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FORECASTING THE VALUE OF THE EXPORT OF UKRAINIAN AGRICULTURAL PRODUCTS BASED ON FUZZY SETS

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Abstract

Ukraine has a significant export potential of agricultural products. Ukraine's acquisition of the status of a candidate for EU membership and the desire to take a worthy position in the global agro-food markets necessitates a permanent monitoring and forecasting of the value of Ukrainian exports of agricultural products. The actual data of the State Statistics Service of Ukraine for 2014–2021 regarding the commodity structure of foreign trade in agricultural products of Ukraine were used for the analysis. It was determined that the following types of goods had the greatest export potential (over USD 100 million annually): 02 meat and meat preparations; 04 milk and milk products; eggs; honey; 08 eatable fruits and nuts; 10 cereals; 11 flour-grinding products; 12 oil seeds and fruits; 15 animal or plant fats and oils. At the same time, the following types of goods had the lowest export potential (less than USD 10 million annually): 06 seedlings and other trees; 13 shellac natural. In the analyzed period, all types of goods (except 04 milk and milk products; eggs; honey; 14 plant materials for producing) had positive dynamics of most or half of export indicators. For each of the 15 types of agricultural products, forecast indicators of the value of exports for 2022 are constructed according to the author's methodology in the form of trapezoidal fuzzy intervals, where optimistic and pessimistic estimates are calculated on the basis of actual data, taking into account average growth rates.

Key words: *export value, agricultural products, Ukraine, fuzzy sets, forecasting*

INTRODUCTION

Ukraine is an agrarian country with great export potential of agro-industrial products. This is facilitated, on the one hand, by fertile soils (product quality, yield), and on the other hand, by a favorable location in the middle of Europe (convenient logistics). Ukraine is among the twenty largest trading partners of the EU in terms of trade in food products, beverages and tobacco products [1]. In the context of international research and Ukraine's acquisition of the status of a candidate for EU membership, it is expedient to analyze and forecast the cost of exporting agricultural products of Ukraine to world markets. Various aspects of export operations with products of the agro-industrial complex of Ukraine were studied by the following scientists: Fediv R. and Fediv I. (2020) – the main trends in the formation and implementation of the export potential of agricultural enterprises [2]; Koliadenko S. *et al.* (2020) – the state and prospective directions of Ukrainian export of agricultural products, including forecasting using the method of mathematical modeling of a continuous system of aperiodic components [4]; Kryukova I. O. *et al.* (2018) – level of competitiveness of agricultural and food products, possible directions of export development [5]; Kvasha S. *et al.* (2019) – possible ways of illegally withdrawing profits abroad, in particular through export trade in agricultural products [6]; Levkovskyy E. (2019) – progressive gains in the export of agri-food products related to environmental requirements (on the example of key players in the global agricultural market) [7]; Matyushenko I. Y. *et al.* (2018) – the state and prospects for the development of Ukraine's foreign trade in products of the agro-industrial complex in the context of European integration and global challenges [8]; Melnyk T. *et al.* (2021) – factors of formation and implementation of the export potential of the agro-industrial complex of Ukraine, the place of Ukrainian products on

the world food market [9]; Nagyova L. *et al.* (2018) – trends in export trade of Ukraine with the countries of the Visegrad Group [10]; Parkhomenko N. *et al.* (2022) – the state of the agricultural sector of Ukraine, development directions and prospects, export opportunities and export potential [11]; Polkovnichenko S. O. and Rosokhach O. V. (2016) – dynamics, commodity and geographical structure of export of agricultural products of domestic producers [12]; Voronych M. (2019) – the state and dynamics of foreign trade in the agricultural sector, the advantages of the domestic agricultural sector on world agricultural markets [13]; Shkolnyi O. O. *et al.* (2019) – the current level of competitiveness of the domestic agro-food sector in the context of foreign economic activity, the possibility of attracting regulatory mechanisms to increase the country's exports [14]. Ukraine's desire to join the EU and take a decent position in the global agri-food markets necessitates permanent monitoring and forecasting of the value of Ukrainian exports of agricultural products.

MATERIALS AND METHODS

The actual data of the State Statistics Service of Ukraine for 2014–2021 on the commodity structure of foreign trade in agricultural products of Ukraine (without taking into account the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol, and the temporarily occupied territories in the Donetsk and Luhansk regions) were used for the analysis [15].

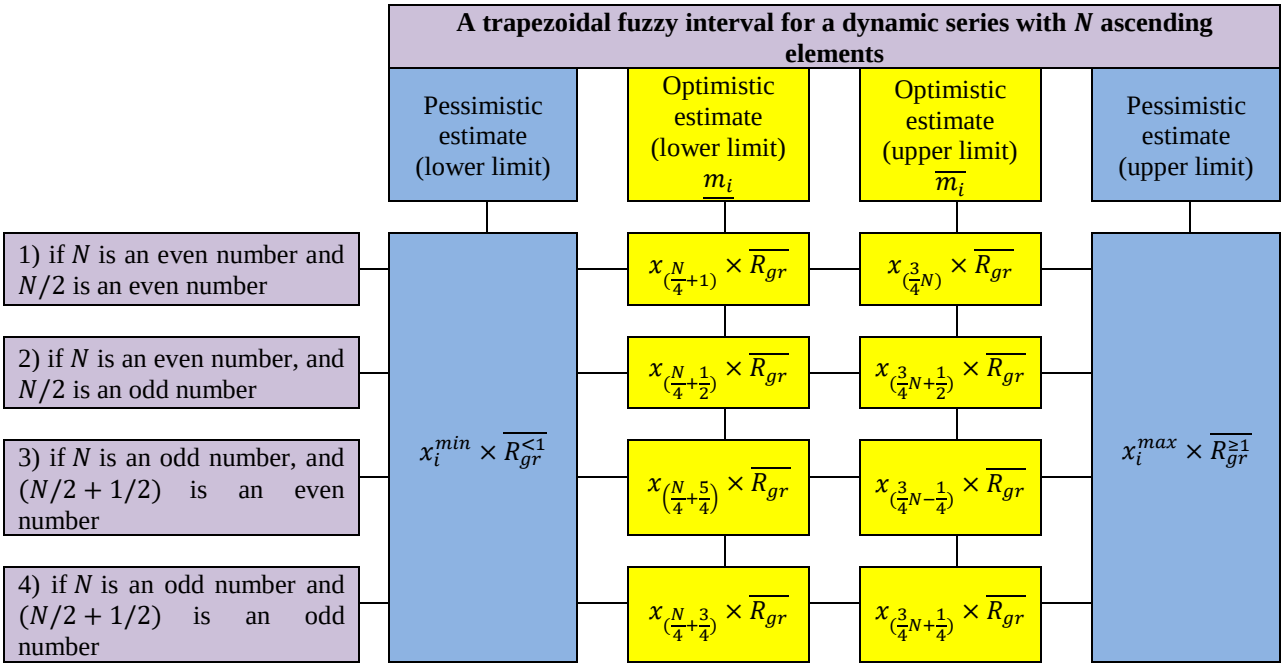

Fig.1. Algorithm for determining the limits of a trapezoidal fuzzy interval.
Source: Author's development [16].

For forecasting, the theory of fuzzy sets was used, in particular, trapezoidal fuzzy intervals of the following form were constructed:

$$indicator_i = (\underline{m_i};\ \overline{m_i};\ a_i;\ b_i), \qquad (1)$$

where: $\underline{m_i}$ – is the lower value of the optimistic (with the greatest measure of belonging $\mu A(x) = 1$) estimate of indicator i;

$\overline{m_i}$ – is the upper value of the optimistic estimate of indicator i;

a_i – is the difference between the lower limits of optimistic and pessimistic (with the smallest measure of belonging $\mu A(x) = 0$) estimates of indicator i;

b_i – is the difference between the upper limits of pessimistic and optimistic estimates of indicator i.

The author's methodology was used to determine pessimistic and optimistic estimates. It is shown in Fig. 1.

According to it, the lower and upper limits of the pessimistic estimate of the forecast indicators will be defined as the smallest (x_i^{min}) and the largest (x_i^{max}) value of the export indicators of agricultural products of Ukraine for the analyzed period, adjusted for the arithmetic mean value of chain growth rates less than 1 ($\overline{R_{gr}^{<1}}$) and greater than or equal to 1 ($\overline{R_{gr}^{\geq 1}}$), respectively.

The optimistic interval (the lower and upper limits of the optimistic estimate of forecast indicators) corresponds to the «golden mean» of the dynamic series ordered by growth, adjusted for the average arithmetic value of all chain growth rates ($\overline{R_{gr}}$).

That is, in our opinion, the optimistic interval includes approximately half of the central elements of the dynamic series ordered by growth; they have the highest probability of verification (measure of belonging). Note that the average growth rates were calculated using the formula of the arithmetic average, not the geometric average, in order to avoid significant miscalculations in the event of significant fluctuations in the series. It should be noted that Gerasymchuk O. B. (2009) determined forecast estimates of the export-import activity of Ukraine based on the principles of the fuzzy game model [3].

RESULTS AND DISCUSSIONS

The commodity structure of Ukraine's export operations for 2014–2021 in terms of the main agricultural products is shown in Table 1.

Table 1. Commodity structure of foreign trade in agricultural products of Ukraine (exports), thsd. USD

Commodity code and title by Ukrainian Classification of Commodities in Foreign Trade (UC CFT)	2014	2015	2016	2017	2018	2019	2020	2021
01 live animals	14,471.8	25,639.9	30,903.4	45,708.8	45,786.6	62,547.7	51,506.9	40,878.5
02 meat and meat preparations	381,775.3	377,668.3	387,791.9	531,240.1	645,982.3	711,895.1	652,106.9	845,553.4
03 fish and crustacea	27,401.3	12,994.8	17,007.3	26,376.9	24,981.4	33,637.5	42,204.0	57,194.7
04 milk and milk products; eggs; honey	575,431.0	386,477.3	330,521.4	494,207.3	480,947.4	453,877.2	426,541.7	378,473.9
05 other animal products	15,394.5	20,654.6	8,812.9	11,224.0	12,940.6	15,058.3	15,805.2	23,094.4
06 seedings and other trees	1,414.4	2,340.4	3,703.8	3,956.6	4,442.8	6,479.7	5,742.6	8,142.6
07 vegetables	129,861.6	97,214.6	152,647.3	235,369.3	235,682.7	184,515.0	168,147.4	196,607.0
08 eatable fruits and nuts	148,191.4	154,083.5	148,221.9	195,287.3	228,564.1	260,112.2	238,390.2	368,197.5
09 coffee, tea	14,645.0	10,595.7	14,088.4	13,610.0	12,059.2	11,709.0	15,011.2	15,900.9
10 cereals	6,544,127.6	6,057,490.0	6,073,915.3	6,501,134.3	7,240,558.1	9,633,333.9	9,410,668.9	12,343,846.1
11 flour-grinding products	124,400.7	117,887.9	138,667.9	181,891.4	175,811.2	202,099.4	154,490.8	148,284.1
12 oil seeds and fruits	1,687,715.3	1,475,455.6	1,534,995.1	2,060,121.4	1,954,149.8	2,563,242.3	1,842,430.9	2,435,156.5
13 shellac natural	557.1	527.0	443.3	587.5	1,090.7	818.5	944.1	3,606.9
14 plant materials for producing	85,226.1	55,897.8	27,010.8	23,750.2	33,701.9	52,233.1	47,412.0	18,286.7
15 animal or plant fats and oils	3,822,031.8	3,299,799.1	3,962,975.8	4,605,666.2	4,496,511.0	4,732,237.5	5,746,921.7	7,037,234.2

Source: Data from the State Statistics Service of Ukraine [17].

As we can see, in the analyzed period, the highest value of export operations (over 100 million USD annually) was observed for such types of goods as 02 meat and meat preparations; 04 milk and milk products; eggs; honey; 08 eatable fruits and nuts; 10 cereals; 11 flour-grinding products; 12 oil seeds and fruits; 15 animal or plant fats and oils.

The lowest value of export operations (less than 10 million USD annually) was observed for such types of goods as 06 seedlings and other trees; 13 shellac natural.

Chain growth rates of export indicators, as well as their average values, necessary for the

calculation of trapezoidal fuzzy intervals, are shown in Table 2.

Table 2. Chain growth rates of agricultural exports of Ukraine

Commodity code and title by UC CFT	2015	2016	2017	2018	2019	2020	2021	The average value of indicators	The average value of indicators which >1	The average value of indicators which <1
01 live animals	1.77	1.21	1.48	1.00	1.37	0.82	0.79	1.21	1.36	0.81
02 meat and meat preparations	0.99	1.03	1.37	1.22	1.10	0.92	1.30	1.13	1.20	0.95
03 fish and crustacea	0.47	1.31	1.55	0.95	1.35	1.25	1.36	1.18	1.36	0.71
04 milk and milk products; eggs; honey	0.67	0.86	1.50	0.97	0.94	0.94	0.89	0.97	1.50	0.88
05 other animal products	1.34	0.43	1.27	1.15	1.16	1.05	1.46	1.12	1.24	0.43
06 seedings and other trees	1.65	1.58	1.07	1.12	1.46	0.89	1.42	1.31	1.38	0.89
07 vegetables	0.75	1.57	1.54	1.00	0.78	0.91	1.17	1.10	1.32	0.81
08 eatable fruits and nuts	1.04	0.96	1.32	1.17	1.14	0.92	1.54	1.16	1.24	0.94
09 coffee, tea	0.72	1.33	0.97	0.89	0.97	1.28	1.06	1.03	1.22	0.89
10 cereals	0.93	1.00	1.07	1.11	1.33	0.98	1.31	1.10	1.17	0.95
11 flour-grinding products	0.95	1.18	1.31	0.97	1.15	0.76	0.96	1.04	1.21	0.91
12 oil seeds and fruits	0.87	1.04	1.34	0.95	1.31	0.72	1.32	1.08	1.25	0.85
13 shellac natural	0.95	0.84	1.33	1.86	0.75	1.15	3.82	1.53	2.04	0.85
14 plant materials for producing	0.66	0.48	0.88	1.42	1.55	0.91	0.39	0.90	1.48	0.66
15 animal or plant fats and oils	0.86	1.20	1.16	0.98	1.05	1.21	1.22	1.10	1.17	0.92

Source: Author's calculation based on data from Table 1.

Note that in Table 2, for better data visualization, annual values of indicators greater than 1 are highlighted in blue, less than 1 in yellow.

As we can see, in the analyzed period, for 13 out of 15 types of goods (except for 04 milk and milk products; eggs; honey; 14 plant materials for producing) the average value of chain growth rates was >1, which proves the positive dynamics of most or half of the indicators export of agricultural products. We should especially note such a product as 13 shellac natural, which reached in 2021 a record mark of chain growth rates of 3.82.

Table 3 shows the dynamic series of exports of goods ordered by growth.

Table 3. Dynamic series of agricultural export indicators of Ukraine for 2014–2021, ordered by growth

Commodity code and title by UC CFT	1	2	3	4	5	6	7	8
01 live animals	14,471.8	25,639.9	30,903.4	40,878.5	45,708.8	45,786.6	51,506.9	62,547.7
02 meat and meat preparations	377,668.3	381,775.3	387,791.9	531,240.1	645,982.3	652,106.9	711,895.1	845,553.4
03 fish and crustacea	12,994.8	17,007.3	24,981.4	26,376.9	27,401.3	33,637.5	42,204.0	57,194.7
04 milk and milk products; eggs; honey	330,521.4	378,473.9	386,477.3	426,541.7	453,877.2	480,947.4	494,207.3	575,431.0
05 other animal products	8,812.9	11,224.0	12,940.6	15,058.3	15,394.5	15,805.2	20,654.6	23,094.4
06 seedings and other trees	1,414.4	2,340.4	3,703.8	3,956.6	4,442.8	5,742.6	6,479.7	8,142.6
07 vegetables	97,214.6	129,861.6	152,647.3	168,147.4	184,515.0	196,607.0	235,369.3	235,682.7
08 eatable fruits and nuts	148,191.4	148,221.9	154,083.5	195,287.3	228,564.1	238,390.2	260,112.2	368,197.5
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10 cereals	6,057,490.0	6,073,915.3	6,501,134.3	6,544,127.6	7,240,558.1	9,410,668.9	9,633,333.9	12,343,846.1
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12 oil seeds and fruits	1,475,455.6	1,534,995.1	1,687,715.3	1,842,430.9	1,954,149.8	2,060,121.4	2,435,156.5	2,563,242.3
13 shellac natural	443.3	527.0	557.1	587.5	818.5	944.1	1,090.7	3,606.9
14 plant materials for producing	18,286.7	23,750.2	27,010.8	33,701.9	47,412.0	52,233.1	55,897.8	85,226.1
15 animal or plant fats and oils	3,299,799.1	3,822,031.8	3,962,975.8	4,496,511.0	4,605,666.2	4,732,237.5	5,746,921.7	7,037,234.2

Source: Author's calculation based on data from Table 1.

In our case, the number of members of the dynamic series $N = 8$ is an even number, and the value $N/2 = 8/2 = 4$ is also an even number, therefore, according to Fig. 1, the 1st and 8th terms of the series will be used to calculate the lower and upper limits of the pessimistic estimate of forecast indicators; the 3rd $(\frac{N}{4} + 1 = 3)$ and 6th $(\frac{3}{4}N = 6)$ terms of the series will be used to calculate the lower and upper limits of the optimistic estimate. They are highlighted in different colors in Table 3.

Therefore, the fuzzy intervals for the export of agricultural products of Ukraine for 2022 will have the form of the following four elements:

01 live animals:

$product_{01}$ = (37,265.0; 55,212.0; 25,563.6; 30,151.4);

02 meat and meat preparations:

$product_{02}$ = (438,573.0; 737,500.0; 78,795.3; 279,090.0);

03 fish and crustacea:

$product_{03}$ = (29,397.4; 39,583.6; 20,162.4; 38,384.9);

04 milk and milk products; eggs; honey:

$product_{04}$ = (373,560.5; 464,873.3; 83,207.8; 395,531.5);

05 other animal products:

$product_{05}$ = (14,547.7; 17,768.1; 10,787.4; 10,879.2);

06 seedlings and other trees:

$product_{06}$ = (4,863.1; 7,540.1; 3,609.6; 3,730.4);

07 vegetables:

$product_{07}$ = (168,468.2; 216,984.0; 89,309.8; 94,276.9);

08 eatable fruits and nuts:

$product_{08}$ = (178,047.5; 275,466.1; 38,862.6; 181,852.5);

09 coffee, tea:

$product_{09}$ = (12,433.9; 15,100.0; 3,039.3; 4,357.0);

10 cereals:

$product_{10}$ = (7,180,469.6; 10,394,035.6; 1,418,211.1; 3,996,273.8);

11 flour-grinding products:

$product_{11}$ = (144,134.8; 182,742.5; 36,901.8; 62,302.9);

12 oil seeds and fruits:

$product_{12}$ = (1,822,115.0; 2,224,177.3; 572,117.8; 990,036.6);

13 shellac natural:

$product_{13}$ = (851.0; 1,442.2; 476.1; 5,911.9);

14 plant materials for producing:

$product_{14}$ = (24,235.1; 46,865.4; 12,122.8; 79,647.3);

15 animal or plant fats and oils:

$product_{15}$ = (4,355,976.8; 5,201,524.8; 1,320,718.8; 3,038,393.6).

Graphically, trapezoidal fuzzy intervals of forecast indicators of the value of exports of agricultural products of Ukraine for 2022 are shown in Figures 2–16.

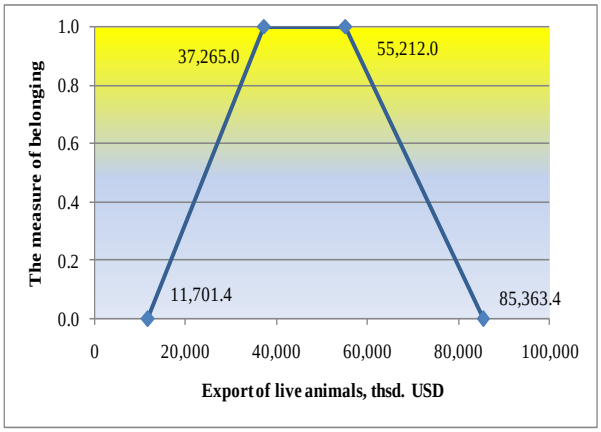

Fig. 2. Trapezoidal fuzzy interval for product 01 live animals.

Source: Constructed by the author based on Tables 2 and 3.

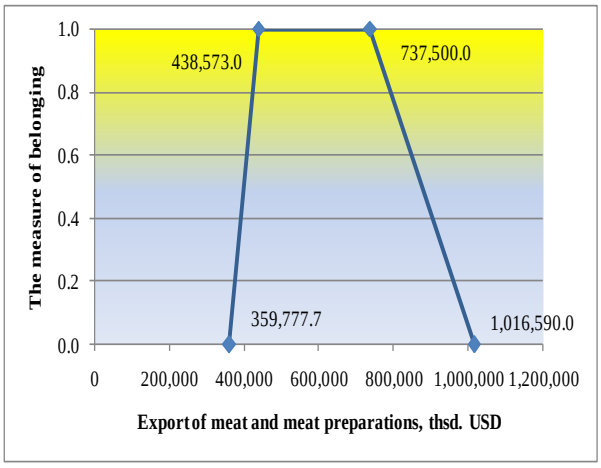

Fig. 3. Trapezoidal fuzzy interval for product 02 meat and meat preparations.

Source: Constructed by the author based on Tables 2 and 3.

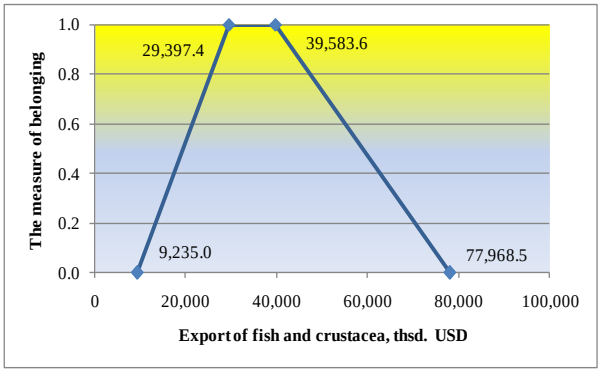

Fig. 4. Trapezoidal fuzzy interval for product 03 fish and crustacea.

Source: Constructed by the author based on Tables 2 and 3.

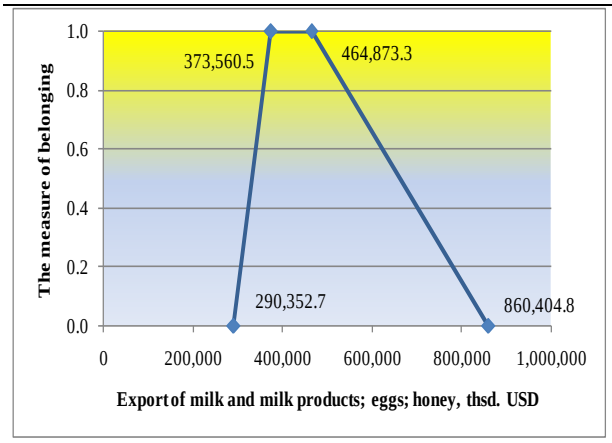

Fig. 5. Trapezoidal fuzzy interval for product 04 milk and milk products; eggs; honey.
Source: Constructed by the author based on Tables 2 and 3.

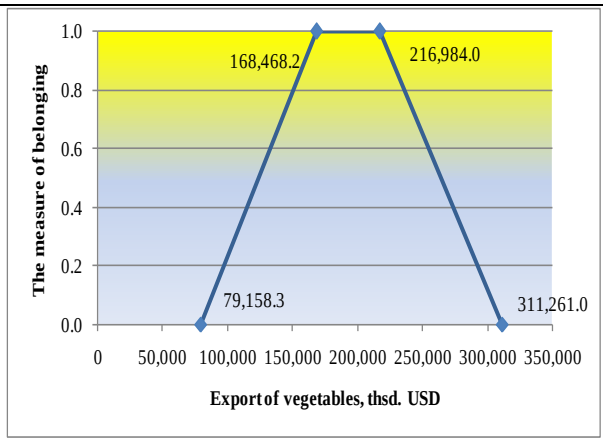

Fig. 8. Trapezoidal fuzzy interval for product 07 vegetables.
Source: Constructed by the author based on Tables 2 and 3.

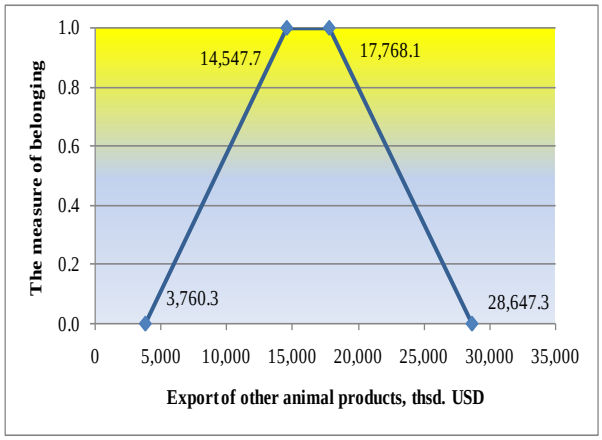

Fig. 6. Trapezoidal fuzzy interval for product 05 other animal products.
Source: Constructed by the author based on Tables 2 and 3.

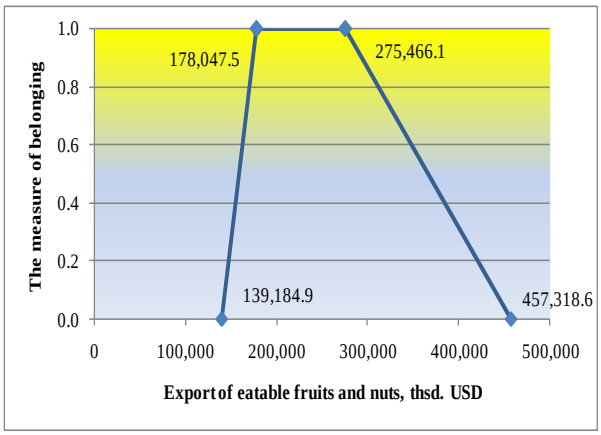

Fig. 9. Trapezoidal fuzzy interval for product 08 eatable fruits and nuts.
Source: Constructed by the author based on Tables 2 and 3.

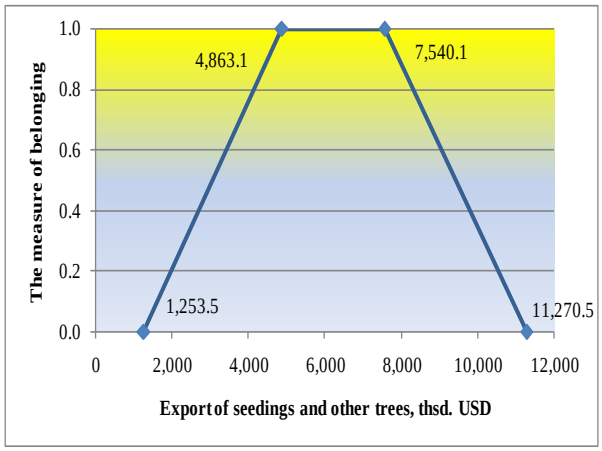

Fig. 7. Trapezoidal fuzzy interval for product 06 seedlings and other trees.
Source: Constructed by the author based on Tables 2 and 3.

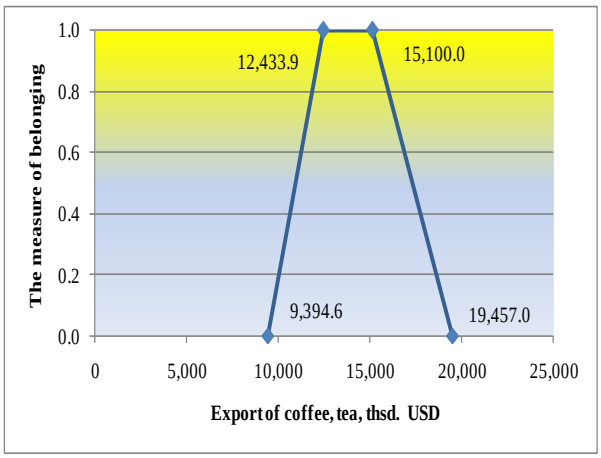

Fig. 10. Trapezoidal fuzzy interval for product 09 coffee, tea.
Source: Constructed by the author based on Tables 2 and 3.

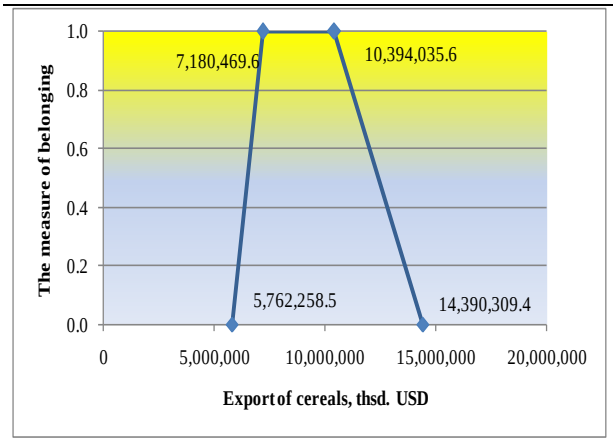

Fig. 11. Trapezoidal fuzzy interval for product 10 cereals.
Source: Constructed by the author based on Tables 2 and 3.

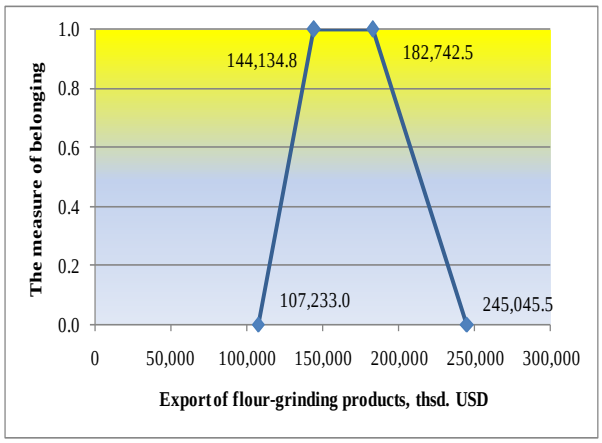

Fig. 12. Trapezoidal fuzzy interval for product 11 flour-grinding products.
Source: Constructed by the author based on Tables 2 and 3.

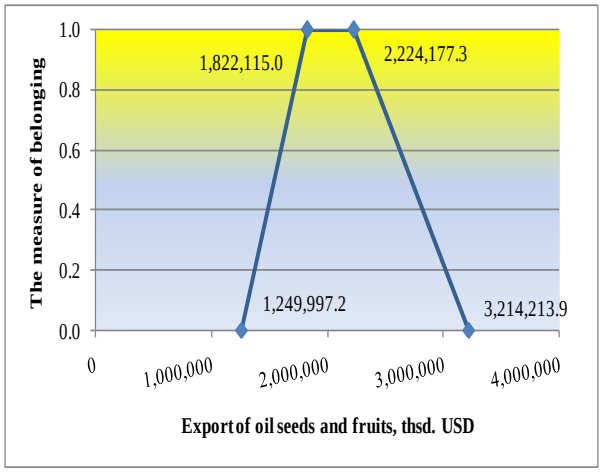

Fig. 13. Trapezoidal fuzzy interval for product 12 oil seeds and fruits.
Source: Constructed by the author based on Tables 2 and 3.

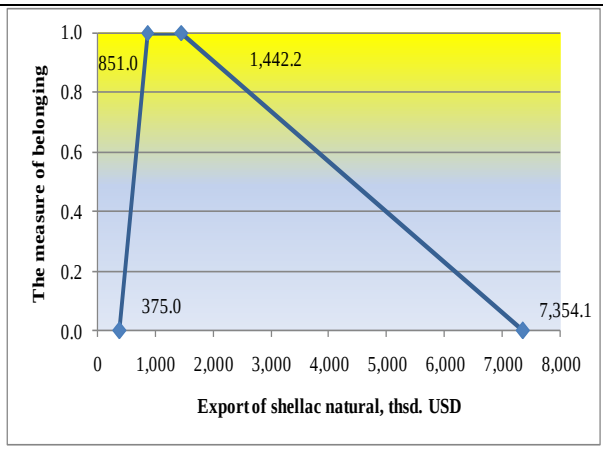

Fig. 14. Trapezoidal fuzzy interval for product 13 shellac natural.
Source: Constructed by the author based on Tables 2 and 3.

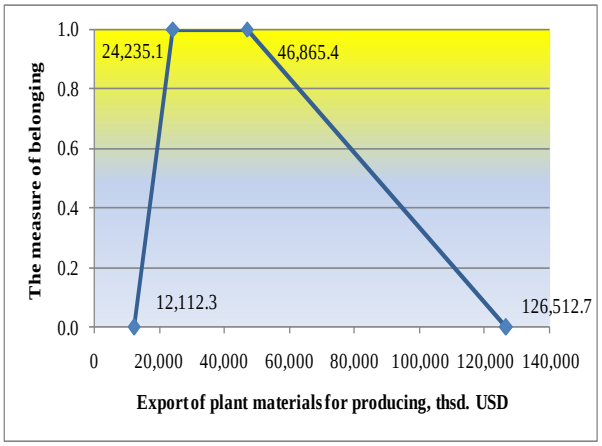

Fig.15. Trapezoidal fuzzy interval for product 14 plant materials for producing.
Source: Constructed by the author based on Tables 2 and 3.

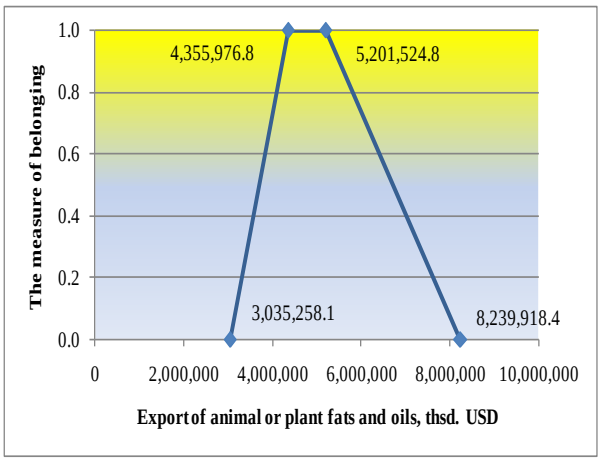

Fig. 16. Trapezoidal fuzzy interval for product 15 animal or plant fats and oils.
Source: Constructed by the author based on Tables 2 and 3.

In these figures, the upper base of the trapezoid is the optimistic interval; the sides of the trapezoid are the pessimistic interval. The forecast indicator has the highest probability of falling into the optimistic interval (measure of belonging). Deviation of the forecast indicator from this interval in a larger or smaller direction (pessimistic interval) has a lower probability of verification. It is unlikely that the forecast indicator will fall outside the pessimistic interval.

CONCLUSIONS

In the context of the European integration of Ukraine and international trade on world agro-industrial markets, it is necessary to constantly monitor and forecast the indicators of the export of agricultural products. Analysis of actual data of the State Statistics Service of Ukraine for 2014–2021 regarding the commodity structure of foreign trade (exports) in agricultural products of Ukraine showed that the following types of goods had the greatest export potential (over 100 million USD annually): 02 meat and meat preparations; 04 milk and milk products; eggs; honey; 08 eatable fruits and nuts; 10 cereals; 11 flour-grinding products; 12 oil seeds and fruits; 15 animal or plant fats and oils. At the same time, the following types of goods had the lowest export potential (less than 10 million USD annually): 06 seedlings and other trees; 13 shellac natural. In the analyzed period, all types of goods (except 04 milk and milk products; eggs; honey; 14 plant materials for producing) had positive dynamics of most or half of the export indicators. For each of the 15 types of agricultural products, forecast indicators of the value of exports for 2022 in the form of trapezoidal fuzzy intervals were constructed according to the author's methodology. It will be possible to check whether the war in Ukraine will prevent the achievement of these indicators after the end of 2022.

REFERENCES

[1]Eurostat, 2022, Extra-EU27 (from 2020) trade of food, drinks and tobacco (SITC 0+1), by main partners, https://ec.europa.eu/eurostat/databrowser/view/tet00022/default/table?lang=en. Accessed on 08.08.2022.
[2]Fediv, R., Fediv, I., 2020, Directions of development and implementation of the Ukrainian export potential. Scientific Papers. Series «Management, Economic Engineering in Agriculture and Rural Development», 20(4):195–202.
[3]Gerasymchuk, O. B., 2009, Applying fuzzy-technologies in tasks of decision-making, Actual Problems of Economics, 10:166–173.
[4]Koliadenko, S., Andreichenko, A., Galperina, L., Minenko, S., Kovylina, M., 2020, Analysis and forecasting of Ukrainian agrarian exports to the EU countries, Agricultural and resource economics-international scientific e-journal, 6(3):29–47.
[5]Kryukova, I. O., Kalyna, T. Y., Panteleiev, V. P., Minakova, S. M., 2018, The export potential of the agrarian sector of Ukraine in a competitive environment, Financial and Credit Activity Problems of Theory and Practice, 3(26):196–207.
[6]Kvasha, S., Pankratova, L., Koval, V., Tamošiuniene, R., 2019, Illicit financial flows in export operations with agricultural products, Intellectual Economics, 13(2):105–209.
[7]Levkovskyy, E., 2019, Ecological component of agricultural enterprises export policy under conditions of EU-Ukraine association agreement, Scientific Horizons, 11:23–31.
[8]Matyushenko, I. Y., Shtal, T. V., Piddubna, L. I., Piddubnyi, I. O., Kvitka, Y. M., 2018, Development prospects of Ukraine's foreign trade in agricultural products in the context of European integration and global challenges, Journal of Advanced Research in Law and Economics, 9(4).
[9]Melnyk, T., Tunitska, Y., Liubyma, A., 2021, Export potential of Ukrainian agro-industrial complex: factors of formation and evaluation, Baltic Journal of Economic Studies, 7(5):130–143.
[10]Nagyova, L., Horakova, M., Moroz, S., Horska, E., Polakova, Z., 2018, The analysis of export trade between Ukraine and Visegrad countries, E & M Ekpnomie a Management, 21(2):115-132.
[11]Parkhomenko, N., Otenko, I., Otenko, V., Chepeliuk, M., 2022, Development of export potential of Ukraine's agricultural sector. Scientific Papers. Series «Management, Economic Engineering in Agriculture and Rural Development», 22(1):485-492.
[12]Polkovnichenko, S. O., Rosokhach, O. V., 2016, Current trends in realization of the export potential of the agricultural sector of economy of Ukraine, Scientific Bulletin of Polissia, 1(5):37-45.
[13]Voronych, M., 2019, Results of analytical reviews of agricultural export of Ukraine, Scientific Horizons, 11:41–50.

[14]Shkolnyi, O. O., Verniuk, N. O., Klymenko, L. V., Pitel, N. Y., Gomeniuk, M. O., Zagorodniuk, O., 2019, The Ukraine's agri-food export performance in the context of competitiveness. Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020, April 10–11, Granada, 7613–7619.
[15]State Statistics Service of Ukraine, 2022, Commodity Pattern of Foreign Trade of Ukraine, https://ukrstat.gov.ua/operativ/menu/menu_u/zed.htm. Accessed on 06.08.2022.
[16]Totska, O. L., 2020, Upravlinnia rozvytkom vyshchoi osvity Ukrainy v Yevropeiskomu osvitnomu prostori [Managing the development of higher education of Ukraine in European educational area], [in Ukrainian], Vezha-Druk Publishing House, Lutsk, Ukraine, 279–280, https://evnuir.vnu.edu.ua/handle/123456789/20037. Accessed on 08.08.2022.