

CHAPTER 4

CATTLE BREEDING IN UKRAINE AS ONE OF THE INDICATORS OF FOOD SECURITY

ABSTRACT

The section of the monograph analyzes statistical data on the production of agro-industrial raw materials for the period from 1990 to 2023. It has been established that during this period the ratio between the produced products of crop production and livestock production has changed significantly. The share of livestock production does not exceed 22.7 %. Animal husbandry in Ukraine, as a separate industry, is not a priority in terms of food security, and this negatively affects the consumption of animal protein by Ukrainians.

In 1990, the consumption of meat and meat products was 82.4 kg per person, which corresponded to 103 % of the recommended supply rate. Out of the total share of meat and meat products consumed in 1990, beef was predominant in the diet – 46.48 %, pork – 36.89 %, and poultry meat – 16.63 %. Over the next ten years, meat consumption decreased to only 41.1 % of the norm. From 2000 to 2020, the level of consumption of meat and meat products varied from 63.75 % to 69.25 %, the share of beef in the total mass of meat consumed decreased to 10.2 %. Beef consumption data correlates with the dynamics of changes in the cattle population.

The state of food security in Ukraine has been analyzed according to the overall value of the Global Food Security Index. According to these data, the situation with food security in the country during the war significantly worsened compared to previous years, but is not critical, in 2022, the food standards in Ukraine were provided at 70.2, the quality of consumed protein – 81.3. Unfortunately, the share of beef consumption as a source of complete protein and certain vitamins for Ukrainians is insignificant.

The reasons for the decrease in the number of livestock are analyzed. The factors that contributed to the decrease in the share of consumption of this type of meat by the population of the state have been considered. It is noted that the state of war had a negative impact on food security in Ukraine, and subsequently on the health of the nation.

KEYWORDS

Cattle breeding, food safety, beef, quality of consumed protein.

Starting from February 24, 2022, after the beginning of the full-scale invasion of the Russian Federation troops on the territory of Ukraine, hundreds of thousands of Ukrainians found themselves on the verge of starvation. The worst situation is for citizens who live in the territories where active hostilities are taking place, or who remained in cities and villages occupied by Russian troops. Under these conditions, the state cannot provide them with a sufficient amount of food, accordingly, fulfill the Constitutional obligations, therefore, it cannot guarantee food security [1].

There is still no unambiguous methodology and single indicators for assessing food security. FAO assesses the food security of countries according to internationally established criteria. However, until now, there is no consensus among scientists regarding the structure, indicators (indicators) of food security.

A team of experts from 27 academic institutions, non-governmental organizations and UN agencies from almost all continents [2] processed FAO regulatory documents, analyzed scientific articles, held more than two dozen meetings and proposed indicators for determining the objective situation of food security in the world (**Table 4.1**). To assess food security, they proposed a framework that assesses five thematic areas and consists of certain indicators. All indicators are divided into domains: diets, nutrition and health; environment and climate; means of livelihood: management: stability and sustainability (a generalized characteristic of the structure is given in **Table 4.1**). This structure, according to its developers, will allow better management of food systems within the framework of the transformation process. The authors note that the lack of food security contributes to the deterioration of the quality of the diet. After all, food security exists when "all people at any time have physical, economic and social access to sufficient, safe and nutritious food that meets their nutritional needs and nutritional preferences for an active and healthy life" [3].

● **Table 4.1** Thematic areas and domains of indicators

Thematic areas	Domains of indicators	Characteristics of indicators
1	2	3
Diets, nutrition and health	Diet quality	A healthy diet is essential to nutrition and health. Suboptimal diets are a direct cause of malnutrition in all its forms, including malnutrition and diet-related noncommunicable diseases (e.g., diabetes, cardiovascular disease, hypertension, stroke)
	Food safety	Food safety is a necessary condition for a healthy diet, providing free access to products. When food is insecure, diet quality also deteriorates Food security exists when "all people at all times have physical, economic and social access to sufficient, safe and nutritious food that meets their nutritional needs and nutritional preferences for an active and healthy life" [3]
	Food environments	The food environment covers the availability, adequacy and properties of food (including safety, quality, convenience and sustainability), as well as information about food and suppliers
	Policies affecting the food environment	Policies may positively or negatively impact food availability, access to products, product properties and/or product information, diets and nutrition in general

● Continuation of Table 4.1

1	2	3
Environment and climate	Land use	Agriculture uses approximately 1.5 billion hectares of arable land and 3.5 billion hectares of pasture. Monitoring changes in land use is important. Land use is at the center of many ecological processes: deforestation, conversion of land to arable land will reduce greenhouse gas emissions, improve the water cycle and protect biodiversity
	Emissions of greenhouse gases	To keep global temperature rise below 1.5 °C, it is important to reduce GHG emissions from the food system, to ensure zero emissions in rural areas. Food systems account for 21–37 % of total greenhouse gas emissions, two-thirds of which come from crop and livestock production, land use and land-use change, and 63–79 % from processing, transportation and packaging
	Use of water	Fresh water scarcity limits food systems and human well-being. Approximately 2.8 billion people have problems with water resources. Food production uses up to 70–80 % of global freshwater consumption – surface and groundwater, which can lead to water scarcity [4]
	Pollution	Environmental pollution from food systems can be classified into four main categories: 1. Loss of nutrients during the production of food products and their entry into water bodies, air and/or soil (for example, nitrogen, phosphorus), which leads to soil degradation. 2. The use of new substances, in particular biocides (for example, pesticides, antibiotics), which are used in agricultural production systems. 3. Air pollution with solid particles with a diameter of less than 2.5 micrometers from organic systems (for example, residues during the combustion of organic fuel – carbon compounds, air pollution caused, to a large extent, by the introduction of manure and nitrogen fertilizers – sulfate and nitrate compounds [5]. 4. Solid waste that appears in the food chain of the creation of the product (for example, the use of non-degradable plastic, the appearance of excess animal waste that is not used as fertilizer, food waste that is sent to landfills)
Livelihoods: poverty and equity	The integrity of the biosphere	The integrity of the biosphere is an indicator of the quantity and quality of natural systems and resources necessary to support nature's contribution to people's lives and stop the extinction of flora and fauna species. In food production systems, nature's ability to support food production is determined. The integrity of the biosphere is determined by indicators: 1. Indicators of the amount and distribution of semi-natural habitats embedded in agriculture track the ability of biodiversity to support food production, including through pollination of crops, regulation of pests and diseases, and support of diverse grassland ecosystems. 2. Soil condition indicators determine soil organic matter, measure the productivity of agricultural soils
	Poverty and income	Livelihoods derived from food systems are often insecure and insufficient to support quality living standards. A disproportionate share of the world's poorest people are employed in agriculture. Wages in food systems are usually lower than the minimum wage set for other sectors
	Employment	Monitoring the quantity and quality of employment is essential to improving the equity and livelihoods of workers involved in food systems. Monitoring should cover the scale of the main employment in agriculture, food production, as well as food production in the hospitality sector. Labor productivity, which is closely related to income and wages, can reflect the quality of employment
	Social Protection	Universal social protection, i.e. guaranteed minimum access to health care, pensions, income or products for vulnerable or low-income citizens regardless of their employment status. Social protection is particularly important to support the livelihoods of many food workers
	Rights	Ensuring human rights for all is key to transforming food systems from their current state to a just one. A fundamental right in food systems is the right to food and water

● Continuation of Table 4.1

1	2	3
Management	Shared vision	The shared vision addresses inclusive processes and aims to prioritize and provide guidance on desired outcomes across all thematic areas of food system transformation. Shared vision can be measured in the activities of multilateral platforms that governments create at regular intervals. Relevant stakeholders are involved in the work of the platforms. A common vision of food systems in many places on the planet is formed during dialogues between countries and independent summits (part of the UNFSS process also became a catalyst for development [6])
	Strategic planning and policy	Strategic planning and national policies should underpin a shared vision, including appropriate legal frameworks and multi-sectoral policy documents that address food systems holistically and negotiate trade-offs
	Effective implementation	Effective implementation requires alignment of strategic planning and policy with state, private sector and civil society capabilities supported by adequate human and financial resources
	Responsibility	Accountability mechanisms use monitoring and evaluation to find out whether policies are working or not, and reward (or sanction) public and private sector actors who meet (or fail to meet) commitments
Durability and stability	Impact of blows (shocks)	Assessing food system resilience requires first assessing and documenting adverse events that affect those systems. Adverse events include natural disasters, local or regional economic crises, political unrest, pandemics, pest outbreaks and protracted crises, military operations. Internationally available country-level data capture the nature, frequency, and intensity of major shocks and determine an indicator appropriate for the resilience of food systems
	Abilities for resistance	Resilience includes characteristics such as redundancy, variety, flexibility, connectivity, predictability, self-efficacy, or access to insurance or formal credit. Potential indicators of resilience include the adaptive capacity of food system participants (e.g. connectivity, social capital), social cohesion, or indicators of value chain flexibility, such as the new FAO Food Sourcing Flexibility Index, which measures diversity in different pathways to source a unit of food
	Agrobiodiversity	Agrobiodiversity plays an important role in creating the sustainability of crop, livestock, forest, fishery and aquaculture production systems. Interactions between genetic, species and ecosystem diversity at different spatial scales maintain stability in the face of increasing shocks and stresses, enable adaptation and support recovery from disturbances
	Stability of food security	One of the most important aspects of food system resilience is the ability to maintain people's food security in the face of possible shocks. Monitoring sustainability indicators (e.g. food availability, access and usability) over time is an important element of food system sustainability. The main emphasis when monitoring indicators is on their variability over time, and not on absolute levels in each report
	Sustainability index of the food system	Two complementary indices are proposed to capture different elements and relationships of sustainable food systems. The first combines all indicators in the previous thematic areas into a comprehensive, one-dimensional composite index. The second is an economical set of emblematic indicators (covering all thematic areas). Both indices can be based on well-established methodologies already used in international initiatives (e.g. Human Development Index (HDI), Global Hunger Index)

Source: [2]

Based on the analysis of the indicators of the food system proposed by scientists [2], it should be noted that food security requires a multifaceted comprehensive assessment approach and is not limited to available food products, is a necessary condition for healthy nutrition and provides access to food resources.

A new methodology based on the concept of "sustainable nutrition security" (SFS) is proposed for assessing food security [7]. This methodology allows to take into account issues of sustainability, economic, ecological and social consequences of meeting the growing demand for food, drinking water shortage and climate change. The authors of the methodology propose the definition of seven indicators, each of which is based on a combination of many indicators, for use in the characterization of sustainable nutrition results of food systems: adequacy of food nutrients; ecosystem stability; availability and sufficiency of food; socio-cultural well-being; food safety; stability; and reducing waste and losses. Dietary nutrient adequacy includes energy value of non-major foods, Shannon diversity, diversity of modified functional traits, nutrient density score, and proportion of population with adequate nutrients (the healthy eating index is specific to the United States as it was developed to measure compliance with the Dietary Guidelines of this countries [8].

The authors, for a better understanding of the impact of food systems on the environment, introduced the concept of ecosystem stability, which is broadly defined as land, water and air, as well as biological ecosystems. In addition, a food system cannot be considered sustainable if its resource base is not stable and does not have a neutral or positive impact on important ecosystem services needed outside of food systems [7].

According to the authors, the identified indicators can be used to set meaningful goals, track progress, assess the potential impact of interventions in the food system, and contribute to improving human nutrition. The characteristics of indicators, which, according to the authors, determine the sustainability of food security, are summarized in **Table 4.2**.

The analysis of **Tables 4.1, 4.2** allows to note a significant difference between the number of indicators that require control to ensure food safety. **Table 4.2** defines indicators that allow analyzing not only the provision of food to the country's population, but also social, climatic and environmental factors. According to **Table 4.2**, it is possible to identify critical situations, predict the emergence of risks and take early corrective measures at the UN level.

● **Table 4.2** SNS indicators and their characteristics

SNS indicators	Detailing of the indicator	Characteristics of the indicator
1	2	3
Adequacy of food nutrients	Energy of non-basic nutrition	This indicator is defined as the percentage of kilocalories available to a representative consumer from non-basic food products. Staple foods vary significantly between countries and are defined as foods that are consumed regularly and in such quantities that they account for a significant proportion of dietary energy intake. The approach is to define staple foods as all grains, roots, tubers, etc., so this figure is simply the percentage of available dietary energy (kilocalories) that does not come from these sources

● Continuation of Table 4.2

1	2	3
	Shannon Diversity	<p>The Shannon Diversity formula is used to calculate certain indicators in the numerical range from 1 to 100.</p> <p>The general Shannon diversity formula:</p> $\text{Shannon Diversity} = -\sum s_i \ln(s_i),$ <p>where s_i is the share (by weight) of the i-th food product in the food supply (it is necessary to take into account that if the consumption of the product drops to zero, then the contribution for this product becomes zero. This requires the application of L'Hospital's rule, since due to the uncertain nature of $\ln(0)$). When all products are available in equal quantities, the index is $\ln(N)$, where N is the total number of products considered. The more uneven the distribution, the smaller the value of the indicator. $\ln(N)$ is normalized to a scale of 0–100 by applying a constant multiplicative factor: $100/\ln(N)$</p>
	Modified functional attribute diversity	<p>The modified functional trait diversity (MFAD) index can be used to track the Modified functional attribute diversity. MFAD – an additional measure of food supply diversity [9] gives a complete mathematical derivation that describes the diversity of functional traits as the sum of pairwise functional differences between all products of the food supply. MFAD is normalized by a constant multiplicative factor such that a value of 100 corresponds to the maximum diversity in the data set</p>
	Assessment of nutrient density	<p>The nutrient density of foods is usually measured as the ratio of nutrients to calories. Foods that contain more nutrients than calories are classified as nutrient dense. Nutrient balance quantifies it from different foods in a combination meal. High nutrient balance scores, scaled to a maximum value of 100, indicate that a particular food combination provided both nutrient adequacy and nutrient balance [10]</p>
	Proportion of the population with sufficient nutrients	<p>Diet quality indicators depend on statistical information collected for different categories of people. A method for estimating the prevalence of adequate nutrient intake in a population [11] is defined as the percentage of the population consuming more than the estimated average requirement. The population distribution of intake is constructed for each nutrient from the mean value using the coefficient of variation. The population distribution of intake can be defined as a simple average of all population shares in such nutrients</p>
Eco-system stability	Ecosystem status	<p>Ecosystem status was quantified by the Yale University Center for Environmental Law and Policy and Columbia University Center for the International Earth Sciences Information Network using the Environmental Performance Index (EPI) [12]. The EPI assesses how well countries are addressing priority environmental issues in two broad policy areas: protecting human health from the harmful effects of the environment and protecting ecosystems. Ecosystem status was calculated as the simple mean of the following indicators: water resources, agriculture, forests, fisheries and biodiversity/habitat</p>
	Emissions of greenhouse gases (GHG) per capita	<p>Food system activities include land transformation, food production, storage, transportation, processing, retailing, preparation and post-consumer waste – the latter of which results in significant CH_4 (methane) emissions. The largest sources of emissions in agriculture are direct land-use change (LDU), fertilizer production, N_2O emissions from fertilizer-based soil, and methane (rice and ruminants). National greenhouse gas inventories and emission reduction targets are monitored through the United Nations Framework Convention on Climate Change (UNFCCC). Accordingly, the GHG indicator is defined as the annual greenhouse gas emissions of the food system per capita ($\text{kg CO}_2\text{e}$ per person per year), converted on a scale of 0–100 using the equation (note). It includes methane emissions associated with food waste</p>

● Continuation of Table 4.2

1	2	3
	Clean intake of fresh water per capita	Much of the water use in food systems is related to crop irrigation, but there are other (generally smaller) uses of water in food value chains [13]. LCA modeling allows the calculation of water use associated with food systems [14]. The proposed indicator is defined as the annual net withdrawal of fresh water per capita by the food system (m^3 of fresh water per person per year), regardless of where this withdrawal is made. "Net withdrawal" is water consumption (that is, water used by food systems and no longer available to other users). It is converted to a 0–100 scale using the equation*
	Non-renewable energy consumption per capita	The fuel is used for the production of fertilizers, increasing the mechanization of agriculture and improving the food industry, and for transportation. The metric is defined as the annual non-renewable energy consumption per capita by the food system (MJ per person per year) and is converted to a scale of 0–100 using the equation*
	Land use per capita	FAO and other organizations monitor land use on the planet to meet growing demand without the need to bring new land into production
Availability and food availability	Availability of food	This indicator is defined as food system land use per capita (m^2 per person per year), regardless of where the land use occurs and what type it is (e.g., grazing pastures are included). It is converted to a 0–100 scale using the equation*. A generally accepted measure of food availability, which is already widely used among economists, is the share of average annual income that goes to food [15]. As incomes rise, the share spent on food decreases. Another set of metrics that have been used are calories and nutrients per unit cost [16]. Definition of this indicator: the share (in percent) of household spending on goods other than food. The advantage of such a definition is that it can be easily calculated for various future socio-economic and climate scenarios using an integrated model such as IMPACT [17]
	GFSI food availability	The GFSI Food Availability indicator measures factors that affect food supply and the ease of physical access to food. It examines how structural aspects determine a country's ability to produce and distribute food, and explores elements that may create bottlenecks or risks to sustainable availability. The GFSI examines several aspects of food availability to determine the ease of access in each country and is calculated by the Economist Intelligence Unit (EIU) using various data sources, including FAO, OECD, World Bank and World Food. The GFSI Food Availability score is calculated on a scale of 0–100, so it is used directly as an indicator
	Poverty index	The Global Food Safety Initiative (GFSI) uses a factor of the proportion of each country's population living below the poverty line, which is defined as 1.90 USD per day. According to GFSI, the authors chose [7] a threshold value of 1.90 USD for the day and converted the indicator into the desired format, simply expressing it as a percentage exceeding the threshold value of 1.90 USD per day
	Income equality	The most widely used measure of income inequality is the Gini coefficient, G , which has a value of 0 in the case of complete income equality and one (1 or 100) in the case of all income received by one person in a country [7]. Thus, the indicator is converted to the desired format using $100-G$, higher values indicating higher income equality

● Continuation of Table 4.2

1	2	3
Socio-cultural well-being	Gender equality	The Global Gender Gap Index (GGGI) was developed by the World Economic Forum as a basis for assessing the magnitude of gender inequality [18], and was chosen as the basis for this indicator. GGGI assessed 140 countries using a methodology that focuses on identifying gender gaps in access to resources. This makes it possible to compare countries regardless of their level of economic development. The four indicators used to determine the overall GGGI are economic participation and opportunity, education, health and survival rates, and political empowerment. The GGGI is scored by the World Economic Forum on a scale of 0–1 and is simply multiplied by 100 to use as an indicator
	Scales of child labor	The child labor indicator is calculated as the percentage of children aged 5–17 (defined by the ILO International Labor Organization) in a country who are employed in the food system. As with environmental scores, this is converted to a score of 0–100 using the equation*
	Respect for community rights	The World Resources Institute (WRI) quantified the degree of community rights in relations with corporate buyers by determining the Environmental Democracy Index (EDI) [19]. The index is based on the presence of adequate legal protection of community rights in the form of national laws. EDI [20] is defined by scale values from 0 to 2.39, so multiplying by a factor of 40 results in results on the desired scale of 0–100
	Animal health and welfare	To determine the health and welfare of animals in agricultural settings, the Animal Protection Index (API) was introduced, which ranks countries according to their commitment to animal protection [21], and can be used to quantify this indicator. The API rating scheme assigns letter grades to countries in the ranking, ranging from a high 'A' to a low 'G'. This converts to a numerical scale of 0–100 as follows: A=95, B=85, C=75, D=65, E=55, F=45, G=35
Stability	ND-GAIN country index	The University of Notre Dame Global Adaptation Index (ND-GAIN Country Index) was introduced to summarize a country's vulnerability to climate change and other global challenges, combined with its readiness to improve resilience for adaptation. The ND-GAIN assessment consists of a vulnerability assessment and a readiness assessment. Vulnerability measures a country's vulnerability, sensitivity and ability to adapt to the negative effects of climate change. Readiness measures a country's ability to attract investments and transform them into adaptation actions, taking into account economic, governance and social readiness. The authors [7] note that not all indicators are the basis of ND-GAIN, that it is advisable to include additional factors related to drought and coastal flood preparedness. ND-GAIN represents the total value indicated on a scale of 0–100, so it is directly used as an indicator
	Variety of food production	The diversity of food production at the national level is recommended to be calculated using Shannon's formula. As s_i , it is recommended to use shares of agricultural production [9], based on the weight of each food product produced in the country. A constant multiplicative factor is used to scale the indicator to a scale of 0–100: $100/\ln(N)$, where N is again the total number of food products considered
Food safety	Consequences of foodborne diseases	WHO has developed models to assess the consequences of foodborne diseases where current data are not available [22]. The GBFI (Global Burden of Foodborne Illnesses) data are the best estimates of foodborne illnesses and are used to estimate the Global Burden of Foodborne Illnesses (based on regional significance). GBFIs are converted to a scale of 0–100 using the equation*

● Continuation of Table 4.2

1	2	3
	GFSI food safety	Each year, the Global Food Security Index (GFSI) [23] provides an additional indicator of food security. It has three components: 1) whether the country has a regulatory authority to ensure food safety; 2) percentage of population with access to potable water; 3) the presence of a formal food sector. The presence of a regulatory body to ensure food safety is a qualitative indicator of 0–1 (0=no, 1=yes) assessed by EIU analysts. The percentage of the population with access to drinking water is a quantitative estimate based on World Bank data that estimates the percentage of the population with access to drinking water from drinking water sources, domestic connections, public drains, boreholes, protected dug wells, protected springs and rain water. The presence of the formal food sector is qualitatively assessed by EIU analysts on a scale of 0–2 (0=minimal presence; 1=moderate presence; 2=extensive presence). The overall GFSI food safety score is calculated from these three indicators and reported on a scale (0–100) that can be used directly as an indicator
Reduction of waste and losses	–	Calculating an indicator to quantify waste and loss is simply to express as a percentage the part of food produced that is not lost (before consumption) and not wasted (after production)

Source: [7]

Note: the equation for obtaining a score of 0–100: Metric Indicators = $100 \cdot \exp \ln(0.5) \cdot (F_i / F_{50})$,

where F_i is the factor (e.g. GHG emissions or land use) for the i -th unit (e.g. country) considered;

F_{50} is the median (50th percentile) of the full range of values for this factor for all study units measured during a specific base year.

Using this equation has the desired characteristics, giving a score of 100 for the hypothetical case of no emissions/use, a score of 50 for the median performance, asymptotically approaching a score of 0 with increasing emissions/use, and resulting in a normal distribution score if the underlying data is log-normal distribution [7]

Comparison of key indicators that determine the stability of food security in the world and Ukraine differ significantly. In Ukrainian legislation, this issue is narrowly limited only to access to food products. Although, in the conditions of war, even this indicator cannot always be guaranteed by the state.

Even before the full-scale war in Ukraine, as of 2021, summarized world reports indicated that 9.9 % of the world's population (768 million people) do not have access to enough calories to meet their needs; about 2.37 billion people are moderately or severely food insecure; and 3 billion people cannot afford a healthy diet [24]. If to compare the years 2021 and 2022, then in general, acute food insecurity in the world has decreased from 11.7 % in 2021 to 11.3 % in 2022, which indicates a reduction of 27 million people who are hungry. However, the number of people living in conditions of lack of food security is 900 million, which is 180 million more than in 2019. According to forecasts [25], up to 600 million people will be chronically hungry in 2030. A positive trend in reducing the number of hungry people is predicted for Asia, no improvement is predicted

for the countries of Latin America and the Caribbean, and a significant increase in hunger is predicted in Africa by 2030.

4.1 LITERATURE REVIEW AND PROBLEM STATEMENT

In order to implement the National Security Strategy of Ukraine, approved by the Decree of the President of Ukraine dated September 14, 2020 No. 392/2020 and the Sustainable Development Goals of Ukraine for the period until 2030, approved by the Decree of the President of Ukraine dated September 30, 2019 No. 722/2019 [1], according by order of the Cabinet of Ministers of Ukraine in 2020, the project "Food security strategies for the period until 2030" was developed [26]. The project has a definition – "food security is the security of a person, which consists in the fact that a person at any time has physical and economic access to a sufficient amount of safe food products that meet its nutritional needs for an active and healthy lifestyle". Therefore, food security must be ensured by the state for all sections of the population, in particular, "risk groups – the most vulnerable sections of the population, persons whose incomes belong to the lower quintile group".

The level of ensuring food security is determined by "food security indicators – quantitative and qualitative characteristics of the state, dynamics and prospects of the physical and economic availability of food products for all social and demographic groups of the population, the level and structure of their consumption, the quality and safety of food, the sustainability and degree of independence of the domestic food market" and "food safety criteria – the limit (threshold) value of the indicator, which is the limit beyond which a food threat occurs". That is, food security is a complex system of measures and actions on the part of the state, which guarantees the satisfaction of the needs for the necessary food products to ensure the full functioning of the human body. Important in the general list are products of animal origin that provide a person with complete protein, which includes beef and its products.

Scientists in the field of economics and the agro-industrial sector paid attention to the study of food security: V. Hrynyshyn, Y. Batyr, Z. Zhyvko, N. Danylenko, M. Stadnyk, S. Oliferuk, M. Fleichuk, A. Mostova, E. Starychenko, O. Varaksina, V. Adamyk, L. Chernobai, V. Shyshlyuk and others. Common to all scientific works is an emphasis on the quantitative factor, the regulation of relations in the agro-industrial sphere [27]. However, insufficient attention is paid to an integrated approach to food security issues. For example, the issues of ensuring the quality and safety of food products by processing enterprises are resolved according to the requirements of regulatory and technical documentation, and attention is not focused on the problem of food and biological value of products, although it should be a priority.

It is possible to ensure a balanced diet at the expense of products from vegetable and animal raw materials. Vegetable raw materials are, to a large extent, a source of carbohydrates, fats of different chemical composition and structure, vitamins, micro- and macroelements. Raw materials

of animal origin: beef, pork, chicken, dairy products, eggs, etc., mainly provide the human body with proteins and fats, in particular, essential amino acids, vitamin-like fatty acids. The presence of all the necessary nutrients in the daily diet determines the completeness of nutrition.

Fish provides more than 4.5 billion people with at least 15 % of their average per capita intake of animal protein. The unique nutritional properties of fish also make it essential to the health of billions of consumers in both developed and developing countries.

In 2012, the Committee on World Food Security (CFS) took an important step in the right direction by requesting the High-Level Panel of Experts (HLPE) to conduct an in-depth study on the role of sustainable fisheries and aquaculture for the FSN. The 2014 HLPE report [28] presents the strongest argument for including fish in the food system. According to recent estimates, for example, in 2009, fish accounted for 17 % of animal protein consumption by the global population and 6.5 % of all protein consumed [29]. According to estimates [30], for example, fisheries and aquaculture provide 3.0 billion people with almost 20 % medieval per capita consumption of animal protein, and another 1.3 billion people with about 15 % per capita consumption. It is noted that significant consumption of fish and seafood is observed in island countries.

Analysis of the possibilities of food supply with products containing complete protein of animal origin showed significant problems with solving this issue on a global scale. This issue is becoming an even bigger problem in Ukraine. Therefore, providing the population of Ukraine with the necessary products that are full-fledged for human life and health should be a priority in the state policy.

4.2 THE AIM AND OBJECTIVES OF RESEARCH

Therefore, in order to implement the state policy in the field of food security, it is necessary to pay attention to providing the population of Ukraine with food products with high nutritional and biological value, which includes beef and its products.

In accordance with the stated problem, the purpose of the article is to analyze the state of cattle breeding in Ukraine over the past 30 years and determine the possible reasons that affect the degree of providing the population with meat and meat products, in particular, beef and its products, in the context of the country's food security. In accordance with the goal, the following tasks were formulated:

- to determine the trend of changes in the state of cattle breeding in Ukraine over the past 30 years and its impact on the consumption of beef by citizens of Ukraine;
- to determine the impact of the worsening situation in cattle breeding on the quality of nutrition of Ukrainians according to the Global Food Security Index, in particular, food security;
- to establish the reasons that affect the decrease in the share of beef consumption by Ukrainians.

To realize the aim, the article uses the following research methods: general scientific methods of analysis, comparison, systematization, and generalization.

4.3 RESEARCH RESULTS

The range of products that provide optimal nutrition for different segments of the population, taking into account physiological needs, activity, and age, is large. There are a number of basic food products, the main types of raw materials for which are plant and animal products. A study of the dynamics of changes in the state of Ukraine's economy, conducted by H. Morozova [31], made it possible to establish that the specific weight of plant and animal products in gross agricultural products has changed over the past 30 years. According to the author's analysis, in 1990 the specific weight of crop production was 51.5 % (3 % more than livestock production), in 2000 it was 61.5 % (23 % more than livestock production), and already in 2011 it was 69.5 %, i.e. the production of plant products is 2.3 times higher than the production of livestock products. In 2020 [32], the ratio of the specific weight of plant and animal husbandry in the total volume of agricultural products in Ukraine was already 77.3 and 22.7 %, i.e., the production of plant products for Ukraine has become the dominant direction in agriculture. The gradual decrease in the production of livestock products contributed to the increase in prices for it, respectively, to a decrease in its share in the general diet of the average Ukrainian. This conclusion is confirmed by the data in **Table 4.3**.

Animal husbandry in Ukraine, as a separate industry, has ceased to be a priority in food security. Such a redistribution in the production of agricultural products is reflected in the balanced nutrition of the population.

In recent years, the share of vegetarians has been increasing. However, the vast majority of the population of Ukraine traditionally satisfies the physiological need for protein with products of animal origin. A decrease in the proportion of complete protein in the diet can lead to a deterioration in the health of the population, life expectancy, etc.

According to the data of the Statistical Collections of Ukraine in figures [33] for the period from 2000 to 2021, there was a tendency to increase the mass of products of animal origin in the diet of the population of Ukraine, with some changes (**Table 4.3**). Minimum consumption values of meat, fish, and eggs, according to the statistical collection, in 2000. In the following years, there is growth with minor changes. The consumption of milk and dairy products has changed little over twenty years. However, when compared with the recommended norms, the consumption of protein products does not meet the recommendations. In 2000, meat consumption was 41 % of the norm, fish – 42 %, milk – 52.4 %, eggs – 57.2 % (**Fig. 4.1**). These shares testify to the negative impact of the economic situation in the country, on nutrition, and, accordingly, the degree of satisfaction with the protein component of the diet of the average Ukrainian.

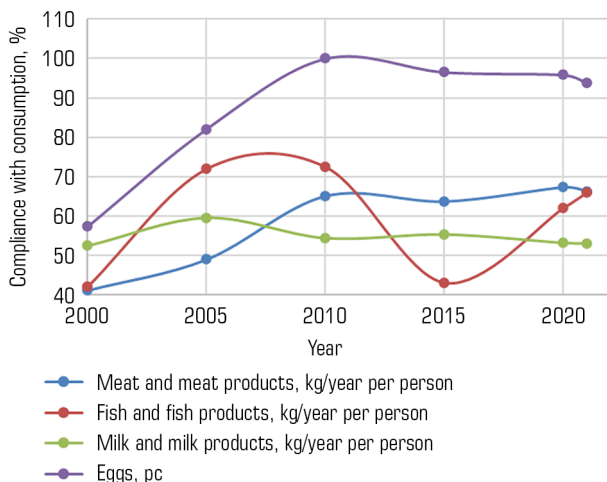
The next 10 years, during 2000–2010, the growth in the level of welfare of the population, the development of the agro-industrial sector, contributed to the increase in the degree of balance of the diet with a protein component. In 2010, the share of meat consumption was 65 % of the norm, fish – 72.5 %, milk – 54.3 %, eggs – 100.0 %.

The economic situation that developed in Ukraine after 2014 had a negative impact on the purchasing power of the population, the consumption of animal products partially decreased (Table 4.3, Fig. 4.1). In the period from 2015 to 2020, there is a positive trend in the growth of consumption of meat and meat products. During these five years, consumption of meat and meat products increased by 3.6 %, fish – by 19.0 %. At the same time, milk consumption varied from 2.0 to 3.1 %, eggs – from 2.0 to 5.1 % (Table 4.3).

● **Table 4.3** Consumption of food products from raw materials of animal origin

The name of the food category	Consumption rate, kg/year [34]	Year									
		2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Meat, meat products	80	32.8	39.1	52.0	50.9	51.4	51.7	52.8	53.6	53.8	53.0
Fish, fish products	20	8.4	14.4	14.5	8.6	9.6	10.8	11.8	12.5	12.4	13.2
Milk, milk products, in terms of milk	380	199.1	225.6	206.4	209.9	209.5	200.0	197.7	200.5	201.9	201.5
Eggs, pc	290	166	238	290	280	267	273	275	282	278	272

Source: [35]



○ **Fig. 4.1** The share of providing the population with products of animal origin, % of the norm

According to the data analysis (**Table 4.3**), for the time period from 2010 to 2020, there is no clear positive trend towards an increase in the share of consumption of food products of animal origin. The main share of protein in the diet is provided by eggs – more than 90 % of the recommended norm, meat – from 60 to 70 %, fish – from 40 to 70 %. Ukrainians consume the least milk and dairy products, the share of consumption of the recommended norm does not exceed 60 %. This share, with minor changes, can be a testimony to the taste preferences of Ukrainians and does not depend on the economic situation in the country.

From the data of **Table 4.3** and **Fig. 4.1**, meat and meat products deserve considerable attention. After all, different types of meat differ in their chemical composition, nutritional and biological value. At the same time, the total share of consumed meat does not provide an opportunity to determine the level of well-being of the population. This is reflected in the data of **Table 4.4** (the difference in the total weight of meat – the data of **Tables 4.3, 4.4** is explained by the fact that in **Table 4.4** the weight of meat of other types of animals, not industrially reared and processed) is taken into account.

● **Table 4.4** Meat consumption in Ukraine by main types

Meat consumption by species, kg/per- son per year [36]	Years							
	1990	2000	2010	2013	2015	2018	2020	2021 [37]
Beef	38.3	15.3	9.8	9.2	8.2	8.5	7.9	5.3
Pork	30.4	13.7	18.0	21.8	18.1	16.6	19.5	15.5
Chicken, duck, turkey	13.7	3.9	23.2	24.4	24.2	29.8	25.6	24.4
Total*	82.4	32.9	51.0	55.4	50.5	54.9	53.0	52.0 (including 6.8 kg of other types of meat, offal, animal fat)

*Note: the data in **Table 4.4** for the final amount of meat consumption differ slightly from the data in **Table 4.3** due to unaccounted statistical summaries and values taken from different information sources

A significant redistribution between types of meat is immediately visible from the data of **Table 4.4**. In 1990, the consumption of meat and meat products was 82.4 kg per person, which corresponded to 103 % of the recommended supply rate. The predominant part of the diet was beef – 46.48 %, a significant share of pork – 36.89 %, and 16.63 % poultry meat. Over the next ten years, meat consumption decreased to 32.9 kg per person, which was only 41.1 % of the recommended norm. Accordingly, there was a decrease in the mass of consumption by various types. However, in 2000, beef was predominant in the diet of Ukrainians and accounted for 46.5 %. In the next twenty years, the share of beef in the total mass of meat consumed decreased to 10.2 %. The share of pork in the total diet varied from 41.6 % in 2000 to 29.8 % in 2021.

The discrepancy between the needs, norms and actual consumption of various types of food products is shown in the work [38]. The author noted that the level of self-sufficiency in Ukraine

for most food products, for example, in 2017, exceeded 100 %. A number of food products produced by the processing industry, in particular of animal origin, exceeded the need for domestic consumption, for example: meat and meat products – 105.4 %, eggs – 114 %, milk – 103.6 %.

However, the production of food products and the level of consumption (**Fig. 4.1**) in this period of time do not coincide. The industry is able to provide the population's physiological needs in products of animal origin, but the population consumes only eggs, at the normal level, meat, meat products, fish, milk and dairy products, according to the level of provision from 40 to 70 % (**Fig. 4.1**). The reasons can be different: the food system – rejection of products of animal origin (veganism), family traditions, lack of material resources for these products, unaccounted for products from one's own household. Of the above, the products obtained in one's own household are of significant importance. After all, these are poultry, rabbits, and small cattle, fish caught in a pond or in a river. A general unofficial survey among applicants of the Mykolaiv National Agrarian University showed that the presence of relatives in the countryside allows providing 1–2 families in the city with agricultural products by 50–70 %.

At the international level, a methodology for assessing food security in the country based on a general index was created. The general index of food security in the country is estimated by the Global Food Security Index (GFSI) and is based on a dynamic benchmarking model and consists of 58 qualitative and quantitative drivers of food security in 113 countries, which are grouped into four main criteria: food availability, sufficiency (availability), quality and security, natural resources and sustainability. food security. Developed by Economist with support from Corteva Agriscience. The index is based on a dynamic comparative analysis of a model built from 58 qualitative and quantitative factors of food security [39].

In general terms, the Global Food Security Index for Ukraine in the same 2017 was 54.1 for 63rd place in the overall ranking out of 113 countries of the world [40]. By 2021, this indicator increased to 62.0 and Ukraine rose in the overall rating to 58th place [39]. The war in 2022 worsened the situation in the state in all directions, this led to a decrease in the overall value of the Global Food Security Index for Ukraine to 57.9, the country found itself on 71st place in the ranking between Paraguay and Myanmar [41]. According to the Global Food Security Index 2022. Ukraine [42] in 2022, the values of each of the analyzed indices were: accessibility – 66.6; sufficiency – 48.1; quality and safety – 71.3; stability and adaptation – 43.5. In addition to the indices of the main groups, each of the 113 analyzed countries is evaluated according to the following indicators: income level – income below the average; prevalence of malnutrition – 2.8 %; the percentage of children with growth retardation – 15.9 %; percentage of underweight children – 4.1 %; prevalence of obesity – 26.1 %; human development index – 0.78. Accordingly, it is impossible to draw an unequivocal conclusion about the lack of food products in Ukraine last year. Due to the military aggression, the loss of a large part of the manufactured products, the disruption of logistics in the supply of products, the sufficiency (availability) has decreased, one might add, the uninterrupted supply. Of all the complex criteria, it is "quality and safety" that measure the variety and nutrition of average rations, as well as the safety of food products and

testify to the level of satisfaction with this or that group of products. In 2022, the quality of food was characterized by an index with a rating of 71.3. According to individual components of this criterion, nutrition standards (source: FAO) in Ukraine were provided at 70.2, the quality of consumed protein – 81.3 (source: calculation of EI based on data of FAO, WHO and the nutrient database of the US Department of Agriculture (USDA)). The amount of protein is measured using the (PDCAAS) amino acid scale methodology with protein digestibility correction. The presence of nine essential amino acids in the average national diet is estimated based on input data: amino acid profile, protein digestibility value, and average amount (in grams) consumed of each food product. On the basis of this information [42] and the initial data for calculating the quality of consumed protein, it is possible to conclude that in the average annual diet of Ukrainians, the protein is mainly animal protein, since it is the protein of animal origin that has the most balanced amino acid composition [41].

Confirmation of the results of calculations of the overall value of the Global Index of Food Security in Ukraine were surveys of higher education students of the Mykolaiv National Agrarian University regarding their diet in May 2022. An analysis of the diet of young people aged 19–20 who lived in the South of Ukraine showed that the caloric content of the diet was insufficient, and it was provided with proteins and fats. Proteins from poultry, pork, river fish and eggs prevailed in the diet, and beef proteins were almost absent. Residents of rural areas had the opportunity to consume a significant proportion of proteins from dairy products. The increase in the prices of cereal products, fruits and vegetables reduced the consumption of functional carbohydrates and vitamins, which worsened the well-being of students. Significant differences in students' diets were explained by the place of stay. Some of them were in the zone of active hostilities, some in the countryside, in a more peaceful place. The result of these observations showed the significant impact of the war on their nutrition and the inferiority of the rations in general.

The previous analysis refers to peacetime. As it is possible to see, before the war, the supply of meat products changed according to the demands of the population. Even the economic crisis related to Covid-19 did not have a significant impact on the level of consumption of livestock products by Ukrainians. Changes in consumption were caused by factors directly responsible for the agro-industrial sector, the food industry, and government policy in the field of food security. The meat processing branch of the food industry is responsible for the nutritional and biological value of meat products. The production of such products requires high-quality raw materials, in particular, beef, which is the basis of a large assortment of meat products.

The quality of beef is affected by everyday factors and processing conditions at meat processing plants. Among the everyday factors that significantly affect the quality of meat, the following can be distinguished: the breed of cattle and its genetic potential; the conditions and technology of cattle breeding, including the intensity of fattening of young cattle and the balance of rations; the state of health of animals and the timeliness of carrying out a complex of veterinary measures. The genetic potential of livestock, which is not revealed in the case of an inferior fattening diet and maintenance, is of great importance. Production factors during processing have

no less influence on the quality of beef: conditions of pre-slaughter aging, slaughter, methods of cold processing.

The efficiency of raising livestock, which is further processed, depends on the technology of keeping, the main goal of which is the maximum satisfaction of all the physiological needs of animals [43]. There are a number of general rules for conducting agricultural activities related to cattle breeding. However, the effectiveness of this activity depends on subjective factors. The technology of raising animals depends on the size of the farm, the soil and climatic characteristics of the region, the availability of its own fodder base and workforce and specialized specialists, etc. The method of keeping animals tethered or untethered determines the level of mechanization. A high concentration of livestock allows mechanization of certain production processes: distribution of fodder, milking of cows, removal of manure. At the same time, the high level of mechanization of the production process contributes to the creation of an additional noise effect, vibration, gassiness of the premises, which negatively affects the emotional state of animals, which must be taken into account when organizing the technological cycle of livestock breeding.

In Ukraine, mainly dairy and meat-milk breeds of cattle are raised. Only some agricultural companies have beef cattle, the total share of which is negligible. According to the Ukrainian Association for the Development of Animal Husbandry and Technologies, as of August 1, 2021 [44] there were 54,205,000 head of meat cattle in the farms of the legal sector, and 19,283,000 in the farms of individuals. At the same time, according to the data of the State Statistics Service of Ukraine [45], the total number of cattle in Ukraine was estimated at almost 3219.1 thousand heads, including cows – in 1662.1 thousand heads. So, the share of beef cattle was 2.28 % of the total number. This amount of livestock is not enough to talk about the industrial scale of cultivation for the processing industry. In the leading countries of the world, 52–53 % of raw materials from cattle of meat breeds are used for the production of meat products. And in countries such as Canada, the USA, Great Britain and France, this percentage is much higher [46].

According to the analysis of H. Morozova [31], the revival of cattle breeding for farmers has become a series of problems associated with significant capital investments – the construction of new livestock farms or the reconstruction of old buildings, the restoration of cultural pastures. The main problem for the development of the industry has become the low productivity potential of the existing herd of cows, for the improvement of which it is necessary to drastically improve the selection and breeding work.

At the same time, along with the decline of cattle breeding in the state, the active development of poultry farming began. The increase in the production and consumption of chicken (**Table 4.4**) contributed to the expansion of the range of meat products and provided economic stability to meat processing enterprises.

The appearance of cheap chicken did not contribute to the improvement of the situation in cattle breeding. Animal husbandry became unprofitable and agricultural enterprises began to reduce livestock. According to the analysis of S. Bohdanko [47], in 1990, 85.6 % of all cattle herds belonged to agricultural enterprises, in 1995 this share was already 78 %, and the number of

herds decreased from 21,083 million heads to 1,511 million heads. However, in the first decades of Ukrainian independence, the number of cattle in households not only did not decrease, but even increased from 14.4 % to 46.5 %. Thus, in 1990, the number of livestock in households was 3. Subsequently, this trend remained (**Table 4.5**). Keeping livestock in households is focused on milk production. For rural residents, dairy animals are a source of small additional income. Owners of 1–2 cows are in no hurry to change the technology of raising animals. Accordingly, the cost of raising and keeping livestock was prohibitively high, and therefore, the cost of 1 kg of beef was and is high. This could not but affect its consumption by citizens of Ukraine.

According to the analysis of O. Kukhar, the situation with the cultivation of cattle in the conditions of agricultural enterprises continued to deteriorate in the next decade [48]. This could not but affect the volume of meat produced. In 1990, the production of beef and veal amounted to 1808 thousand tons, in 2011 it decreased to 97 thousand tons. Households produced 302 thousand tons of beef in 2011 against 177 thousand tons in 1990. Such changes affected on beef consumption by the population. Poultry became predominant in the diet.

Breeding and, in some cases, cattle processing in households has had a significant impact on meat processing enterprises. During the analyzed period, large, powerful plants and factories ceased to function, and instead small sausage shops were opened, the production activity of which was connected with the regional supply of meat products to the population. The emergence of low-power enterprises had advantages and disadvantages. On the one hand, the enterprise quickly responded to consumer demand, their activity did not require the supply of large batches of raw materials, on the other hand, there was a problem with the quality of products, their nutritional value. The lack of continuous laboratory control over the quality of raw materials and finished products could not guarantee the safety of these products for Ukrainians.

In recent decades, before the military aggression of the Russian Federation, there was a tendency to decrease the number of cattle in Ukraine. Analysts of the agro-industrial sector predicted a further decline in beef production and an increase in the price of meat [49]. The main reasons, according to experts, were: "disparity in prices for agricultural and industrial products; increase in the cost of fodder; the inability of the majority of domestic producers to apply the latest technologies for keeping and feeding animals, since the enterprises do not have free funds for this; destruction of large highly specialized farms for growing and fattening young cattle [36]; low solvency of the country's population, which mostly buys cheaper types of meat (about 48 % of all meat consumed in Ukraine is poultry meat, pork – 35 %, beef – 14 % [37]); an increase in the amount of foreign-made raw materials on the domestic market, the price and quality of which is significantly lower; reducing the amount of state support". This forecast is confirmed by the statistical data shown in **Table 4.5**.

Analysis of the **Table 4.3** shows a rapid decrease in livestock in Ukraine during the first 15 years after the collapse of the Soviet Union. At the beginning of 2022, the share of livestock is 1/10 of the number in 1990. By region, the livestock is distributed as follows [50]: more than 50 % of all cattle are kept in 9 regions – Vinnytsia (8.4 % of the total), Poltava (6.6 %),

Khmelnitskyi (6.3 %), Chernihiv (5.3 %), Lviv (5.3 %), Kharkiv (5.3 %), Zhytomyr (5.0 %), Cherkasy (4.8 %) and Odesa (4.6 %). The main producers of beef and veal, as in the previous decade, were and are private households. Their share accounts for 73.6 % of its total volume in the slaughter mass. If to talk about breeding stock, then according to the results of 2021 [51], Poltava region became the leader in terms of the number of cattle and cows in agricultural enterprises, and fourth in terms of pig stock. It is in the Poltava region that 70 agricultural enterprises operate, which have the status of a subject of tribal business in animal husbandry. Poltava region is the leader among the regions of Ukraine in terms of the number of breeding cattle – 32.079 thousand heads or 10.2 % of the total breeding livestock in Ukraine. However, for an agrarian country, such a number of breeding cattle is tiny.

● **Table 4.5** Dynamics of changes in the cattle population according to the State Statistics Service of Ukraine

Year	Cattle number as of 01 January (° of 01 February [52]), thsd. Heads [53]		Current year/up to 1990, %
1990	25194.8*		100.0
1995	19624.3*		77.9
2000	10626.5*		42.2
2005	6966.9*		27.7
2010	4826.7*	1627.1 (Enterprises) 3199.6 (Households)	19.2
2015	3983.9	1314.1 (Enterprises) 2669.8 (Households)	15.8
2019	3332.9	1138.1 (Enterprises) 2194.8 (Households)	13.2
2020	3117.7	1049.1 (Enterprises) 2068.6 (Households)	12.4
2021	2874	1008.4 (Enterprises) 1865.6 (Households)	11.4
2022	2689.4	998.5 (Enterprises) 1690.9 (Households)	10.7
2023*	2644.0 [54]	1003,4 (Enterprises) 1640,6 (Households)	10.49
2024*	2307.1 [54]	942.1 (Enterprises) 1365,0 (Households)	9.16

*Note: the information was formed on the basis of reports actually submitted by enterprises (the level of reporting was 88 %) and additional assessments of indicators. Data can be refined [54]

4.4 DISCUSSION OF RESULTS

The general dynamics of changes in the number of cattle (**Table 4.5**) logically explains the decline in the production of chilled beef and veal (carcasses, half-carcasses and quarters) in Ukraine. During the analyzed period, production volumes decreased unevenly, in 2018 this decrease was minimal, and in 2019 it reached 8 %. In 2020, during the COVID-19 pandemic, production fell by 23 % [55].

In 2021 (according to the results of the State Statistics Service as of January 1, 2022, **Table 4.5**), the smallest decrease in the number of livestock and an increase in beef production is noted. Unfortunately, its consumption by the population decreased (**Table 4.3**), the produced meat in the form of deboned and frozen beef and veal in blocks was exported [56].

Analysts of agro-industry [49] explain the increase in export supplies of beef with the constantly growing need for animal protein of the global population. This, to a large extent, stimulates the cultivation of cattle for meat on a global scale. The main driver of cattle meat prices is Asian countries, especially China, as one of the main consumers of beef. According to the data of the Ukrainian Agribusiness Club [57], the Ukrainian meat market increased the volume of deliveries of Ukrainian beef abroad in 2021 to 27.55 thousand tons of meat, which is 11 % more than in 2020. According to thermal condition, 99 % of beef is frozen. Before the full-scale military invasion, the main beef exporters were the following countries: People's Republic of China – 12,330 tons, Republic of Belarus – 3,680 tons, Republic of Kazakhstan – 3,100 tons, Republic of Uzbekistan – 2,890 tons. At the same time, beef imports increased to 2.78 thousand tons, which is 34 % more than in 2020. Frozen meat was supplied to Ukraine the most – 1.94 thousand tons (70 % of total supplies), 0.84 thousand tons of chilled meat. The main suppliers of beef to Ukraine were Republic of Austria, Republic of Lithuania, Republic of Poland, and the United States of America. The given statistical data show that in the absence of state regulation on food safety issues, internal beef shortage, reduction of livestock, Ukraine increased exports.

The main suppliers of beef for enterprises with an average shift capacity of 10 tons of products per shift and above are large agricultural companies, which, as mentioned above, are concentrated in Central and Western Ukraine. Meat from industrial slaughter is brought chilled in half carcasses or quarters, or in the form of frozen blocks. Meat processing enterprises with a capacity of 1 to 5–7 tons of products per shift provide their raw material needs at the expense of the private sector, which is regionally concentrated. Slaughter of such animals is carried out, as a rule, without observing technological requirements. This testimony is the result of my own observations of the slaughter process at the processing enterprises of Southern Ukraine. The same conclusions were published by the FAO and the WHO – a significant proportion of animals are processed in inappropriate conditions, the basic requirements of slaughtering technology, cold processing, and storage are not met [58].

Under such processing conditions, the obtained meat raw materials have low functional and technological properties and require the inclusion of additional ingredients in the recipes that will

ensure stable quality indicators. Such additives to the main raw materials reduce the nutritional and biological value of the product as a whole. That is, meat products will not meet the requirements of food safety indicators.

After the start of the war on the territory of Ukraine, the situation with the production of livestock products has changed significantly. In April 2022, according to Taras Vysotskyi, First Deputy Minister of Agrarian Policy and Food of Ukraine, livestock farming in Ukraine was destroyed by 15 % of the total volume [59]. However, Olena Dadus, Deputy Director of the Department of Agrarian Development, during the "UA FARMING AT WAR TIME. LIVESTOCK FARMING IN FOCUS" webinar [60] reported that these losses are not critical for the food security of the state. Further actions at the front, the de-occupation of captured territories, made it possible to stabilize the situation with the supply of products to all regions of Ukraine.

Farms in the Kharkiv, Chernihiv, Kherson, Dnipropetrovsk, Zaporizhzhia, and Mykolaiv regions suffered significant losses. Destroyed buildings, dead animals and birds [61]. Under such conditions, products of animal origin, in the near future, may become a delicacy, which will worsen the supply of the human body with complete animal protein.

According to the calculations of the Ministry of Agrarian Policy and Food of Ukraine, the population of agricultural animals in agricultural enterprises and households as of January 1, 2023: cattle – 2,432,700 heads (the data do not match the data of the State Statistics Service [52], which can be explained incomplete information from farms in the conditions of hostilities); sheep and goats – 965,200 heads; pigs – 5,028,400 heads. As of April 1, 2023, the available livestock, heads of agricultural animals have changed: cattle – 2,505,267; sheep and goats – 332,065; breeding pigs – 79,740; commercial pigs – 3,410,798 [62].

As of April 1, 2024, according to preliminary data from the Ministry of Agrarian Policy and Food of Ukraine, 2 million 330.5 thousand cattle are kept in the domestic and industrial sector of Ukraine, including 1 million 263.8 thousand cows. Compared to April 1, 2023, the cattle population decreased by 172,400 heads (–7 %), including cows – by 91,100 heads (–7 %). About 39 % of animals are kept at industrial enterprises, and 61 % – at households. A certain slowdown in the rate of cattle herd reduction is noticeable compared to last year's period. For comparison, as of April 1, 2023, Ukraine lost 264,400 head of cattle (–10.6 %) and 138,400 cows (–10.25 %) compared to the same period in 2022.

Regionally, about 53.5 % of animals from the total cattle population are kept in farms of all categories in the following regions: Khmelnytskyi region – 215.8 thousand heads; Vinnytsia region – 187.3 thousand heads; Poltava region – 181.7 thousand heads; Ternopil region – 144.6 thousand heads; Odesa region – 136.9 thousand heads; Chernihiv region – 127,000 heads; Cherkasy region – 126.2 thousand heads; Zakarpattia region – 125,700 heads [63].

The difference in numerical values is explained both by the increase in the herd and by the emergence of the possibility to register an animal in the Register.

The significant difference in the data of the Unified State Register of Animals based on identified animals and the calculations of the Ministry of Agrarian Policy and Food of Ukraine can be

explained by the fact that in active combat zones there is no possibility to quickly provide up-to-date information on changes in the number of animals. However, it should be noted that the main share of farm animals is concentrated in the regions that were least exposed to rocket attacks and were not occupied. A more optimistic situation in animal husbandry in the Western part of Ukraine, in some regions, there is an increase in the number of certain species of animals, sheep and goat breeding have begun to revive. For example, in Prykarpattia, at the beginning of July 2022, the number of cattle in agricultural enterprises of the region increased by 0.8 thousand heads (7.8 %) and amounted to 11.1 thousand heads, including cows by 0.3 thousand heads (6.7 %) and, accordingly, 4,800 heads were kept despite the start of the war [64].

Our agrarians cannot provide an unequivocal forecast regarding the increase or decrease in the number of animals and poultry, the decrease in the cost of meat and meat products, milk and dairy products. Analysts of the Association of Milk Producers of Ukraine foresee an adjustment of livestock in farms due to the increase in the cost of the new grain crop by 70–80 %, compared to 2021 [65]. At the same time, problems with the sale of cereals can contribute to the use of a strategy where cereals are used for the production of compound feed and the cultivation of farm animals and poultry [66]. This strategy was confirmed by the increase in live weight livestock exports in January 2023 by 3.23 million USD, i.e., by 78.8 % compared to January 2022 [67].

At the same time, in the same January 2023, agricultural enterprises sold 8.1 thousand tons of cattle for slaughter, which is 11.11 % less than in January 2022. The main supplier of beef was small farms that produced 16.7 thousand tons of meat, however, they also reduced the total production by 5.39 % compared to last year. This situation is due to the increase in the cost of breeding and primary processing of animals, the absence or unstable supply of electricity and low demand for a product that is expensive for the average Ukrainian. These factors contributed to a decrease in beef exports by 1.11 thousand tons, which is 1 % less compared to January last year [68].

The greatest decline is noted in regions with active hostilities and significant population outflow. In regions where the situation is stable and the share of internally displaced persons has increased, the volume of beef production has increased. Difficulties in the domestic market are associated with a decrease in demand and an increase in prices.

The situation is similar with all types of animal husbandry products. According to the testimony of the "Ukrainian Club of Agrarian Business", in comparison with last year, in 2022 the production of all types of meat decreased by 11 % – equal to 3 million tons, milk by 12 % – 7.7 million tons, eggs by 18 % – 11.6 billion pcs [69].

According to the calculations of the National Academy of Agrarian Sciences of Ukraine for 2022 [70], in order to ensure the food security of the state, domestic processing enterprises must ensure the production of at least 8,230,000 tons of milk, 135,000 tons of beef, and 600,000 tons of pork, chickens – 1,620,000 tons, eggs – 14,100 million pcs [71]. In the conditions of active hostilities in a significant part of the territory of the state, unequivocally, no one today will be able to provide real statistical data regarding the conformity of previous calculations

and volumes of produced products, in particular, livestock products. It is difficult to determine the level of food security.

However, the reduction in livestock production does not pose a threat to food security in the country. The problem for the population is not in the quantity of produced products, but in their availability. A significant increase in prices for these types of products reduces their share in the general diet and limits the nutritional status of the population as a whole.

CONCLUSIONS

Based on the analysis of statistical data, it should be noted that in Ukraine over the past 33 years, the total cattle population has decreased to 2,307.1 thousand heads, as of January 1, 2024, which is 9.16 % of the 1990 population. This situation had a negative impact on citizens' consumption of food products made from animal raw materials, in particular, beef and its products. In 1990, the consumption of meat and meat products was 82.4 kg per person, which corresponded to 103 % of the recommended supply rate. Of the total share of meat and meat products consumption in 1990, beef dominated the diet – 46.48 kg per person per year. Over the next ten years, meat consumption decreased to 32.9 kg per person, which was only 41.1 % of the recommended norm, the weight of beef in the general diet was 15.5 kg per person per year. From 2000 to 2021, the share of ensuring the consumption of meat and meat products varied from 63.75 % to 69.25 %, the share of beef in the total mass of meat consumed decreased to 10.2 %. The decrease in beef consumption had a negative effect on the quality of nutrition. This is confirmed by the overall value of the Global Food Security Index, which determines food security in the country. In 2022, the level of food security was 70.2, the quality of consumed protein – 81.3.

It was established that the main reasons affecting the decrease in the share of beef consumption by Ukrainians are an unstable economic situation, a decrease in the income of the population of Ukraine, an increase in the price of beef and its products, and a decrease in the number of livestock in general. If to look at the war years 2022–2024, it is not possible to hope for an improvement in the situation with the consumption of beef by Ukrainians, for an increase in the quality of the consumed protein.

Therefore, without the development of cattle breeding, as a basis for adequate nutrition, the state will not be able to provide one hundred percent food security to our population.

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