sciendo

RURAL SUSTAINABILITY RESEARCH
48(343), 2022
ISSN – 2256-0939



Received: 18 September 2022 Revised: 3 November 2022 Accepted: 21 November 2022

Challenges for fodder production in Ukraine during the war

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Abstract. This study aimed to identify the most characteristic trends in the area of fodder production and the use of fodder as factors in the development of animal husbandry in Ukraine under conditions of war as the modern challenge for these industries. Russian military aggression is a powerful challenge for the economy of Ukraine, including its fodder production, as well as other countries of the world, reflecting on the aggravation of global problems of food shortages and food security. The effect of the mentioned challenge in Ukraine is superimposed on the identified negative trends and situation, which were formed before the beginning of 2022. Calculations based on them show that the occupation of large areas of Ukraine by Russian aggressors and hostilities caused a significant decrease in the production of livestock products due to a 13–17% decrease in the number of animals. Accordingly, consumption of fodder at the expense of these regions decreased by 16%. However, the situation is very dynamic as the war continues. Given the limitations of state support for the industry, until the end of the war the main efforts to improve fodder production in Ukraine should objectively be related to the maximum optimization of the structure of fodder rations by increasing the share of less energy-intensive forages. Every challenge creates new opportunities, therefore the post-war development of fodder production and use in Ukraine will become highly innovative.
Key words: fodder production, animal husbandry, modern challenge, Russian military intervention in Ukraine.

Introduction

The importance of fodder and fodder production for the livestock industry is objectively decisive. The urgency of improving the efficiency of production and use of feed in Ukraine is increasing in connection with the deterioration of the structure of the population's diet due to the decrease in domestic production of livestock products. Certain modern challenges have a particular impact on the production and use of fodder in Ukraine, among which the aggressive military invasion of Russia is absolutely the most relevant factor, the consequences of which go far beyond the borders of Ukraine creating prerequisites for the onset of famine in certain regions of the world. Researchers in general note the presence of a number of negative trends in fodder production in Ukraine, which caused the deterioration of the situation in the livestock industry even in the pre-war period (Stepasyuk & Titenko, 2016). A number of scientific publications consider the functioning of the feed market, in particular concentrated feed (Voronetska, Kravchuk & Korniychuk, 2016; Hnatyshyn, Prokopyszyn & Pylypenko, 2022; Ibatullin, 2017; Petrychenko, 2015), evaluations of the efficiency of fodder production [Marynych, 2017], trends in the use of fodder, the influence of the level of fodder supply and individual characteristics of the fodder base on the efficiency of livestock production (Lavruk, 2017; Stepasyuk & Titenko, 2016), the primary importance of creating a developed fodder base for efficient animal husbandry (Avercheva, 2021; Stepasyuk & Lopanchuk, 2016). It was established that the fodder base forms 60% of animal productivity (Tzvigun, 2002; Stepasyuk & Titenko, 2016) and that fodder production itself is the main factor in the formation of the competitiveness of animal husbandry (Kalinchyk, Alekseenko & Lysenko, 2013). Fodder in the cost structure of livestock production accounts for almost 70% of production costs (Lavruk, 2017), which is especially important in the current conditions of rising feed prices. L. Dotterweich confirms that feed is often the largest expenditure in raising livestock and poultry and that improving feed efficiency can also have a substantial positive effect on costs, profitability and the

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DOI: 10.2478/plua-2022-0013
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need for more inputs (Dotterweich, 2020). According to J. Byrne, for feedlot producers, feed costs have historically represented between 50–70% of the cost of production and during periods of high corn prices these costs can increase to over 80% (Byrne, 2018). As for the National Program for Genetic Improvement of Feed Efficiency in Beef Cattle (USA), an improvement of 1% in feed efficiency has the same effect as an improvement of 3% in the rate of gain (Taylor *et al.,* 2016).

Fodder production and use of fodder are objectively of primary importance for the development of animal husbandry, especially in the formation of the required level of food security. At the same time, scientists note the presence of tendencies to the deterioration of the state of animal husbandry due to the deterioration of the state of fodder production and use of fodder, which were formed in Ukraine even before the active phase of the war and now are intensifying even more. Therefore, the main task of this article is to present the results of research into the dynamics and state of fodder production and animal feeding in order to identify the most characteristic changes in these phenomena in Ukraine under the conditions of a modern challenge – Russian military aggression – with the purpose of creating the basis for further elaboration of the main ways of their further development.

Materials and Methods

The study covers producers of animal husbandry products throughout the territory of Ukraine, which are enterprises and households. The sources of the necessary information were the data of the State Statistics Service of Ukraine, publications of domestic and foreign scientists dealing with the interrelated problems of fodder production and animal husbandry, as well as the author's own observations.

The methodological basis of the conducted research is the dialectical method of cognition, which allows revealing the effect of economic laws in combination with a systematic approach to the study of the essence and manifestations of economic phenomena and processes in their interconnection and interdependence taking into account the factor of time. In the process of research, the following methods and techniques were used: dialectics of induction and deduction, analysis and synthesis, monographic, economic-statistical, index analysis, constructive calculation, comparison, elimination. The research was conducted using the methods of economic analysis of feed costs per unit of production of livestock products, comparison of processes and phenomena in different forms of farms and regions of the country, as well as the tabular method of presenting information.

Methodical aspects of the study of the problem of production and effective use of fodder are also related to the peculiarities of these processes and phenomena: fodder production belongs to all three spheres of the agro-industrial complex – resource (fodder is the means of production (items of labour) of animal husbandry products); direct production (growing, harvesting and storage of fodder); processing industries (compound feed production) (SSSU – State statistics service of Ukraine 2021, 2022). In addition, the products of fodder production are not consumed directly by humans, but through feeding animals. The feed can be produced by both producers of livestock products and specialised feed producers, as well as industrial combined feed enterprises. These features led to considering the problems of fodder production in an inextricable relationship with the problems of animal husbandry.

Results and Discussion

Calculations carried out on the basis of SSSU data indicate that fodder occupies a fairly significant specific weight in the structure of costs for the production of livestock products, and over the last 5 years, as a whole there has been an increase in this share, especially in the production cost of cattle raising and milk products (Table 1).

Such a trend influenced the formation of negative dynamics of the development of livestock industries as the main consumer of fodder in Ukraine (Table 2).

As can be seen from the data in Table 2, during 1960–2022 there were significant changes in the number of agricultural animals: the number of cattle as a whole decreased by 85%, including cows by 80%, in particular in enterprises by more than 90%. The reduction in the number of pigs was 92% and 90%, respectively; sheep and goats – 90% and 99%. However, the poultry population increased by 1.6 times including in enterprises – by almost 4 times. In households, the rate of decrease in the number of agricultural animals and poultry was much lower, compared to the trends in enterprises. However, from 2019–2022, the trends have somewhat changed. In particular, there is a steady decrease in the poultry population in all categories of producers. During the same period, enterprises showed a steady trend of an increase in the number of pigs. However, the rate of decrease in the number of cattle, including cows, during this last period became even higher than during the entire analysed period. For 2019–2022 in Ukraine, the number of enterprises that maintained a household income decreased by 22% (Table 3).

Among the enterprises that kept cattle, the most numerous was the group in which on average there were 100-499 heads per enterprise (32.3% of

Table 1

The specific weight of feed costs for feeding agricultural animals by species in the frame of costs for the production of livestock products, %

The share of the cost of fodder in:	Year						
	2015	2016	2017	2018	2019	2020	2020 +/- to 2015.
Costs of the production of animal husbandry products	61.1	72.6	40.7	56.2	57.5	61.7	0.6
Production cost: Live weight gain of cattle	56.3	59.1	55.5	58.5	57.7	57.8	1.5
Live weight gain of pigs	69.7	70.1	66.8	66.9	634	65.8	-3.9
Live weight gain of poultry	72.2	70.8	70.2	73.5	69.2	70.2	-2.0
Milk	51.5	54.6	52.0	53.7	526	53.3	1.8
Eggs	75.1	68.3	58.7	63.0	57.6	57.7	-17.4

Source: calculated by author according to SSSU – *Costs of enterprises for the production of agricultural products in 2020.* 2021.

Table 2

The dynamics of agricultural animals in Ukraine as of January 1 (thousand heads)

Agricultural animals	Year								
	1961	1991	2001	2019	2020	2021	2022	2022 as % of	
								1961	2019
All agricultural producers									
Cattle	17632	24623	9424	3333	3092	2874	2644	15.0	79.3
incl. cows	7813	8378	4958	1919	1788	1673	1544	19.8	80.4
Pigs	18194	19427	7652	6025	5727	5876	5609	30.8	93.1
Sheep and goats	10631	8419	1875	1269	1204	1140	1094	10.3	83.9
Poultry, mil. heads	129.6	246.1	123.7	211.6	220.5	200.6	202.2	156.0	95.5
Enterprises									
Cattle	13358	21083	5037	1138	1049	1008	1003	7.5	88.2
incl. cows	4546	6192	1851	468	439	424	425	9.3	90.8
Pigs	13452	14071	2414	3396	3300	3629	3577	26.6	105.3
Sheep and goats	9175	7165	413	182	169	151	168	1.8	92.4
Poultry, mil. heads	301.8	132.9	25.3	118.8	127.8	109.8	113.5	375.9	95.5
Households									
Cattle	4274	3540	4386	2195	2042	1866	1641	38.3	74.8
incl. cows	3267	2187	3107	1452	1350	1249	1119	34.2	77.1
Pigs	4741	5356	5238	2630	2427	2247	2032	42.8	77.3
Sheep and goats	1455	1253	1462	1086	1036	989	926	63.6	85.2
Poultry, mil. heads	99.5	113.1	98.4	92.9	92.7	90.9	88.7	89.2	95.5

Source: calculated according to SSSU – State statistics service of Ukraine 2021, 2022*, p. 11*

Table 3

The dynamics of the number of enterprises keeping livestock in Ukraine

Enterprises with animals, units	Year				
	2019	2020	2021	2022	2022 as % of 2019
Cattle	2296	2045	1911	1792	78.0
incl. cows	2130	1894	1791	1686	79.1
Pigs	1729	1551	1437	1297	75.0
Sheep and goats	688	591	548	513	74.5
Poultry	449	424	385	316	70.3

Source: calculated by author according to SSSU – State statistics service of Ukraine 2021, 2022

enterprises). But only 17.8% of all cattle were kept in this group. And 40% of livestock were kept in a group of enterprises with an average number of more than 1,500 heads (8.4% of enterprises). In 2022, this defined group of enterprises continued to remain the most numerous (31.4%), in which only 15.1% of all livestock were kept, and in enterprises with more than 1,500 livestock, already 42.5% of the total herds were kept. This is evidence of strengthening processes of concentration of the herds of cattle.

As can be seen from Table 3, the number of enterprises keeping cows decreased by almost 21%. The most numerous group of enterprises were the same as in the case of cattle in general (41.2%), the enterprises kept 44.2% of livestock. In 2022, these enterprises already accounted for 42.5% of the total

Table 4

The dynamics of breeding of agricultural animals in Ukraine (in live weight; thousand tonnes)

Kinds of agricultural animals	Year							
	1960	1990	2000	2019	2020	2021	2021 as % of	
							1961	2019
All agricultural holdings								
Agricultural animals	3389.5	6465.0	2278.0	3445.5	3409.3	3329.8	98.2	96.6
incl. by kinds: cattle	1367.0	3248.1	1090.1	556.4	537.5	475.1	34.7	85.4
pigs	1448.0	2097.8	841.8	966.9	966.7	971.2	67.1	100.4
sheep and goats	135.0	99.3	39.0	26.3	24.4	24.6	18.2	93.1
poultry of all kinds	308.0	940.1	264.9	1859.3	1845.7	1825.4	592.7	98.1
Enterprises								
Agricultural animals	1845.2	4206.1	556.4	2331.1	2327.8	2359.3	127.9	101.2
incl. by kinds: cattle	883.3	2498.9	371.0	143.9	136.8	134.7	15.2	93.6
pigs	725.2	1119.0	117.6	546.1	562.1	601.0	82.9	110.0
sheep and goats	97.8	60.2	3.2	2.2	3.0	3.1	3.2	140.9
poultry of all kinds	77.2	509.6	58.7	1637.3	1624.0	1619.0	20 times	98.9
Households								
Agricultural animals	1544.3	2258.9	1721.6	1114.4	1081.5	970.5	62.8	87.1
incl. by kinds: cattle	483.7	749.2	719.1	412.5	400.7	340.4	70.4	82.5
pigs	722.8	978.8	724.2	420.8	404.6	370.2	51.2	88.0
sheep and goats	37.2	39.1	35.8	24.1	21.4	21.5	57.8	89.2
poultry of all kinds	230.8	430.5	206.2	222.0	221.7	206.4	89.4	93.0

Source: calculated by author according to SSSU – State statistics service of Ukraine, 2021, 2022, *p.15*

Table 5

The dynamics of production of milk, eggs, wool and honey in Ukraine by categories of producers

Kinds of products	Year							
	1960	1990	2000	2019	2020	2021	2021 as % of	
							1961	1990
All agricultural holdings								
Milk, thousand tonnes	13995.1	24508.3	12657.9	9663.2	9263.6	8713.9	62.2	90.2
Eggs, mil. pieces	7186.7	16286.7	8808.6	16677.5	16167.2	14071.3	195,8	84.3
Wool, tonnes	27583	29804	3400	1734	1573	1497	5.4	86.3
Honey, tonnes	42202	50858	52439	69937	68028	68558	162.4	98.0
Enterprises								
Milk, thousand tonnes	8214.6	18634.1	3668.7	2728.6	2761.2	2767.7	33.7	101.4
Eggs, mil. pieces	1065.2	10126.0	2977.3	9357.6	8913.5	7012.8	658.3	74.9
Wool, tonnes	24005	26466	1311	200	146	151	0.6	75.5
Honey, tonnes	18131	10837	3564	787	655	685	3.8	87.0
Households								
Milk, thousand tonnes	5780.5	5874.2	8989.2	6934.6	6502.4	5946.2	102.9	85.7
Eggs, mil. pieces	6121.5	6160.7	5831.3	7319.9	7253.7	7058.5	115.3	96.4
Wool, tonnes	3578	3338	2089	1534	1427	1346	37.6	82.4
Honey, tonnes	24071	40021	48875	69150	67373	67873	28.5	98.1

Source: calculated by author according to SSSU – State statistics service of Ukraine, 2021, 2022, *p.21*

number of enterprises keeping cows, but the share of livestock in this group decreased to 42%. However, the share of enterprises with more than 1,000 cattle increased from 3.2% to 4.9% on average, and the share of the number of cows kept in enterprises of this group increased from 23.2% to 28.9%. In general, the strengthening of concentration processes in this group of animals can be overseen as well.

The analysis showed that in the Ukrainian pig industry in 2022, enterprises with a herd of 1,000–4,999 heads had the largest share (17.3% of the total number of pig enterprises against 16.3% in 2019), 15.1% of all herds were kept (against 18.9% in 2019). By the beginning of 2022, 66.5% of the pig population was kept in farms with more than 10,000 pigs (compared to 62% in 2019).

70% of sheep and goats in 2022 were kept on farms with more than 500 heads (against 63.5% in 2019). 81% of the poultry population was also in the largest enterprises with a population of more than 500,000 heads (against 78.5% in 2019).

In almost all branches of animal husbandry in recent years there has been a trend towards the concentration of livestock in large farms. But at the same time, a general trend towards a decrease in the volume of production of livestock products is clearly observed during the studied period (Table 4 and Table 5).

As evidenced by the results of the calculations presented in Table 4 and Table 5, for 1960–2021, there is a clearly visible tendency to decrease production volumes of almost all types of animal husbandry products, with the exception of poultry products, which during this period were concentrated mainly in large enterprises and acquired the level of industrial poultry farming in the form of industrial-type poultry farms (in households according to the specified period, there is a decrease in the volume of these products, excluding eggs), as well as the volume of milk production in households. But over the last ten years, there has been a sharp decrease in the production of livestock products by almost all types of producers.

The decrease in the production of livestock products is not the result of only a decrease in the productivity of animals. For example, milk production per cow increased 1.8 times between 1990 and 2021, including in enterprises – by 2.33 times, but the volume of gross milk production during the same period decreased by 65% (in enterprises – by 85%), because the herd of cows decreased during this period by almost 90% (in enterprises – by 95%) (calculated by author according to SSSU, 2022).

Dynamic changes in the area of animal husbandry are organically connected with the dynamics of feed costs for farm animal feeding (Table 6).

Superimposing trends in the volume of production of livestock products on trends in the volume of spent feed forms a corresponding trend in the dynamics of the level of feed capacity of products, which also reflects the practical level of efficiency of feed use (Table 7).

At the same time, the level of specific feed capacity of a unit of livestock production is quite diversified across regions of the country (Table 8), which is determined by the specifics of each of them.

In recent years, there have been changes in the structure of spent feed both in enterprises and in households. If in 2000, in the structure of fed feed, juicy feed accounted for the largest specific weight – 39.9%, and concentrated feed accounted for only 26.6%, while coarse feed and other feed accounted for 20.5% and 13.2%, respectively, then in 2021 these indicators changed by 7.1%, 83.0%, 8.5% and 1.4%, respectively. There is a sharp (more than 3 times) increase in the share of concentrated feeds that can be explained by the intensive predominant development of "fast" industries – pig breeding and poultry farming, as was established above (Table 2 and Table 3). On the contrary, in households, the share of succulent fodder in the structure of those feeds increased slightly – from 32.9% to 34.9%. The share of concentrated feed increased slightly from 29.4% to 35.1%, which is significantly less than in enterprises. This can be explained by the increase in prices for concentrated feed and their components and by the corresponding

Table 6

The use of fodders of agricultural animals in Ukraine (thousand tonnes of feed units[1])

	Year							
	1990	2000	2015	2019	2020	2021	2021 as % of	
							1990	2019
All agricultural holdings								
Fodders of all kinds	103562 4	42513	30987	29612	27788	26541	25.6	89.6
concentrated	35524	12037	14684	16283	15607	14968	42.1	91.9
incl. mixed fodders	15156	2258	6440	9115	8730	8060	53.1	88.4
coarse	15004	7191	4875	4422	4078	3844	25.6	86.9
rich	35301	15087	8401	6868	6357	5991	17.0	87.3
other kinds	17733	8198	3027	2039	1746	1738	9.8	85.2
Enterprises								
Fodders of all kinds	78209	15951	11857	12862	12188	11804	15.1	91.8
concentrated	27710	4219	8694	10783	10247	9801	35.4	90.9
incl. mixed fodders	14040	996	5920	8735	8360	7690	54.8	88.0
coarse	11948	3265	1085	1022	978	1004	8.4	98.2
rich	26891	6361	1701	868	817	841	3.1	96.9
other kinds	11660	2106	377	189	146	158	1.3	83.6
Households								
Fodders of all kinds	25353	26562	19130	16750	15600	14737	58.1	88.0
concentrated	7814	7818	5990	5500	5360	5167	66.1	93.9
incl. mixed fodders	1116	1262	520	380	370	370	33.1	97.4
coarse	3056	3926	3790	3400	3100	2840	92.9	72.9
rich	8410	8726	6700	6000	5540	5150	61.2	85.8
other kinds	6073	6092	2650	1850	1600	1580	26.0	85.4

Source: calculated by author according to SSSU – State statistics service of Ukraine, 2021, 2022, *p.22*

[1] feed unit – the nutritional value of 1 kg of medium-quality oats that when fed, 150 g of fat, which corresponds to 5920 kJ (1414 kcal) of net energy, is synthesised in the body of an adult ox in addition to the supporting feed. According to this method of evaluation, the nutritional value of any feed is equal to 1 kg of oats in terms of the productive effect of fat deposition.

Table 7

The use of fodders of all kinds per unit of animal production and per conditional head of cattle, feed units [2]

	Year							
	1990	2000	2015	2019	2020	2021	2021 as % of	
							1990	2019
All agricultural holdings								
Per 1 kg of:								
live weight gain of cattle	11.73	8.88	10.03	9.18	8.52	8.29	70.7	90.3
live weight gain of pigs	7.92	9.05	5.99	5.38	5.23	5.18	65.4	96.2
milk production	1.41	1.33	0.96	0.90	0.87	0.96	68.1	106.7
Per conditional head of cattle	3250	2963	3071	3193	3129	3135	96.5	98.2
Enterprises								
Per 1 kg of:								
live weight gain of cattle	13.53	16.73	14.80	13.95	12.84	13.17	97.3	94.4
live weight gain of pigs	9.85	17.90	4.46	4.84	4.79	4.60	46.7	95.0
milk production	1.47	1.63	1.00	0.89	0.84	0.86	58.5	96.6
Per conditional head of cattle	3250	2551	2646	2959	2878	2870	88.3	97.0
Households								
Per 1 kg of:								
live weight gain of cattle	6.28	5.05	8.36	7.60	7.07	6.36	101.2	83.7
live weight gain of pigs	5.78	7.62	8.05	6.08	5.85	6.13	106.0	100.8
milk production	1.23	1.21	0.95	0.91	0.88	1.01	82.1	111.0
Per 1 conditional head of cattle	3139	3287	3430	3361	3361	3389	108.0	100.8

Source: calculated by author according to SSSU – State statistics service of Ukraine, 2021, 2022, *p.23*

Table 8

The extreme values of feed capacity levels of some kinds of animal products in enterprises by regions of Ukraine in 2021, feed units

Use of fodders per kg of:	Extremism	All feeds	Region (oblast)	Incl. concentrated	Region (oblast)
live weight gain of cattle	min	10.45	Zaporizhia, Kherson	3.09	Zakarpattia
	max	16.86	Odessa	7.97	Ternopil
live weight gain of pigs	min	3.16	Ivano-Frankivsk	3.16	Ivano-Frankivsk
	max	15.36	Luhansk	15.06	Luhansk
milk	min	0.68	Ternopil	0.39	Odessa
	max	1.31	Zakarpattia	0.61	Chernivtsi, Ivano-Frankivsk
1 conditional head	min	1240	Zakarpattia	1076	Zakarpattia
	max	4231	Zhytomyr	3569	Chernivtsi

Source: calculated by author according to SSSU – State statistics service of Ukraine, 2021, 2022, *p. 153–156*

2 The conditional population of agricultural animals is defined as the sum of the multiplication results of the number of agricultural animals by age/sex groups and the corresponding coefficients of the conditional population. The coefficients of the conditional stock are: for cows, breeding bulls of the dairy herd, buffaloes, horses, working oxen – 1.0; other cattle (excluding cows and breeding bulls of the dairy herd, buffaloes, working oxen) – 0.6; pigs – 0.3; sheep and goats – 0.1; poultry of all types – 0.02.

changes in the number of animals by species in this category of producers of livestock products (Table 2).

The most important challenge for fodder production in Ukraine today is undoubtedly Russia's war of aggression on the territory of Ukraine, which causes a reduction in the number of animal herds due to the occupation of large territories and the physical destruction of livestock, as well as of agricultural and processing enterprises and households including agricultural ones, and feed areas by bombing and mining them. The effect of this challenge is further strengthened by superimposing its consequences on the consequences of the recently experienced pandemic and is significant not only for Ukraine, but also on a global scale, which is primarily reflected in the increase in prices for the main components of feed rations, especially concentrated feeds due to the sharp rise in grain prices since Ukraine is one of the main suppliers of this product to the world market, and due to Russia's blockade of Ukrainian ports the destruction of grain stocks in storage and the theft of Ukrainian grain its supplies have significantly decreased. As a result, at least in a broad perspective on a global scale, there is evidence of a broken supply chain and a significant shortage of feed grain in the world. The above leads to the formation of another challenge for Ukrainian agriculture as a whole – an almost complete lack of budgetary support due to the involvement of the main funds of the country's budget to solve the most important problem for the country – the defeat of the Russian army and its expulsion from the territory of Ukraine.

The absence of comparable precedents complicates the assessment of the consequences of military actions for the agricultural sector of Ukraine. Since the Second World War, there has not been a case in the world when a country with such a large-scale and agricultural sector of an economy important for the world market as Ukraine was involved in war. According to preliminary estimates, the amount of damage caused to Ukrainian agriculture corresponds to its pre-war scale and has already exceeded $30 billion (Kravchenko, 2022). Today, the territories of the Donetsk and Luhansk regions and the Autonomous Republic of Crimea, most of the territories of the Mykolaiv and Kherson regions, part of the Zaporizhia, Sumy, Kharkiv and Chernihiv regions are temporarily occupied by the Russian invaders, as a result of which they practically fell out of the overall balance of animal husbandry product production. Based on the latest statistical data for the beginning of 2022 (*SSSU*…2022) the loss of cattle in the country as a result of the occupation of significant territory in 2022 will amount to 17.3%, cows – 15%, pigs – 15%, poultry – 13%, due to which the country will practically not receive the corresponding part of livestock products. Accordingly, the production of fodder decreased or was practically eliminated in these territories as a result of the destruction and mining by the Russian occupiers of agricultural areas including fodder, as well as the destruction of agricultural enterprises, migration and kidnapping of workers, destruction of feed stocks and the animals themselves, which, according to the author's calculations, is about 16% of their volume in peacetime.

The occupation regime in the temporarily occupied territories do not allow realisation of the measures to improve the development of fodder production. Such development will become possible only after the end of the war and the liberation of the mentioned territories from the occupiers and the implementation of restoration and reclamation works. According to estimates of the Ukrainian Association of Sappers, currently about 83,000 sq. km are contaminated by various types of land mines. According to FAO, the cost of demining in Croatia was about €1.25 per square km, the cost of destroying one stacked anti-personnel mine is €0.56. Taking this into account, the cost of a demining campaign in Ukraine could cost $10 billion (Kravchenko, 2022).

The conditions of the territories controlled by Ukraine allow for the development of fodder production here in accordance with the needs of animal husbandry based on traditional recommendations for growing fodder crops, forming a fodder base, improving animal feeding rations, increasing the level of their environmental friendliness and reducing the level of energy consumption of feed products. At the same time, under conditions of the war and of the already mentioned consequences related to it for animal husbandry and fodder production, including lack of funds, one should take into account certain temporary phenomena of a local shortage of products, caused either by the destruction of animal husbandry or fodder production, as well as by the senseless destruction by the Russian occupiers of livestock enterprises as well as the animals themselves, as well as violations of logistics.

Analysing the possible short-term and long-term prospects by taking into account the current challenges and their consequences, we can come to the conclusion that during the period of hostilities and in the first post-war years in Ukraine, it is quite logical to expect certain changes in the structure of cultivated areas, including fodder crops, which is also associated with a lack of funds, which will accordingly cause the expansion of areas under relatively less expensive crops and an increase of its share in the structure of sown fodder areas.

Considering the problem of fodder production more broadly, the development of market relations requires the allocation of fodder production into a specialised

branch of high-quality feed production for livestock, which would develop in specialised farms, which is connecting with the increase of the concentration of production, where fodder will become a commodity, as well as other types of agricultural products, and an intermediate product will turn into a final product and into a market good. An example of such a way to solve the problem was the development of the compound feed industry in Ukraine in the early 1990s, when both large agricultural holdings and medium and even small farmers – producers of livestock products – began to produce feed. In agricultural holdings with developed animal husbandry, plants were loaded at 80–90%, and the capacity of companies working on the feed market were at about 60% (Nikishyna, 2014). It should be noted that vertically integrated companies produce 70% of compound feed for poultry, and about 60% for pig farming. The main problem faced by manufacturers of compound feed is the formation of a raw material base. In modern conditions, the most profitable option is the cultivation of fodder, also including cereals independently. However, only certain producers have this option. Given the difficulties in purchasing raw materials or the high prices for it, the most common scheme is payment for the service of processing raw materials into feed by part of the same raw materials (Ibatullin, 2017). Therefore, it is possible and expedient to talk about the development of inter-farm cooperation in fodder production.

Conclusions

1. The importance of fodder production as an industry that is the basis of animal husbandry is determined by its influence on solving the significant part of the problem of food security. Because of this, it is appropriate to consider the problems of the development of fodder production through the prism of the problems of the development of animal husbandry, which is especially relevant in the context of the military aggression of the Russian Federation in Ukraine.

2. The specificity of the challenges for fodder production caused by Russian aggression in Ukraine is that this industry, like all agriculture, like no other industry, is connected with its territorial allocation. Therefore it suffers to a special extent from military actions taking place in the country, a fairly significant part of which is currently under temporary occupation or in the zone of active hostilities.

3. The effect of the mentioned challenge in Ukraine is superimposed on the revealed trends, which were formed up to beginning of 2022, and relate to the decrease in the number of animals with the simultaneous concentration of their numbers mainly in large enterprises, to the decrease in the amount of fed feed and violation of the structure of fodder rations.

4. Based on the situation at the beginning of 2022, the occupation of significant territories of Ukraine by the Russian invaders caused a significant decrease in the production of livestock products due to a decrease in the number of cattle by 17%, including cows by 15%; pigs by 15%, poultry by 13%. Accordingly, consumption of fodder at the expense of these regions decreased by 16%.

5. Russian aggression in Ukraine has negative consequences for animal husbandry and fodder production worldwide as well, as the reduction of areas for the production of Ukrainian fodder, the destruction of agricultural enterprises and livestock, the theft of grain and the destruction of terminals for its storage, the disruption of logistics and the blocking of Ukrainian ports are powerfully reflected on the aggravation of global problems of food shortages and food security. The shortage of raw materials for the production of fodder in the countries of the world (grain, for the production of concentrated fodder) as a result of forced restrictions on Ukrainian exports causes a rapid increase in their prices with all the corresponding consequences.

6. Until the end of the war, the main efforts to improve fodder production in Ukraine should be objectively related to the maximum optimisation of the structure of fodder rations, which, based on real opportunities and available resources, will refer to the orientation to give preference to feed that is less energy-intensive in production, and, accordingly, to such crops which are especially relevant in connection with the limitations of state support for the agriculture during the war and in the first post-war years. Revival of livestock industries in the territories liberated from the occupiers will take place much more slowly than crop production due to the specificity of livestock farming as an industry of a natural and technological nature and the need for at least both the restoration of the herd and the reconstruction of animal buildings destroyed by Russian aggressors.

7. Every challenge creates new opportunities, therefore the post-war development of fodder production in Ukraine will have every reason to become highly innovative. The use of grain and products of its processing for the production of livestock products due to complications with its export due to Russia blocking Ukrainian seaports can become an important factor in solving the problem of concentrated feed for Ukrainian livestock. This will contribute to solving the problem of grain producers in the realization of the harvest of 2021 and 2022 and can also have a positive effect on the increase in the volume of exports of livestock products.

8. In order to improve the system of production and use of fodder, especially in households, it is expedient to create a kind of cooperative in which all its members, without harming their right to private ownership on land and means of production, jointly use part of it, simultaneously achieve an equal benefit for this type of cooperation. An equally effective way to improve the condition of fodder production and increase the quality of fodder can be the development of farms specialised in this field and the creation of a fodder market.

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