental damage from the pollution of water resources

The volume of potential environmental damage due to pollution of water resources is estimated on the basis of regional indicators of specific damage, which are specific cost estimates of damage per unit (1 conditional ton) of the reduced mass of pollutants (Heshmati et al., 2021):

$$E_w = \sum_j \left(E^{w}_{per_{rj}} \times \sum_{k=1}^{k} M^{w}_{nk} \right) \times K^{w}_{e_r} \quad (2)$$

where $E^{w}_{per_{rj}}$– indicator of specific damage to water resources caused by a unit (conditional ton) of the reduced mass of pollutants for the *j-th* water body in the *r-th* region under consideration (reference value);

M^{w}_{nk}- reduced mass of pollutants not discharged (prevented from discharge) into the *j-th* water source from the *k-th* object as a result of the implementation of the *i-th* field of environmental protection activities in the *r-th* region.

Assessment of the reduced mass of pollutants in the atmosphere and water resources

The reduced mass of pollutants for the k-th particular object is calculated using the following equation (3):

$$M^{w,a}_{nk} = \sum_{i=1}^{N} m^{w,a}_{i} K^{w,a}_{ei} \quad (3)$$

where $m^{w,a}_{i}$–actual mass of the *i-th* pollutant or a group of substances with the same coefficient of relative environmental and economic hazard at the *k-th* object, tons, prevented from entering into the water, atmosphere;

$K^{w,a}_{ei}$– coefficient of relative environmental and economic hazard for the *i-th* pollutant or a group of substances (reference value);

i - type of pollutant or group of substances;

K – number of facilities (enterprises, production facilities) that do not allow (reduce) discharges of pollutants into the water and the atmosphere;

N – number of pollutants taken into account.

The approved values of maximum permissible concentrations of pollutants in the water of fishery reservoirs (as the most stringent) are used as the basis for calculations of the reduced mass of pollution. Coefficients of ecological and economic danger of pollutants. Given the huge number of pollutants entering the water bodies and in order to simplify the calculation of the coefficients of relative environmental and economic danger of pollution, they are grouped by hazard classes and the sign of close values of maximum permissible concentrations.

Assessment of potential environmental damage from soil and land degradation.

Environmental damage from degradation and destruction of soils and lands under the impact of anthropogenic (technogenic) loads is expressed mainly in the following: degradation of soils and lands; pollution of lands with chemical substances; littering of lands with unauthorized dumps, other types of unauthorized and unregulated waste disposal; increase of the areas allocated for landfills of waste disposal. Degradation of soils and lands occurs as a result of: economic activities in rural forestry; construction and mining activities; recreational loads (Verburg et al., 2015). The amount of potential environmental damage from soil and land degradation is estimated using the following equation (4):

$$E_d = E^d_{per_r} \times \sum_j S^d_j \times K^d_{l_j} \quad (4)$$

S^d_j– area of land of the *j-th* type saved from the degradation as a result of environmental protection activities, hectares;

$K^d_{l_j}$- coefficient of natural and economic significance of soils and lands of the *j-th* type (reference value).

Assessment of potential environmental damage from land pollution by chemical substances

Chemical pollution of land occurs as a result of: unauthorized disposal of waste of different hazard classes; accidental discharges of sewage and various chemicals; irrigation of agricultural land with contaminated water; and precipitation with chemical emissions into the air (El-Shahawi et al., 2010). The amount of potential environmental damage from pollution of land with chemicals is estimated using the following equation (5):

$$E_{ch} = E^{ch}_{per_r} \times \sum_j S^{ch}_j \times K^{ris}_i \times K^d_{l_j} \quad (5)$$

S^{ch}_j– area of land of the *j-th* type, which was prevented from pollution (or eliminated pollution) by a chemical substance of the *i-th* hazard class, ha;

K^{ris}_i– coefficient taking into account the hazard class of the *i-th* chemical substance prevented (prevented) from getting to the soil or eliminated pollution as a result of implementation of the respective field of environmental protection activities (reference value).

Assessment of potential environmental damage from land littering by unauthorized dumps.

The amount of potential environmental damage resulting from land littering by unauthorized landfills (Seng et al., 2018), an increase in the area of waste disposal facilities is estimated using the following equation (6):

$$E_{tr} = \sum_j S^{tr}_j \times K^d_{l_j} \quad (6)$$

S^{tr}_j - the area of land that was prevented from littering (to eliminate the detected littering or reduce the area of waste disposal facilities), hectares.

Assessment of potential environmental damage from cutting down green spaces.

The amount of potential environmental damage caused to green spaces as a result of disasters, natural calamities, allocation of areas for logging, construction, field development (Rutkin, 2015) is estimated using the following equation (7):

$$E_{pl} = \sum_{i=1}^{N} \left(H_{pl_i} \times H_i\right) \times S_{pl} \times K_{bio} \quad (7)$$

N – the number of forest plant species in the preserved area;

H_{pl_i} – average stock of the *i-th* forest species determined for the preserved area;

S_{pl} – area of the preserved area for which the calculation is made;

H_i – cost of timber of the *i-th* forest species;

K_{bio}– regional biodiversity coefficient (reference value).

Integral level of ecosystem state is calculated by taxonomy method.

A matrix for assessing the quality of components and potential risks of an ecosystem:

$$\begin{matrix} d_1 & d_2 & d_3 & d_4 & d_5 & d_6 \\ E_a & E_w & E_d & E_{ch} & E_{tr} & E_{pl} \end{matrix} \quad (8)$$

Dimensionless standardized matrix:

$$r = \left[r^a_1;\ r^w_2;\ r^d_3;\ r^{ch}_4;\ r^{tr}_5;\ r^{pl}_6\right] \quad (9)$$

Reference matrix:

$$r_0 = \left[r^a_0;\ r^w_0;\ r^d_0;\ r^{ch}_0;\ r^{tr}_0;\ r^{pl}_0\right] \quad (10)$$

Multidimensional Euclidean distance:

$$L^r_i = [(r^a_1 - r^a_0)^2 + (r^w_2 - r^w_0)^2 + (r^d_3 - r^d_0) + (r^{ch}_4 - r^{ch}_0) + \left(r^{tr}_5 - r^{tr}_0\right) + \left(r^{pl}_6 - r^{pl}_0\right)^2]^{1/2} \quad (11)$$

$$\overline{L^r} = \frac{1}{N} \cdot \sum_{i=1}^{N} L^r_i , \quad (12)$$

where N is the number of constituents and potential risks of the *ecosystem*.

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The standard deviation of multivariate distances:

$$\sigma^r = \frac{1}{N} \cdot \left[\sum_{i=1}^{N} \left(L_i^r - \overline{L^r} \right)^2 \right]^{1\backslash 2}$$ (13)

Integral indicator of the level of environmental protection of ecosystem constituents:

$$\eta_i^r = 1 - \frac{L_i^r}{\overline{L^r} + 2\sigma^r}$$ (14)

The value of the integral indices obtained is measured from 0 to 1. The higher the level of ecology of the i-th ecosystem component, the closer the value of the integral index is to 1.

All statistical analyses, including the statistical description of the processed field samples (min, max, standard error, coefficient of variation, standard deviation, construction of a multifactorial graph-analytical scheme) were carried out using the STATISTICA 13 software package.

Construction of a multifactor model of the impact of the state of the ecosystem on the quality of produced organic products was carried out as follows. Quality of produced organic products in 24 regions of Ukraine was evaluated by expert method.

The optimality of an expert decision is achieved by checking the consistency of expert judgments by calculating the concordance coefficient. Since ranking involves congruent ranks, the formula for W (concordance coefficient) is as follows (Hair et al., 1998):

$$W = \frac{12S}{{}^{1}/_{12} m^2(n^3 - n) - m\sum_{j=1}^{m} T_j}$$ (15)

where m is the number of experts, n is the number of evaluations given by one expert;

$S = \sum_{i=1}^{n} \left\{ \sum_{j=1}^{m} r_i^j - \frac{1}{2} m(n+1) \right\}^2$ – the sum of squares of the differences between the elements of the total ranking and the elements of the series composed of the mean values of *1/2*$m(n+1)$;

$T_j = \frac{1}{12} \sum_{i=1}^{n} \left(t_{ij}^3 - t_{ij} \right) \div t_{ij}$ – the number of repetitions of the *i-th* rank in the *j-th* row.

The value of W varies from 0 to 1. If W = 1, it means that all experts gave the same ranks. To estimate the significance of the concordance coefficient we use the χ2 distribution with the number of degrees of freedom $v = n - 1$, to which (n - 1) is subject. The significance check is reduced to testing the statistical hypothesis that the concordance coefficient is equal to zero.

Consistency of expert assessments was determined on the basis of Kendell's coefficient of concordance, which was 0.89, indicating a high consistency of expert opinions. Further, the obtained estimates of the quality of organic products in 24 regions of Ukraine were interpreted by us as a dependent variable in the model of multiple regression analysis (Y). As independent variables were taken 6 variables characterizing the possible environmental damage from the negative anthropogenic impacts:

X_1 - potential environmental damage from emissions of harmful substances into the atmosphere;

X_2 - potential environmental damage due to pollution of water resources;

X_3 - environmental damage from soil and land degradation and destruction;

X_4 - potential environmental damage from pollution of land with chemicals;

X_5 - potential environmental damage from land littering by unauthorized dumps;

X_6 - potential environmental damage from cutting down green spaces.

In order to bring all the initial data to a single dimensionality, the standardization procedure was applied. The standardized input data are presented in Table 1.

Table 1. Standardized input data for constructing a multiple regression model of the impact of the state of the ecosystem on the quality of organic produce

Region	Y	X_1	X_2	X_3	X_4	X_5	X_6
Vinnitsa region	-0.2759	-0.0099	-0.4596	0.7922	0.8000	-0.3523	-0.8129
Volyn region	1,9817	-0,5153	-0,5660	2,3602	-1,2596	-0,3523	-0,5666
Dnepropetrovsk region	-0.4264	2.5449	1.6529	-0.7105	1.1775	-0.3523	-1.2322
Donetsk region	-0.8780	3.5974	3.2673	0.9555	-0.2573	-0.3523	0.7913
Zhytomyr region	-0.5769	-0.4757	-0.4183	-0.2858	-0.3562	-0.3523	0.7913
Zakarpathian region	2.1322	-0.5239	-0.5283	-0.2858	-1.8754	-0.3523	-0.1007
Zaporizhzhya region	-0.8780	0.3847	2.1509	-1.1025	0.8460	-0.3523	-0.1007
Ivano-Frankivsk region	0.9281	0.5538	-0.4561	0.6615	-1.5293	-0.3523	0.0058
Kyiv region	-0.1254	-0.0918	0.9590	-0.0245	0.2847	-0.3523	1.6299
Kirovograd region	-1.0285	-0.4751	-0.5489	-0.6778	0.8943	3.3783	1.6299
Lugansk region	-0.8780	-0.3434	-0.5283	-0.8412	-0.3906	0.8912	-0.6065
Lviv region	1.0786	-0.0677	-0.1298	0.1388	-1.0177	-0.3523	0.4651
Mykolaiv region	-0.5769	-0.4789	-0.4080	-0.7105	0.4005	2.8809	0.4651
Odesa region	-1.0285	-0.3665	-0.1367	0.0735	1.2740	-0.3523	0.4651
Poltava region	-0.5769	-0.2706	-0.4321	-0.7105	1.0913	-0.3523	-1.0725
Rivne region	0.9281	-0.4907	-0.4870	0.7269	-1.2541	-0.1036	-0.6531
Sumy region	-0.2759	-0.4275	-0.5179	0.7269	0.5714	-0.3523	0.1123
Ternopil region	1.5302	-0.4933	-0.5317	1.9355	-0.4656	-0.3523	-1.0725
Kharkiv region	-0.8780	0.0265	0.3202	-0.8739	1.2674	-0.3523	-0.7729
Kherson region	0.0251	-0.4484	-0.3702	-1.3312	-0.0069	-0.3523	-0.7729
Khmelnytsky region	-0.5769	-0.4350	-0.5076	-0.1225	0.3439	-0.3523	-0.6931
Cherkasy region	-0.5769	-0.2663	-0.3634	0.0082	0.3180	-0.3523	2.8547
Chernivtsy region	1.3797	-0.5308	-0.5317	-1.7232	-1.7068	-0.3523	-0.2205
Chernihiv region	-0.4264	-0.3964	-0.4286	1.0209	0.8506	-0.3523	-0.5333

Results of research

The results of the constructed multiple regression model of the impact of the state of the ecosystem on the quality of organic products are presented in Table 2.

Table 2. Results of a multiple regression model of the impact of the state of the ecosystem on the quality of organic produce

	b*	Std.Err.	b	Std.Err. of b	t (17)	p-value
Intercept			**4,1458**	**0,3754**	**11,0435**	**0,0000**
potential environmental damage from emissions of harmful substances into the atmosphere (X_1)	-0,2152	0,2181	-0,0007	0,0007	-0,9865	0,3376
potential environmental damage due to pollution of water resources (X_2)	0,0511	0,2289	0,0001	0,0005	0,2233	0,8259

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environmental damage from soil and land degradation and destruction (X_3)	0,2098	0,1146	0,0045	0,0024	1,8299	0,08484
potential environmental damage from pollution of land with chemicals (X_4)	-0,7511	0,1147	-0,0014	0,0002	-6,5489	0,0000
potential environmental damage from land littering by unauthorized dumps (X_5)	-0,0780	0,1209	-0,1289	0,1998	-0,6453	0,5272
potential environmental damage from cutting down green spaces (X_6)	-0,1972	0,1154	-0,0008	0,0005	-1,7079	0,1058

Adequacy of the model was evaluated on the basis of adjusted coefficient of multiple determinacy and Student's test.

The equation of dependence of the quality of produced organic products on the variables characterizing the state of the ecosystem in accordance with the obtained model is as follows:

$$Y=4.145834\ 0.000766X_1+0.000117X_2+0.004554X_3-0.001434X_4-0.128996X_5-0.000872X_6$$

The greatest influence on the quality of produced organic products has a variable X_4 - the potential environmental damage from pollution of land with chemicals, as evidenced by the p-value criterion.

Next, using the clustering procedure, we divided the 24 regions of Ukraine into 4 groups, which correspond to a certain level of quality of produced organic products.

The results of the cluster analysis are presented in Table 3.

Table 3. The results of the cluster analysis of 24 regions of Ukraine on the criterion of “the level of quality of organic products”

Intercept	Between SS	df	Between SS	df	F	signif. P
The quality of organic products produced	6	2	4,4	21	13,5353	0,0001
potential environmental damage from emissions of harmful substances into the atmosphere	566274	2	236185,5	21	25,1746	0,0000
potential environmental damage due to pollution of water resources	1636125	2	313313	21	54,8311	0,0000
potential environmental damage from pollution of land with chemicals	2094741	2	692637,6	21	31,755	0,0000

As shown in Table 3, the values of intergroup variance exceed the values of variance within clusters for all factors that are analyzed. Calculated values of F - criterion exceed table values at appropriate significance level and appropriate degrees of freedom. The value of the confidence level (p - level) allows us to conclude that the relationship found in the clusters between the factors is determined by a random feature of this sample with a probability of 1%. Thus, the clustering presented in Table 4. can be considered reasonable.

Table 4. Classification of 24 regions of Ukraine on the criterion of "the level of quality of organic products produced"

Region	Observed. Classif	p=,41667	p=,29167	p=,12500	p=,16667
Vinnitsa region	above average	above average	average	high	below average
Volyn region	high	high	average	above average	below average
Dnepropetrovsk region	below average	below average	above average	average	high
Donetsk region	below average	below average	above average	average	high
Zhytomyr region	average	average	above average	high	below average
Zakarpathian region	high	high	average	above average	below average
Zaporizhzhya region	below average	below average	above average	average	high
Ivano-Frankivsk region	high	high	average	above average	below average
Kyiv region	above average	above average	average	below average	high
Kirovograd region	above average	above average	average	high	below average
Lugansk region	average	average	high	above average	below average
Lviv region	high	high	average	above average	below average
Mykolaiv region	above average	above average	average	high	below average
Odesa region	above average	above average	average	below average	high
Poltava region	above average	above average	average	high	below average
Rivne region	high	high	average	above average	below average
Sumy region	above average	above average	average	high	below average
Ternopil region	high	high	average	above average	below average
Kharkiv region	above average	above average	average	below average	high
Kherson region	average	average	above average	high	below average
Khmelnytsky region	average	average	above average	high	below average
Cherkasy region	above average	above average	average	high	below average
Chernivtsy region	high	high	average	above average	below average
Chernihiv region	above average	above average	average	high	below average

In the next stage of constructing a multifactor model of the impact of the state of the ecosystem on the quality of organic products produced, we carried out discriminant analysis, which allows us to study the differences between groups of objects simultaneously on several variables. The main goal of discrimination is to find such a linear combination of variables that will optimally distribute the groups under consideration. The results of the discriminant analysis of groups on the level of quality of produced organic products in 24 regions of Ukraine are presented in Table 5.

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Table 5. Results of the discriminant analysis of groups on the level of quality of produced organic products

N=24	Wilks' Lambda	Partial Lambda	F-remove (3,15)	p-value	Toler.	1-Toler. (R-Sqr.)
potential environmental damage from emissions of harmful substances into the atmosphere (X_1)	0,0118	0,8891	0,6234	0,6107	0,7195	0,2804
potential environmental damage due to pollution of water resources (X_2)	0,0221	0,4754	5,5172	0,0093	0,6497	0,3502
environmental damage from soil and land degradation and destruction (X_3)	0,0126	0,8339	0,9957	0,4216	0,8623	0,1376
potential environmental damage from pollution of land with chemicals (X_4)	0,0848	0,1239	35,3289	0,0000	0,5999	0,4000
potential environmental damage from land littering by unauthorized dumps (X_5)	0,0111	0,9427	0,3037	0,8222	0,8025	0,1974
potential environmental damage from cutting down green spaces (X_6)	0,0169	0,6193	3,0727	0,05992	0,5918	0,4081

According to the data of Wilks 'Lambda indicators and F-criterion value, which exceeds the table value, we can conclude that this classification is correct. It should be noted that uninformative variables X_1 and X_5 were excluded from the discriminant model, because their tolerance value is less than 0.01. All 24 regions of Ukraine were correctly assigned by the cluster analysis to the groups "level of quality of organic products", as the overall coefficient of correlation in the classification matrix is 100%. This conclusion confirms the absence of incorrectly assigned regions by the results of the analysis of classification cases.

So, after analyzing the results of discriminant functions, classification matrix and the results of classification of cases, we obtain the coefficients of discriminant functions, which correspond to 4 clusters: «below average», «average», «above average», «high». Discriminant functions that correspond to each cluster are presented in Table 6.

Table 6. Discriminant functions of the clusters on the criterion of “the level of quality of organic products produced» regions of Ukraine”

Cluster	Ukrainian regions	Discriminant function
Cluster 1 «the level of quality of produced organic products is below average»	Dnepropetrovsk region, Donetsk region, Zaporizhzhya region	$Y=-74.6150+0.0758X_{2+}0.0802X_3+0.0723X_4+0.0296X_6$
Cluster 2 «the average level of quality of organic products produced»	Zhytomyr region, Lugansk region, Ternopil region, Kherson region Khmelnytsky region	$Y=-24.041+0.0085X_{2+}0.1036X_3+0.0444X_4+0{,}0312X_6$
Cluster 3 «the level of quality of produced organic products is above average»	Vinnitsa region, Kyiv region, Kirovograd region, Mykolaiv region, Odesa region, Poltava region, Sumy region, Kharkiv region, Cherkasy region, Chernihiv region	$Y=-47.5378+0.0168X_{2+}0.1167X_3+0.0679X_4+0.0477X_6$
Cluster 4 «high quality level of produced organic products»	Volyn region, Zakarpathian region, Ivano-Frankivsk region, Lviv region, Rivne region, Chernivtsy region	$Y=-15.3520+0.0008X_{2+}0.1544X_3+0.0173X_4+0.0180X_6$

Conclusions

The interrelation of various natural and anthropogenic factors (the state of atmospheric air, water resources, soil cover and green areas, the level of pollution of land with chemicals and littering by unauthorized dumps) predetermines the quality of organic products produced. The methodology for constructing a model of the impact of the state of the ecosystem on the quality of organic products produced is based on a combined approach. The use of integral taxonomic indicator allowed to assess the state of the ecosystem of 24 regions of Ukraine, which will allow to develop management decisions and environmental measures based on a system of indicators reflecting the state of individual components of the ecosystem.

In addition, based on the built model of the impact of the state of the ecosystem on the quality of organic produce by multiple regression, 24 regions of Ukraine were classified according to the criterion of «the level of quality of organic produce». Correlation-regression analysis revealed the dominant role of potential environmental damage from pollution of land with chemicals on the quality of organic products. This study will allow to develop a strategy to eliminate the disproportion in the level of quality of organic production in the regions of Ukraine through a step-by-step elaboration of each component of the ecosystem of the region.

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