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Shannon Entropy as an Indicator of the Effectiveness of E-Advisory in Ukraine

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Abstract

The paper considers the possibilities of optimizing the search for agricultural information based on Shannon information entropy criterion. A comparison of the degree of uncertainty of information search through the Internet – search systems with similar indicators of Ukrainian agricultural websites. According to the number of hit count in Ukraine in July 2020 to the search engine, which consists of 10 sources, and to agricultural websites (43 sources) by estimating entropy, a conclusion was made about the significant degree of dispersion of agricultural information sources. It should be emphasized that the artificial division into 4 categories (AgroMedia, Agrotrade web resources, Information and advisory resources, Specialized web resources) did not improve the situation according to the degree of uncertainty compared to the search engine system. As for the entropy index, for almost all 4 categories of entropy indices (heterogeneity or diversity) is close to the case of uniform distribution, i.e., the same hit count of all possible resources (their number for all categories is

approximately the same 10-11). As a result of the analysis of the potential client base of electronic consulting, it can be quantified as 4,700,000 of agricultural households and about 50,000 small and medium-sized farms. The transition to the land market is likely to lead to a substantial increase in the number of the latter. It was demonstrated that the current educational level of household owners indicates both the need to increase this indicator and the presence of a close relationship with the existing system of professional advisory in Ukraine, which operates in recent years through self-sufficiency and uncertain financial support from central and regional authorities. The existing official database of advisors should be restructured in line with the call of the times to reduce the degree of uncertainty in finding a specialist of the desired profile.

Keywords: E-advisory; Electronic advisory; Professional advisory; Information Consulting Services (ICS); Agricultural information; Shannon information entropy.

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Introduction

Ukraine has been living under extremely tight budgetary constraints. The impact of the coronavirus pandemic on the world economy and particularly on the economy of Ukraine has worsened the situation. Against this background, as sad as it may be to admit, the agrarian sector of the economy, which accounts for a large share of the country's exports, plays an increasingly important role in maintaining macroeconomic stability. It should be emphasized that food needs are fundamental and, in accordance with marketing studies at the national and global levels, the demand for agricultural products, though it has been declining recently, but at a much lower rate, than the demand for products from other sectors of the economy.

At present, the Ukrainian agricultural sector is an extremely heterogeneous conglomerate of various forms of agrarian business, in which large (more than 10 thousand hectares of cultivated area) vertically integrated agricultural enterprises become increasingly important (Skrypnyk et al., 2019). However, households, that cultivate parcels on their own, also retain a significant share of the existing land fund. Of course, 'nature abhors the vacuum', and between households and large enterprises there is many small and medium-sized agribusinesses, i.e., the principles of classical mechanics, rather than quantum ones, are applied to the structure of agribusiness.

The success of the agricultural sector depends on the efficiency of the development of new technologies, the use of market conditions, as well as organizational changes necessary

for its development. However, given its significant heterogeneity and the existing asymmetry of information between large and small businesses, the request for information support is quite difficult to meet.

In each country, the development of advisory has its own characteristics, which are mainly dictated by production needs. For the Ukrainian agricultural sector, this is primarily a mismatch between the level of efficiency of large enterprises that have access to global innovation and most rural households that need socially oriented advisory services. The middle segment of commodity producers needs both advisory support from the state and creates a demand for quality commercial advisory services. The transition to the land market can significantly change the ratio between the shares of production of large and small businesses in favor of the latter. However, delays (land market penetration, climate change, and the transition to renewable energy, the global pandemic, political instability, and the external military threat) require a significant expansion of the range of issues addressed by the advisory body.

In Ukraine in the early 2000s, the establishment of an institution of advisory services was provided by law, which procured state funding for the formation of service centers and compensation for socially oriented services, which was almost completely stopped after the economic crisis of 2008-2009 (Bakun et al., 2020). Today, those advisory services that have survived and gained considerable experience operate in part through self-sufficiency and in part through the support of local budgets, and, to a lesser extent, receive compensation from the budget.

At the turn of the 2000s (approximately in the 1997-2005s), there were processes of the emergence of specialized web resources, outside the usual corporate sites of companies and organizations in the Ukrainian agricultural segment of the Internet (Bakun et al., 2020). This was due to the processes of digitalization of paper data with their subsequent structuring into electronic databases, based on which the first information and reference web resources of the advisory direction were built. Such steps were mainly carried out at leading agricultural universities, which at that time had the appropriate technical, personnel and information base.

For example, the project of the Department of Information Systems of the National Agrarian University (now NULES of Ukraine), which has evolved into the construction of the information and reference agricultural web-portal “Agrarian sector of Ukraine” Agroua.net (ASU, 2021) and involved leading specialists from the university and the Academy of Agricultural Sciences.

However, with the development of Internet technologies in Ukraine since the mid-2000s, many similar web resources of different quality and with different content volumes began to emerge in the domestic segment of the Internet, created by both specialists and amateurs in the sphere of industry information. The volume of information on corporate websites, portals, and web services, including those of the executive authorities, has gradually begun to grow.

This resulted in the dispersion of user focus and uncertainty about the quality and reliability of the information obtained for practical application. If we use the concept of entropy as an index of the degree of uncertainty, we can say that the latest 15 years have been characterized by a significant increase in the entropy of the information space due to the large number of overlapping and low-informative sources about agricultural activity (Babenko et al., 2020).

The aim of the research is to estimate the effectiveness of the current structure of agricultural advisory and proposals for its transformation to effectively support the socio-economic changes taking place in the agricultural sector.

Literature Review

Information Consulting Services (ICS) of developed countries are represented by various organizational and legal forms, such as university (USA), state ministerial (Germany, Canada, Poland), private (UK, France), public (Denmark), mixed (the Netherlands, Hungary, Russia) (DER, 2019; FAO, 2010). In Ukraine, there is a mixed model of ICS, which is characterized by a combination of different sources of funding and different production patterns. The legislation divides consultancy services provisionally into commercial (paid) and socially oriented (provided at the expense of budget funds) (FAO, 2010; Skrypnyk et al., 2019).

The issue of state participation in the distribution of agricultural advisory services is extremely relevant. First, it is solved based on the ratio of shares of socially oriented and monetized advisory services, and as the development of agribusiness, these shares change over time (FAO, 2010). Recent studies of current trends in advisory services in the United States have shown that more than 90% of farmers obtain counsel of private advisors, 80% of whom in turn consider the advisory services of Iowa State University (ISU) to be a source of agricultural innovation. That is, the source of information (university) is not focused on the end consumer, a farmer, but on a more qualified intermediary (advisor) (Bahn et al., 2019). These results underline the reorientation of the university customer base in terms of innovations generated by it from end users – farmers and agronomists – to advisors who work with them.

Researchers pay a lot of attention to raising the educational level of farmers, because they, and not advisors, make decisions that determine the success of agricultural business (Bahn et al., 2019; FAO, 2010). It is important that the farmer makes decisions in conditions of partial uncertainty: so, he does not know the future prices for his products, as well as possible government decisions (such as reducing the degree of protection of the domestic market or using monetary policy levers that may reduce the competitiveness of its products) (Mahdi et al., 2015). Recently, methods of overcoming uncertainty have appeared in advisory, which is associated with the expansion of the market range of the main components of the production process in the field of crop production, which will allow to reduce risks (Morton et al., 2013).

Similar issues arise in Ukraine, where there are many forms of management in the agricultural business, the interests, and capabilities of which may differ significantly (Skrypnyk et al., 2019). At the same time, there is usually a big difference between the information support of large, small, and medium-sized agricultural businesses (Zherlitsyn et al., 2020). The practical collapse of state support for the agrarian advisory system has deprived both numerous small and medium-sized businesses and millions of households of socially oriented information services (Bakun et al., 2020). The existing system of information support of agrarian business in the country cannot be considered satisfactory (Babenko et al., 2020).

This conclusion is because a significant proportion of rural residents are still without the access to the Internet (Babenko et al., 2020) and do not have the skills to search for information and determine its reliability (Hlazunova et al., 2020). This largely applies to the information support of agribusiness and the rural population by the current authorities (web resources of state institutions), which are characterized by a low level of information and, therefore, virtually no visits by users (Kuznetsov et al., 2020). As for the system of agricultural consulting in Ukraine, as seen by the authors and based on the processes taking place in the agrarian sphere, it should rather be considered ineffective due to the lack of coverage of a wide range of potential users of these services (Skrypnyk et al., 2019; Bakun et al., 2020; Zherlitsyn et al., 2020) and the difficulties faced by all parties, obtaining social services.

Results

Food security has been addressed satisfactorily now, largely through large businesses, but several socio-economic problems remain. These are, primarily, the degradation of the Ukrainian countryside, the underdevelopment of small and medium-sized businesses and the growing gap in living standards between peasants and urban residents (Skrypnyk et al., 2019). Due to the introduction of the land market, there is a great need for legal support for decisions made by households – owners of shares regarding the further use of their own agricultural lands.

The increasing impact of climate change is a challenge, and there is an urgent need for advice on how to mitigate the impact of climate and weather risks on economic activities.

We will start the analysis of the level of information support with the help of electronic advisory in Ukraine with a modern vision of Shannon information entropy, which was introduced to primarily solve purely engineering problems of coding information in a three-element system from the information source, transmitting network and its consumer (Shannon, 1948). However, over time, it became clear that Shannon entropy has much in common with standard physical entropy, which is often interpreted as a measure of the uncertainty of the system and increases with the number of its states. Currently, Shannon

entropy is used starting from the analysis of income inequality, natural diversity to the entropy of artificial systems created as humanity develops. There are two main limitations to Shannon's approach. First, it cannot be used to compare diversity distributions that have different levels of scale. Second, it cannot be used to compare parts of the distribution and diversity (Rajaram et al., 2017).

The variety of probability distributions of the system under study is defined as the number of uniformly distributed states (NUDS) that have the same entropy as the system under study.

To illustrate the legitimacy of the approach, we will consider the use of different search engines by users for information purposes. To do this, we use the share of monthly hits in Ukraine of various search engines that took place over the past year (Table 1). The absolute leader in the percentage of hits was Google (92-96%), the second place with about 5% share was taken by Yandex, the share of all others does not exceed 1%.

Table 1. The share of monthly hits of various search engines from 01 Jul 2019 to 31 Jul 2020

Date	Google	Yandex RU	bing	Yahoo!	Mail.ru	DuckDuckGo	Yandex	Baidu	Ecosia	Other
2019-07	92.09	5.95	0.53	0.5	0.43	0.25	0.01	0.18	0	0.05
2019-08	95.39	3.44	0.41	0.24	0.26	0.18	0.01	0.03	0.01	0.03
2019-09	93.85	4.54	0.45	0.33	0.42	0.27	0.01	0.06	0.01	0.06
2019-10	93.03	4.61	1.26	0.35	0.39	0.23	0.01	0.06	0.01	0.03
2019-11	94.1	4.48	0.46	0.29	0.37	0.21	0.03	0.04	0.01	0.03
2019-12	94.19	4.24	0.54	0.31	0.33	0.25	0.08	0.03	0.01	0.02
2020-01	93.77	4.77	0.45	0.33	0.31	0.26	0.03	0.03	0.01	0.03
2020-02	93.46	5.09	0.43	036	0.3	0.23	0.03	0.03	0.01	0.05
2020-03	94.1	4.4	0.48	0.38	0.3	0.23	0.03	0.04	0.01	0.04
2020-04	93.93	4.56	0.43	0.31	0.33	0.26	0.11	0.02	0.01	0.03
2020-05	93.81	4.42	0.4	0.31	0.3	0.31	0.41	0.02	0.01	0.03
2020-06	93.67	4.43	0.55	0.29	0.22	0.35	0.44	0.02	0.01	0.03
2020-07	93.79	4.24	0.6	0.26	0.21	0.42	0.43	0.02	0.01	0.04

Source: Search Engine Market Share Ukraine, 2021.

Let us estimate Shannon entropy for the information system of search engines in Ukraine. Estimates of H entropy are made based on the individual search engine shares pi in the following ways (Shannon, 1948):

$$H = -\sum_{i=1}^{N} p_i \ln p_i ; (\sum_{i=1}^{N} p_i = 1) \quad (1)$$

It should be emphasized that the entropy is equal to 0 only in case of 1 source (*p=1; ln(p)=0*), the maximum value of entropy for a given *N*, occurs with a uniform distribution (*pi=1/N, i=1,2,…,N*): entropy is equal to: *H=ln(N)*.

The variability of the shares of individual search engines over time is insignificant, so we will estimate the entropy of the system according to the data of July 2020. The number of search engines is 10, i.e., the maximum entropy for this system is $H^m = \ln(10) = 2.3$. The

actual value of the Entropy (1) according to Table 1 is *H=0.3*. This means that the system has a high degree of order due to the almost complete dominance of the Google search engine. The number of uniformly distributed states having the same entropy with the system under study slightly exceeds one ($e^H = e^{0.3} = 1.3$).

As for the entropy index of the whole system of agricultural information space, its value of 3.2 is also quite close to the maximum of 3.8, which is possible with 43 separate sources. This is based on the significant diversity of web resources that serve the agribusiness. The path of evolution of information sources, which have adapted to the requirements and needs of users, has formed a certain thematic specialization of these resources, which can be divided into 4 categories: 1) AgroMedia; 2) Agrotrade Web resources; 3) Information and advisory resources; 4) Specialized Web resources. Estimates of the entropy of the entire information system and its parts according to observations of the number of hits in July 2020 are given in Table 2.

Table 2. Parameters of the hit count of certain categories of agricultural web resources in Ukraine and their entropy

Name	The number of hits (mln)	The number of resources	The share of the category (%)	Equilibrium entropy	Entropy	NUDS
Agromedia	1.25	10	32	2.3	2.1	8.2
Agrotrade Web resources	1.57	11	40,2	2.4	1.8	6.0
Information and advisory resources	0.77	11	19.6	2.4	2.0	7.4
Specialized Web resources	0.32	11	8.2	2.4	1.6	5.0
Total value	3.91	43	100	3.8	3.2	24.5

Source: developed by the authors based on the analysis of the agrarian web resources (UAspectr, 2020; AgroPortal, 2021).

The total hit count of agricultural web resources in July 2020 was 3,900,000. If you compare this monthly number of hits with the same number of hits to different search engines, you will certainly have a great advantage of the latter (28 million per month). We analyze the characteristics of individual categories of information space in the agricultural sector. The largest hit count is 1,570,000. Located on trading platforms and bulletin boards (Agrotrade Web Resources), the smallest is in specialized web resources, which usually focus on narrow issues that might be of interest to rural people (beekeeping, land cadaster, renewable energy, etc.). As for the entropy index, for almost all 4 categories the entropy index (heterogeneity or uniform distribution) is close to the case of uniform distribution, i.e., the same access to all possible resources (their number for all categories is approximately even: 10-11). This may indicate that the same users are trying to find the information they need on all the web resources that fall into a given category, and most likely fail to do it. That is, all this conditional electronic information system based on web resources, focused on information support of agribusiness, is largely out of order.

Let us consider the state of the information space supporting agrarian business from the point of view of the consumer, that is, the agrarian producer or the usual resident of rural areas. It should be noted that both the management and a large part of the personnel of large agrarian companies are located and live-in cities, and it is therefore natural that there is a significant difference in the range of demand for information services for small and large agrarian businesses as opposed to the urban and rural residents.

It should be emphasized, however, that for any user of information services, the criterion of optimality can be the minimization of the time needed to find information for a certain agrarian project. If large agricultural enterprises have special units or qualified industry specialists who can search for information effectively, then for households and small farmers, the search for information is usually carried out by a person who performs all other responsibilities for the operation of their own business. Therefore, searching for information becomes a significant problem in this case and most small (land use) consumers would prefer to get information from one or two reliable sources (if you look at Google consumers (Table 1).

Let us have a closer look at the potential client base of electronic advisory.

Out of the existing 31,1 million hectares of privately owned agricultural land, 16.6 million hectares are let on lease by the (MLRU, 2018), i.e. 14.5 million hectares are cultivated independently by households that do not lease land. That is, we can assume that with the existing 4.7 million households, one household has about 3.1 hectares. The land reform will most likely bring some reduction in the number of unit holders and an increase in land use per farm. However, in any case, virtually all households, except for traditional forms of advisory (crop technology and to a substantially lesser extent livestock) will require legal and financial advisory in the transition to the land market. That is, the demand for e-advisory services will be created by 4.7 million households and approximately 50 thousand small and medium-sized farms and enterprises (Table 3). All this is without considering the medium (more than 1 thousand hectares) and large (more than 10 thousand hectares of land use) agricultural business, which has the capacity to provide professional information support for innovative development.

Table 3. Potential customers of the electronic advisory system and their characteristics

Characteristics	**Farm enterprises with land parcels**	**Farm enterprises without land parcels**	**Agricultural enterprises with land parcels**	**Agricultural enterprises without land parcels**	**Households**
Quantity (thnd)	30. 441	2.723	6.051	8,875	4739
Land use (mln ha)	4.8	-	1.8		14.4
Average size (ha)	130-170	-	280-300		4-7
Mode (ha)	40-50		180-220		3-4
Profit from 1 ha					

Source: (SSOU, 2021; MLRU, 2018).

Thus, we can conclude that 33 thousand farms and 15 thousand agricultural enterprises with a size of their cultivated areas up to 1 thousand hectares are among the potential customers of the e-advisory system in addition to millions of households. In the current conditions of land reform, which according to the valid Constitution was to take place immediately after the land parceling in the early 2000s, the current status quo contributes to increased competition for the main resource factor of agrarian business, land. Although most of the land remained owned by households, large agricultural businesses have lobbied for laws that significantly reduce the emergence of a full-fledged land market with equal access for both sellers (unit holders) and buyers (agrarian business) since the land parceling times.

In our opinion, the current situation with the introduction of the land market is in many respects similar to the situations that arose during the establishment of market relations in the days of "wild capitalism", where the agrarian business, which was being formed for over 20 years and which is now competitive in the global commodity market, is opposed by households, a significant proportion of which doesn't even have access to the Internet (Skrypnyk et al., 2019), and, accordingly, no prompt access to information. If we have a look at the educational level of the heads of the households as of 2018, it does not encourage excessive optimism either about the competence to search and interpret information (Table 4). Only fewer than 10% out of them have completed higher education, but given the average age of the villagers, it can be said that they received education in the years when access to information technology for the population of the former USSR was very limited.

In the conditions of rapid changes in the factors of external influence on the conditions of agribusiness (climate change, the impact of the pandemic on global and local markets for agricultural products, the introduction of the land market) information support for small and medium agribusiness becomes extremely relevant. Despite the significant average age (58-61 years) of household owners (decision-makers), today they need access to qualified multi-faceted advisory and training on specialized electronic platforms (Hlazunova et al., 2020).

Table 4. Educational level of rural heads of households in 2018 (expressed as percentage)

Name	Male	Female
Households' heads which have:		
whole higher education	8,5	9,6
basis higher education	1,0	1,3
uncompleted higher education	11,8	16,6
professional-technical education	26,6	12,9
whole secondary education	34,2	30,4
basis secondary education	14,2	18,4
elementary education	3,4	9,9
Households' heads which do not have elementary education	0,3	0,8
Illiterate households' heads	0,0	0,1

Source: (SSOU, 2021)

Contemporary processes of digitalization of the economy and agriculture create a lot of new economic opportunities, but also challenges to business processes and their participants. Digital data can be used for development purposes and for solving social problems. Digital platforms facilitate transactions and networking, as well as the exchange of information between participants. From a business perspective, the transformation of all sectors and markets through digitization can contribute to the production of higher quality goods and services at reduced costs. However, this requires new approaches in educational processes to the development of digital competences, which can be achieved through digital and consultative-and-educational platforms. Furthermore, digitization transforms value chains in various ways and opens new channels for adding value and for broader structural change in both agriculture and the service industries.

The latest statistics data testify that, at hard times, the big business is adapting more quickly to climate change (Bakun et al., 2020; Skrypnyk et al., 2019) and changes in market conditions, has significant advantages at the initial stage of implementation of the land market not only due to higher levels of resources, partly owing to the strong information support of own experts and possibility to allocate by them the reliable innovative information suitable for application.

These same factors have already begun to worsen the financial situation of the rural population due to the low adaptability of technology and the practical lack of support for the legal component of economic activity. Today, the predominant share of income of the rural population is provided by budgets of all levels (pension revenues, salaries of representatives of the educational and social spheres), while the share of income from the sale of own products is not more than 10% (SSOU, 2021). We will take a closer look at the use of the main resource (land) by 4.6 million rural households. This considers the presence of homesteads, the use of shares that are not leased, and the possibility of renting from other owners (Table 5).

Table 5. Use of different forms of small-scale agrarian business depending on the amount of land use

Name	**Average for all**	**S< 0,5 ha**	**0,5<S<1,0**	**S>1,0**
Total area (ha)	3.0	0.3	0.7	4,2
The share of land parcels and lease parcels (ha)	1.2	0.2	0.4	3,1
The share of arable land under individual crops (%)	100	100	100	100
Wheat (%)	21.8	4.8	13.1	25.8
Barley (%)	13.6	2.0	5.8	16.7
Sunflower (%)	13.3	0.4	0.6	17.5
Potato (%)	11.5	40.4	24.1	5.2
Corn (%)	9.9	11.8	11.2	9.4
Other crops (%)*	29.9	40.6	45.2	25.4
Proportion of households with livestock (%):	100	100	100	100
Cows (%)	32.0	18.1	33.7	51.9
Swine (%)	39.5	26.4	41.4	58.0
Poultry (%)	96.0	94.5	96.6	97.7

Source: (SSOU, 2021)

* It should be considered that "other crops" include field vegetables (average of 3.3%), fodder crops – 13.3%, uncropped areas 7.6% and crops whose area does not exceed 1% of the total arable area.

Households with less than 0.5 ha of arable land use 40% of it for growing potatoes, and a significant proportion of corn for poultry and vegetables for their own consumption. Cows and pigs are present in these households in some cases (1 cow per five households and one pig per 4 households). The poultry is present in all categories of households, regardless of the amount of land use, but its population mostly depends on the forage base, which is determined by the amount of land use. That is, households with less than 0.5 ha of land use for their own consumption of all types of products. It should be emphasized that these households have additional income (rent) for the use of land shares by agricultural businesses. As for the household of the last category with an average land use of 4.2 hectares, they usually produce a significant share of crop production as a commodity. In addition, they have much greater opportunities for breeding all kinds of livestock, due to the presence of their own fodder resources. It can be concluded from the data that there has already been a significant difference in the income level of the rural population, and the advisors should take this fact into account in their future work. The level of opportunities for the introduction of innovative technologies by households with different amounts of land use varies significantly and therefore advisors should consider this factor as well.

Staffing of advisors and services are available in the current form on the information-analytical portal "AIC of Ukraine" ("Rural Development" section), where you can find registers of services and agricultural advisors and expert advisors. As of August 17, 2020, the registers contain data from 556 advisors and 26 regional services (which do not cover all regions of the country). As for the possibility of estimating the cost of advisory services when choosing a service or its advisor, only one regional service (Sumy Chamber of Commerce and Industry, according to the analysis of web resources of advisory services as of March 2020) provided an estimate of its services.

The register of advisors makes it possible to list the main declared directions of advisory and a share of the certified advisors, of which: Economy – 267 (48%), Agronomy – 108 (19%), Legal science – 33 (6%), Development of rural areas – 30 (5.4%), Marketing – 21 (3.8%), Accounting and Audit – 17 (3.1%), Plant Protection – 15 (2.7%), Livestock – 10 (1.8%), Land Management – 10 (1.8%), Finance – 10 (1.8%), Hydrotechnical amelioration – 6 (1.1%), Zooengineering – 6 (1.1%), Taxation – 6 (1.1%). Among the remaining 17 experts are specialists in rabbit farming, horticulture, mechanization, Ukrainian language, and others. Interestingly, of the 556 experts, 180 did not indicate their full contacts (telephone, mail), more than half did not indicate e-mail, and no one indicated their website where you can learn more about their activities and experiences. There are almost no advisors, who would declare assistance in information technology, renewable energy or weather and climate risks mitigation. As for the large number of certified advisors in the field of "Economics", there are

also many questions, because it is unlikely that there can be such many specialists on economic efficiency of all areas and forms of agricultural business development.

In our view, the existing system of consultation has the highest possible degree of uncertainty as determined by entropy, the value of which is calculated as the natural logarithm of their sum $H=ln(556)=6.3$. The case of uniform selection of each of the advisors was chosen by us because the information about their competencies is extremely scanty and monotonous, it is chaotic. To make a choice, a potential client needs to consider a list of all advisors and the choice is unlikely to be unambiguous. Entropy, as the degree of uncertainty in the register of advisors, can be reduced by dividing them by areas of service provision (up to 10), where in turn the most popular areas can be divided into individual issues that coincide with the defined competences of advisors. Of course, this primarily applies to the direction of the economy, which in our opinion should be divided into the following current issues: 1) Payback period and the amount of investment in agricultural innovation; 2) Increasing profitability and diversification of existing business risks; 3) Economics and finance of land relations; 4) Renewable energy; 5) Mitigation of climate and weather risks. In this case, all the uncertainty will be reduced to finding the right advisor from a complete list of those who have attributed themselves to this area. That is, the system will be reduced to separate subsystems, the entropies of which are calculated separately, so that the client will not need to search the entire register of advisors.

In the case of a client request relating, for example, to the subject matter of the various sections, advisory teams may be established from existing regional advisory services to deal with such matters. Another important factor in reducing entropy will be the introduction of a territorial feature of the advisor's activity. The following conclusions can be drawn from the analysis of the information space of an agrarian direction in Ukraine.

Conclusion and Discussion

A lot of the existing information sources of agricultural orientation does not contribute to increasing the efficiency of agricultural production. If we use Shannon's information entropy index, the existing system of information support of agribusiness based on a set of web resources in a few thematic groups has the highest possible degree of uncertainty due to its diversity, low power, and repeatability of information in different sources, in which its veracity is not confirmed. For comparison, we use the indicator of uncertainty on a national scale for search engines (entropy), which is equal to 0.3, whereas for the agricultural information sphere it is 3.2, the hit count differs by an order of magnitude in favor of search engines. This means that users of the agricultural information space spend a lot of time searching for the necessary information and are most dissatisfied with the result.

Demand for e-advisory services will be generated by 4.7 million households and approximately 50,000 small and medium-sized farms and enterprises. At present, the available land resource is the main source of support for the rural population, whose standard

of living differs significantly (much lower) as compared to the standard of living of residents. Even at the household level, there is already a significant difference in approaches to land use and, of course, to finding useful information depending on its size. There is an even greater asymmetry of information between powerful vertically integrated agricultural enterprises and small and medium-sized businesses.

The current educational level of rural residents does not allow to take full advantage of e-advisory, so we offer a binary system based on an electronic platform, which will serve as a source of reliable data, in which the content component will be formed by HEIs' scientists and by professional advisors. Based on the accumulation of content and statistics of user hits of its individual units, it will be possible to determine the priority of the requested advisor not only in the declared areas, but also in the fact of their confirmed activity.

Thus, digitization of the existing system of professional advisory in the country, which operates on the e-advisory platform, in cooperation with agricultural universities is aimed to reduce information entropy (randomness) of agricultural information space by way of forming basic content through their own and adapted innovations. This will also be facilitated by the creation of a full-fledged register of advisors, based on deeper identification and clustering of data, and the use of statistics obtained from the mutual integration of several advisory web resources in the electronic platform.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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