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Harmony of the Sectoral Structure of Agrarian Enterprises of Ukraine: Methodological Approach to Assessment

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Abstract:
The article explores modern scientific and methodological approaches to optimization of the branch structure of agricultural enterprises. A methodological approach to the estimation of the state of harmonization of the branch structure of agricultural enterprises is proposed, which is based on the application of a set of indicators of specialization and diversification. The article describes the method of hierarchy analysis for the calculation of the entropy sectoral index, which allows to measure the harmony of the branch structure of agricultural enterprises.

Keywords: *branch structure, harmonization, agricultural enterprise, industry, method of hierarchy analysis.*

I. INTRODUCTION

The process of forming a market economy in Ukraine is accompanied by a constant reduction in production of the most important types of agricultural products and a decrease in the efficiency of using the means of production. (Balmann et al., 2013, Danko et al., 2019).This is due to changes in structural intragranular relationships, disruption of their proportionality and balance. The existing territorial-sectoral structure of agricultural enterprises has a number of significant disadvantages, through which there is a decrease in the efficiency of the use of means of production, deteriorates the food security of the state, violates the environmental sustainability of agricultural production.

At present a new scientific trend is being formed in domestic science, based on the use of entropy to harmonize economic systems. Existing scientific and practical developments are aimed at assessing the sectoral structure of enterprises at the local and regional levels using different indicators. That is why there is a problem of interpreting the results obtained in the context of the harmony of certain structures. This also applies to agricultural enterprises, the sectoral structure of which must be considered comprehensively, using the same indicators at different organizational levels. In addition, attention should be paid to finding ways to balance the economic, environmental and social components that underpin sustainable agricultural development. Therefore, the solution to the problem of developing a methodology for assessing the harmony of the sectoral structure of agricultural enterprises is relevant.

We propose to consider the harmonization of the sectoral structure of agricultural enterprises as a multidimensional process of bringing a set of units involved in the production of agricultural products and services, as well as structural parts of the enterprise in a state of balance and consistency, which promotes the establishment of proportions for further development. We believe that the main goal of harmonization is to achieve proportionality in the development process, to find

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a balanced proportion between economic, social and environmental components.

II. METHODS

The essence of the methodological approach proposed by the authors is to apply a set of indicators that would reflect the economic, environmental and social components and on their basis - to assess the harmony of the sectoral structure of enterprises.

In order to implement the methodological approach, it is necessary to define such indicators that would allow to estimate the level of specialization, diversification and branch structure of economic systems at all levels of the organization. These indicators (evaluation criteria) should characterize both the level of production of individual products and the structure of the industry as a whole. Thus, for agricultural enterprises the criteria for assessing the sectoral structure are considered necessary to choose the main (e.g. structure of gross and commercial products), minor (e.g. structure of costs for production of goods, structure of labor costs) and ancillary (e.g. structure of collected areas, livestock) indicators.

In order to achieve this goal, we consider it expedient to calculate an entropy index where X is the fraction of the element of the studied structure; n is the number of elements of the structure (Prangishvili, 2003).

$$E(t) = 1 + \frac{\sum_{i=1}^{n} X_i(t) \ln X_i(t)}{\ln n} \quad (1),$$

By entropy (E (t)), scientists propose the following classification of economic systems: if the indicator E (t) is in the range from 0.25 to 1, then the economic system is considered highly specialized. If E (t) belongs to the interval from 0.15 to 0.25, such an economic system is considered to be medium specialized. The diversified system is considered when the entropy index is in the range from 0 to 0.15 (Konysheva&Nazarov, 2011, Kolkov, 2016).

As already mentioned, entropy is measured from 0 to 1. It is thought that this interval can be divided into two parts. The first part of the interval from 0 to 0.382 characterizes the level of uncertainty of the system and from 0.382 to 1 - the structure of the system. Separating the interval at a ratio of 0.382: 0.618 is called the "Golden Crossing" and is a characteristic of the harmonic state of the system. In science this ratio of relative entropy has been called the entropy-harmonic norm of organizational systems (EHNOS) (Blumin&Shuikova, 2018).

We consider it necessary to reconcile the valuation indicators with the use of the method of cause and effect analysis, which takes into account the strengths and weaknesses of each criterion for the evaluation of the sectoral structure and determines the degree of influence of one or another criterion on the resultant indicator of the sectoral structure of the enterprise.

It is also advisable to use a hierarchy analysis method to coordinate the results of the sectoral structure assessment, a systematic procedure for hierarchically displaying elements that reflect the essence of any problem. To implement this method, a complex problem must be broken down into simpler components , it is necessary to decompose the problem and then sequentially process the results of the study by pairwise comparison. (Sharipova, 2010).

Since one of the tasks of harmonization of the sectoral structure of agricultural enterprises is to find the optimal balance between economic, social and environmental components, we propose to choose the following criteria to coordinate the results of the assessment of the sectoral structure of enterprises (Table 1).

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Table 1. Providing of the notation criteria for the harmonization of the assessment results of the sectoral structure of agricultural enterprises

Name of Criterion Designation	Name of Criterion Designation
The presence in the approaches of characteristics that reflect the economic results of the enterprise	A
The presence of characteristics in the approaches that reflect the environmental component	B
The presence of characteristics in the approaches that reflect the social component	C
The amount and depth (aggregate value) of data used in a sectoral structure study	D

The next step is to identify priorities in the criteria by pairwise comparison. To do this, construct an inverted symmetric matrix and a ratio scale.

Pairwise comparisons are made by determining the degree of dominance of one criterion over another and expressing the results in integers (points) on a 10-point scale. A slight advantage is estimated in points from 1 to 3, a significant advantage from 4 to 6, a clear advantage from 7 to 10 (Table 2)

Table 2. Scale of comparison of criteria for evaluation of components of the sectoral structure of agricultural enterprises

Criterion	Above Criterion	Degree of Excellence	Ball
A	B	Obvious	7
	C	Obvious	8
	D	Significant	5
B	C	Insignificant	3
	D	Insignificant	2
C	D	Insignificant	3

Then for each matching criterion, it is necessary to determine the weight using the formula where Ba_{ij}– is the criterion score; n – number of criteria:

$$W_{ij}=(Ba_{ij})(1/n) \quad (2),$$

The weight of each criterion must be normalized using the formula:

$$Wnorm_{ij}= W_{ij} / \sum W_{ij} \quad (3).$$

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III. RESULTS

In the table. 3 shows an example of the calculation of the entropy index of the structure of harvested area $(E(t)_{Ta})$ in agricultural enterprises of one of the districts of Kharkiv region.

Table 3. Dynamics of the structure of collected areas in agricultural enterprises which are studied

Periods (Years)	Total area, ha	Structure, %				$E(t)_{Ta}$
		cereals and legumes	technical cultures	potatoes and vegetables and melons	Fodder crops	
Period 1	28972	57,2	35,2	7,5	0,1	0,359
Period 2	31523	69,3	30,6	0	0	0,555
Period 3	32771	55	45	0	0	0,503
Period 4	35044	55,9	44,1	0	0	0,505
Period 5	34628	51,7	35,4	9,3	0	0,329
Period 6	25828	70,9	29,09	0,01	0	0,564
Average	31461	60,0	36,6	2,8	0	0,469

We see that the entropy indicator characterizes the structure of the harvested areas as a medium specialized with the predominant production of cereals, legumes and industrial crops. The calculations confirmed that when equilibration of particles of a certain structure decreases the entropy index, that is the structure becomes diversified. Thus, in Period 1, the enterprises specializing in the production of cereals and legumes, set aside areas for the production of technical, vegetable and fodder crops. As the share of the collected areas of the last two groups of crops was insignificant, the structure of the collected areas could be characterized as specialized. Given the predominant production of cereals and legumes, but the increase in the share of fodder crops, the structure would approach or become harmonious. This ratio of harvested areas would be the basis for livestock development and would indicate compliance by crop producers with crop rotation requirements. In the Period of 3 years, enterprises focused on the production of commodity products. This has led to the fact that the structure of the collected areas has become diversified. At the same time, it is evident that there is a violation of the requirements of rotation.

Similar calculations were made on such indicators as the structure of gross agricultural production $(E(t)_{Gp})$, the structure of the total cost of production $(E(t)_{Tc})$, the structure of total areas $(E(t)_{Ta})$, and the structure of costs for the main production by elements $(E(t)_{Cmp}$.

The results of calculations of the normalized weight of the criteria for harmonizing the assessment of the sectoral structure of agricultural enterprises are given in Table. 4.

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Table 4. Calculation of the normalized weight of the criteria for the harmonization of the results of the evaluation of the sectoral structure of agricultural enterprises

Criterion	A	B	C	D	Calculation	Weight criterion *(W)*	Normalized criterion weight *(Wnorm)*
A	1	7	8	5	(AxBxCxD)1/4	4,09	0,67
B	0,14	1	3	2	(AxBxCxD) 1/4	0,96	0,16
C	0,13	0,33	1	3	(AxBxCxD) 1/4	0,60	0,10
D	0,2	0,5	0,33	1	(AxBxCxD) 1/4	0,43	0,07
Total	-	-	-	-	-	6,08	

The obtained values represent the final weight value of each criterion. Similarly, the implementation of the above procedure to determine the priorities for each metric evaluation of the sectoral structure for each matching criterion, resulting in the determination of weight values for each criterion (table. 5).

Table 5. Calculation of normalized weight of indicators of estimation of branch structure agricultural enterprises

Component of evaluation		Structure:				Weight (W_{ij})	Normalized weight *(Wnorm)*
		gross production	total cost	total areas	the cost of main production		
By criterion A							
Structure:	gross production	1,00	2,00	8,00	3,00	2,63	0,48
	total cost	0,50	1,00	7,00	2,00	1,63	0,30
	total areas	0,13	0,14	1,00	0,17	0,23	0,04
	the cost of main production	0,33	0,50	6,00	1,00	1,00	0,18
	Total					5,49	1,00
By criterion B							
Structure:	gross production	1,00	2,00	0,13	0,25	0,50	0,08
	total cost	0,50	1,00	0,17	0,17	0,34	0,06
	total areas	8,00	6,00	1,00	4,00	3,72	0,61
	the cost of main production	4,00	6,00	0,25	1,00	1,57	0,26
	Total					6,13	1,00

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By criterion C							
Structure:	gross production	1,00	2,00	2,00	0,13	0,84	0,14
	total cost	0,50	1,00	0,50	0,14	0,43	0,07
	total areas	0,50	2,00	1,00	0,17	0,64	0,10
	the cost of main production	8,00	7,00	6,00	1,00	4,28	0,69
	Total					6,20	1,00
By criterion D							
Structure:	gross production	1,00	1,00	5,00	0,17	0,96	0,15
	total cost	1,00	1,00	5,00	0,17	0,96	0,15
	total areas	0,20	0,20	1,00	0,13	0,27	0,04
	the cost of main production	6,00	6,00	8,00	1,00	4,12	0,65
	Total					6,30	1,00

It should be noted that, depending on the priorities of development of an enterprise or district the list of components of the assessment of the sectoral structure may be modified or supplemented, for example, such indicators as the structure of labor costs, the structure of land in possession or use of the enterprise, etc. Also, depending on the purpose of harmonization, the list of criteria for agreeing the results of the assessment of the sectoral structure and the points that determine the superiority of one criterion over another may be modified.

According to the calculations, it can be concluded that according to criterion A, which takes into account the presence in the approaches of characteristics that reflect the economic results of the enterprise, the structure of gross production (0.48) is of the greatest importance and the least is the structure of the total area (0.04). The calculation of the final normalized weight of each component of the sectoral structure of agricultural enterprises is given in Table. 6.

Table 6. Calculation of the final normalized weight (W_{nw}) components of the assessment of the sectoral structure of agricultural enterprises

Component of evaluation		**Normalized weight of the matching criteria:**				W_{nw}
		A	**B**	**C**	**D**	
		0,67	0,16	0,10	0,07	
Structure:	gross production	0,48	0,08	0,14	0,15	0,36
	total cost	0,30	0,06	0,07	0,15	0,23
	total areas	0,04	0,61	0,10	0,04	0,14
	the cost of main production	0,18	0,26	0,69	0,65	0,28
TOTAL		1,00	1,00	1,00	1,00	1,00

According to the calculations, it is possible to calculate a complex entropy industry coefficient of

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agricultural enterprises (Table 7).

Table 7. Calculation of the complex entropy industry coefficient (E(t)ci) of agricultural enterprises

№	Enterprises	Entropy index of E (t) structure:				E(t)ci
		gross production	total cost	total areas	the cost of main production	
		W_{nw}=0,36	W_{nw}=0,23	W*nw*=0,14	W*nw*=0,28	
1	Enterprise A	0,800	0,982	0,878	0,385	0,745
2	Enterprise B	0,400	0,395	0,128	0,274	0,330
3	Enterprise C	0,230	0,195	0,112	0,264	0,217
4	Enterprise D	0,430	0,389	0,255	0,316	0,368
5	Enterprise E	0,752	0,851	0,785	0,857	0,816
6	Enterprise F	0,310	0,278	0,3	0,321	0,308
7	Enterprise G	0,530	0,325	0,112	0,654	0,464
8	Enterprise H	0,180	0,116	0,101	0,351	0,204
9	Enterprise I	0,546	0,326	0,112	0,314	0,375
10	Enterprise J	0,271	0,254	0,089	0,247	0,238
11	Enterprise K	0,613	0,452	0,215	0,315	0,443
12	Enterprise L	0,276	0,215	0,187	0,287	0,255
13	Enterprise M	0,167	0,058	0,157	0,222	0,158
14	Enterprise N	0,059	0,036	0,174	0,358	0,154
15	Enterprise O	0,285	0,137	0,387	0,241	0,256
16	Enterprise P	0,237	0,137	0,265	0,387	0,262
17	Enterprise Q	0,714	0,651	0,341	0,543	0,607
18	Enterprise R	0,456	0,541	0,014	0,501	0,431
19	Enterprise S	0,233	0,215	0,157	0,874	0,400
20	Enterprise T	0,208	0,135	0,197	0,621	0,307
21	Enterprise U	0,111	0,147	0,104	0,354	0,188
22	Enterprise V	0,339	0,415	0,487	0,441	0,409
23	Enterprise W	0,060	0,056	0,012	0,854	0,275
24	Enterprise X	0,374	0,431	0,215	0,212	0,323
25	Enterprise Y	1,000	1,000	1,000	0,365	0,832
In average						0,375

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IV. CONCLUSION

According to the results of the calculation of the complex entropy industry coefficient E (t) kg, it can be concluded that according to the results of activity of agricultural enterprises there was no enterprise with a diversified sectoral structure (0≤E (t) ci≤0,150), the sectoral structure of 6 enterprises can be characterized as specialized (0,151≤E(t)ci≤0,250). The rest of the enterprises have a high level of specialization of the branch structure (0,251≤E (t) ci≤1), of which in six enterprises (S, V, R, Y, G, Q) the complex entropy industry coefficient was in the harmonic range from 0,382 to 0,618.

The article proposes a methodical approach to the harmonization of the sectoral structure of agricultural enterprises based on a comprehensive assessment of their specialization and diversification. It is proposed to use the method of hierarchy analysis for harmonization of the obtained results by which it is possible to calculate a complex entropy industry coefficient.

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