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RESOURCE REQUIREMENTS OF BULGARIAN CATTLE FARMING AND OPPORTUNITIES FOR ADAPTATION OF DIGITAL SYSTEMS

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Abstract

Bulgarian cattle farming plays a key role for the advancement of local agriculture. Bovine milk is an important product for local consumers, with dairy products forming a large part of the local diet. Cattle farming has not stray from the tendency of transformation that Bulgarian agriculture has undergone, resulting in lowering production capacity at the end of the 20th century and continuing development under the CAP of EU after 2007 (the accession of Bulgaria to the EU). Resource management has been an issue for local producers, that face fierce competition on the Common market for most of the processed products. Improving production efficiency through the adaptation of digital resource management can create opportunities for the development of the sector and improving its competitiveness. The purpose of this study is to analyse the resource requirements of Bulgarian animal husbandry farming and disclose some opportunities for application of digital solutions for resource management. The methods used are analysis and synthesis, statistical analysis based on data from centralised databases. The main result from the study is focused on the growth of cattle farming in Bulgaria during the studied period and thus the feeding material requirement, while at the same time the prices of these materials have risen significantly. The conclusion is focused on this significant market change, which leads to the necessity of better resource management for Bulgarian cattle farms and the introduction of digital systems to support it.

***Key words*:** *fodder stock, digital management, supply chain management*

INTRODUCTION

In recent years, livestock breeding in Bulgaria has developed dynamically, with an increase in the number of animals, investments in modern technologies and production practices. This sector has a key role in feeding the population and provides basic raw materials for the processing industry. It creates jobs for people, improves food security, promotes rural development, and contributes to economic growth.

Bulgaria has good natural conditions for the development of animal husbandry and the state policy is aimed at creating conditions for the sustainable development of the sector and protecting the interests of farmers. The sector is supported through various financial instruments with funds from the European budget under the two pillars of the CAP (for direct payments and market measures and for rural development), as well as with national funds.

Ensuring a favourable regulatory and economic environment enables more efficient management of farms, improving the profitability of production, increasing safety and quality of production. This contributes to guaranteeing farmers' incomes and accelerating the sector's economic growth.

The main goal of this research is to evaluate the state of Bulgarian cattle farming, assess its resource requirements and analyse the opportunities for adaptation of digital system for improved resource management.

MATERIALS AND METHODS

In order to achieve the goal of this research, the following tasks are solved:

-to analyse the state of the cattle farming sub sector of Bulgarian farming and its role;

-to evaluate the requirement for resources of Bulgarian cattle farming;

-to propose and assess the opportunities for adaptation of digital technologies for improved resource management.

This study is based on data from multiple sources, among which are the Agrostatistics desk of the Ministry of agriculture and food of

the Republic of Bulgaria [8], as well as its System for agro-market information, as well as the FAOSTAT database [4]of the UN.
The methods used in this study are literature review, analysis of data sourced from centralized databases and synthesis of information.

RESULTS AND DISCUSSIONS

By the end of 2022, a total of 559,544 cattle were bred in the country - 5.1% less than a year earlier. The total number of cows decreased by 5.2% on an annual basis, to 361,476 cows, with a more significant decrease recorded in dairy cows - by 7.9% (to 197,996 cows), and a weaker one in beef cattle - by 1.8% (up to 163,480 units). The share of beef cattle in the total number of cattle increased to 45.2%, at 43.6% in 2021. This is a result of the ongoing process of specialization of production in cattle breeding, which is characterized by a shift from dairy to meat.
Bulgarian cattle farming has improved in 2021 by 3.7% with cattle rising to over 589 thousand. The increase in the number of cows in the country was leading the trend with growth rate of 3.8% or 381,419 producing animals, this process was also evident in the significant rise of 19.1% of beef cattle, that was to the expense of dairy cows, which reduced by 5.6%. This process has led to the improvement of the role of bovines, as they reached 43.6%, compared to 38% in 2020.
Cattle bred in the country in 2020 totalled 568,726 - 11.4% more than a year earlier. The total number of cattle increased by 10.9% on an annual basis (up to 367,529), with the increase being less pronounced in dairy cows - by 5.8% and more significant in beef cattle - by 20.3%. Thus, the share of beef cattle in the total number of bovines reached 38%, compared to 35% in 2019. In 2020 in connection with the global pandemic of COVID-19 and the introduced state of emergency and anti-epidemic measures, eligible farmers are supported to offset the increased costs under measure 21 "Extraordinary temporary support for farmers and small and medium-sized enterprises that are particularly affected by the crisis, caused by COVID-19" from the Rural Development Program 2014-2020, including under measures 21.1 "Extraordinary temporary support for farmers COVID 1" also covering the sector "Livestock" (cattle, buffalo, sheep and goats), and 21.3 "Extraordinary temporary support for small and medium-sized enterprises and recognized groups and organizations of producers COVID 3".
In 2019, the negative trend of decreasing as the size of Bulgarian cattle farming is maintained. By the end of 2019, the number of cattle in the country dropped by 16,031, meanwhile, the number of buffaloes grew by 7.1%. In 2019, the trend of increasing the number of large ruminants from the meat sector continues, and by the end of the year, the number of beef cattle increased by 8.8% compared to a year earlier. The reason for this negative trend is the difficulties faced by livestock breeders - lack of markets for milk, low purchase prices, huge bureaucracy, and heavy European requirements.
In the case of buffaloes, there is a persistent trend of increase in animals during the study period. By 2022 – the tail end of the studied period, the number of buffalo has raised by nearly 60% compared to 2017, the first year studied.
Although buffalo products - both milk and meat are valued and have a high price, buffalo breeders also complain about difficulties in selling milk, which many dairies buy at the price close to the cost of production [5].
For the studied period, a trend of increase in large ruminants from the meat sector was observed. This contributes to the deepening of the process of production specialization in cattle breeding, which is characterized by a shift from dairy to meat production. The applied schemes for production-linked support in animal husbandry (including schemes for beef cows and animals under selection control) favour this process.
In 2022, for almost all types and categories of farm animals, the number of farms reduced, but their average size expanded in comparison with the prior year (Table 2). The most significant rise in the average number of animals observed on average was recorded for

buffaloes - by 20.1% (up to 37). The year-on-year rise in the average number of buffaloes is 12.8%, of cattle - by 12%, of cows - by 10%.

Table 1 Number of bovines bred in Bulgaria for the period 2017-2022

Kind of animals	2017	2018	2019	2020	2021	2022
Cattle - total, incl.	540,115	526,491	510,460	568,726	589,512	559,544
Cows in general	348,691	340,818	331,415	367,529	381,419	361,476
- dairy cows	252,056	234,055	215,219	227,795	214,936	197,996
- beef cows	96,635	106,763	116,196	139,734	166,483	163,480
Buffaloes-total, incl.	12,809	15,625	16,734	20,179	21,686	20,317
buffaloes	8,720	10,309	11,471	14,147	15,407	14,841

Source: Ministry of Agriculture and Food Industry, Agrostatistics [8].

By the end of 2021, there were 460 farms raising buffaloes - 5.5% less on an annual basis, while the number of buffaloes in them increased by 8.9%. The number of farms raising cattle and cows also decreased by 10% and 8%, respectively, but the average number of animals raised in them increased by 15% for cattle and 13% for cows.

By the end of 2022, farms raising buffaloes decreased by 11.7% on an annual basis, to 406, and the number of buffaloes in them - by 3.5%.

In improvement of the number of farms raising all types of bovines was registered in 2020, as well as the amount of producing animals and animals for fattening in them. Buffalo farms expanded by 53.1% up to 487, and the animals in them by 23.3%. Cattle farms have risen by 25.2%, and the number of animals in them - by 11.4%. The number of farms with cows increased by 22.5%, and the number of animals in them - by 11%.

In 2020, there was a contraction in the average size of livestock holdings, which is explained by the larger number of farms. The most serious is the decrease in the number of buffalo per farm - from 38.3 in 2019 to 28.2 in 2020, which is a decrease of over 26%. The annual decrease in the average number of buffaloes is by 19.4%, of cattle by – 11%, of cows – by 9.5%.

Table 2. Number of farms and animals in Bulgaria for the period 2018-2022

Years	Indicators	Cattle - general	Cows in general	Buffaloes-general	Buffaloes
2018	No. of animals, thousand	526.5	340.8	15.2	10.3
	Farms, thousand nos.	27.2	25.6	0.4	0.3
	Avrg. No. of animals/farm	19.4	13.3	39.0	34.3
2019	No. of animals, thousand	510.5	331.4	16.7	11.5
	Farms, thousand nos.	22.6	21.3	0.4	0.3
	Avrg. No. of animals/farm	22.6	15.6	41.8	38.3
2020	No. of animals, thousand	568.7	367.5	20.2	14.1
	Farms, thousand nos.	28.3	26.1	0.6	0.4
	Avrg. No. of animals/ farm	20.1	14.1	33.7	28.2
2021	No. of animals, thousand	589.5	381.4	21.6	15.4
	Farms, thousand nos.	25.5	24.0	0.6	0.5
	Avrg. No. of animals/ farm	23.1	15.9	36.0	30.8
2022	No. of animals, thousand	559.5	361.5	20.3	14.8
	Farms, thousand nos.	21.6	20.7	0.5	0.4
	Avrg. No. of animals/farm	25.9	17.5	40.6	37.0

Source: Ministry of Agriculture and Food Industry, Agrostatistics [8].

In 2019, the trend of sectoral withdrawal continues with farms raising cattle and cows decrease 17% each, while at the same time the buffalo farming has preserved its positions.

The average farm size has been improved providing a base for further development and technological performance. When analysing cattle farming this increase is 16.5%, while dairy farming has an improvement of 17.3%, in buffaloes of 7.85%.

The trend of reduction in the number of farms raising animals is maintained in 2019, mainly due to the termination of part of the small farms. The process of consolidating the sector contributes to the greater sustainability of farms, more efficient and profitable production.

Compared to the previous year, cattle farms decreased by 16.9% and buffalo farms decreased by 3.1%.

The development of Bulgarian cattle farming trough the studied period has led to the further concentration of production. These larger farms are characterized by more sophisticated management techniques in most cases and a closer attention to resource management. The demand for compound feed and other feeding materials needed for the farms is continuous and managing the farm's supply chain is of great importance for its final economic results.

The processes underway in Bulgaria's cattle farming are complex. Some of the smaller farmers are closing due to higher EU production standards and low economic results. The milk production part of cattle farming in the country has seen a slight decline in its production capacity, but a significant decline in overall production – 23% from 2016 to 2022 (Figure 1).

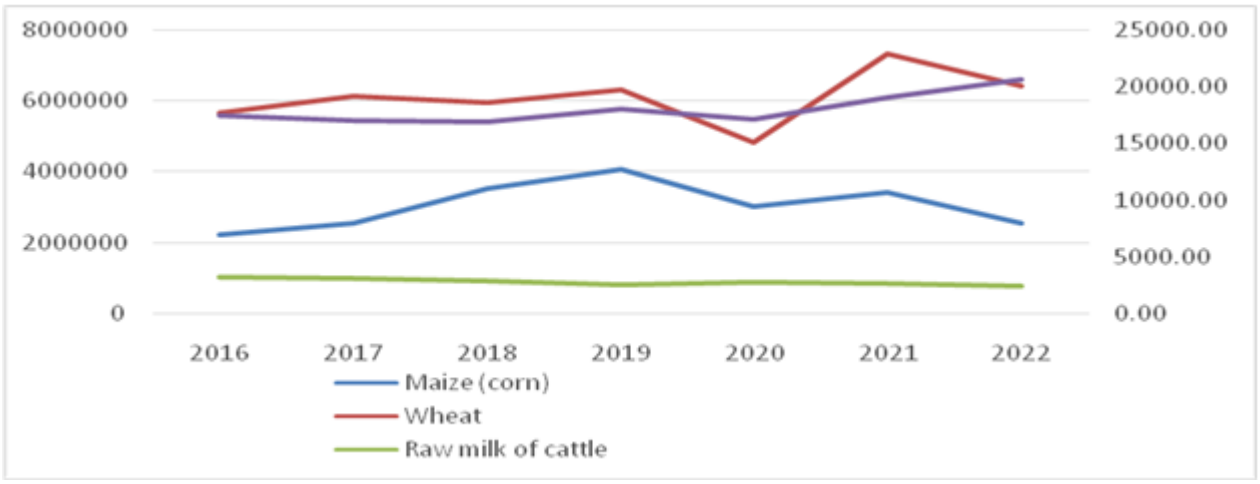

Fig. 1. Production of key feeding materials and their relation to main products in cattle farming
Source: Ministry of Agriculture and Food Industry, Agrostatistics [8].

While milk production has declined, the overall production of meat has increase throughout the period (Figure 1 scale for meat is on the right axis). This slow change in production type for some farms and focus more on meat than milk production has led to changes in the used feeding materials. The main feeding materials in the country are bran of maize and other by maize byproducts as well as wheat as the main ingredient for compound feed. Combined they attribute to over 60% of the feed used by local farmers (Mihaylova, et al., 2015) [7]. This has led to a high economic impact of the price increase of these products on the international market, as Bulgarian producers are export oriented (Figure 2).

The prices for both products follow the same trajectory throughout the studied period. With small early changes the overall tendency is toward an increase and at the end of the period both maize and wheat are exported at a price close to 350 USD per ton. This 75% increase in the price of maize in just two years – from 2020 to 2022 and its significant importance as feeding material in Bulgarian cattle farming has raised production costs significantly. Some producers have tried to replace maize with other materials, but their prices have also increased.

These higher prices are also reflected in the compound feed offered on the local market with an average price of over 450 euro per ton (Figure 3). That market increase in prices for the main production resources has led to significant decline in farms economic results. The buffalo farms, as previously noted has suffered the most from these raises in feeding material costs.

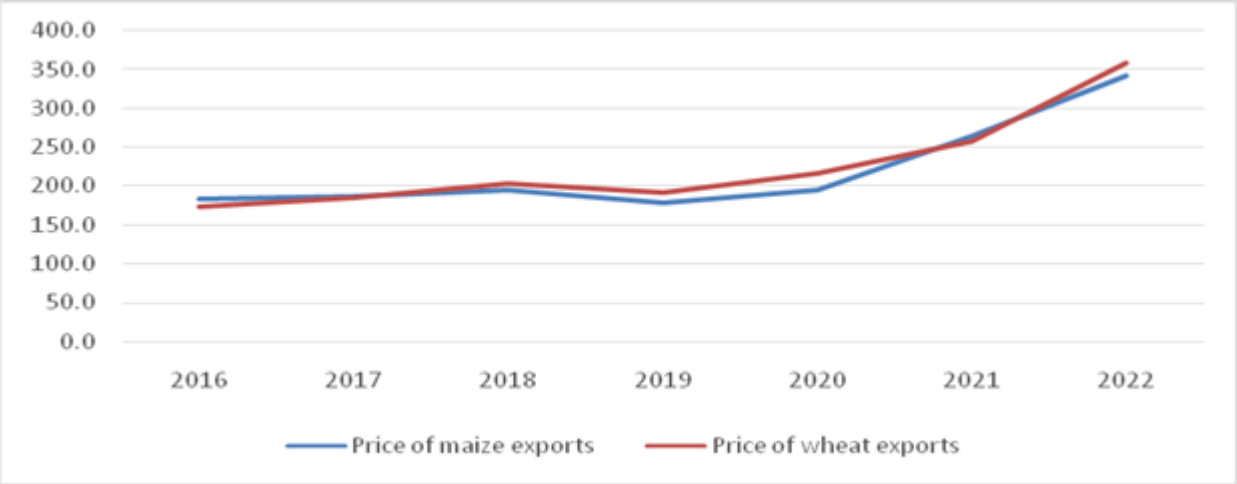

Fig. 2. Average yearly export prices of maize and wheat (in USD per ton)
Source: Own calculation based on data sourced from FAOSTAT Database [4].

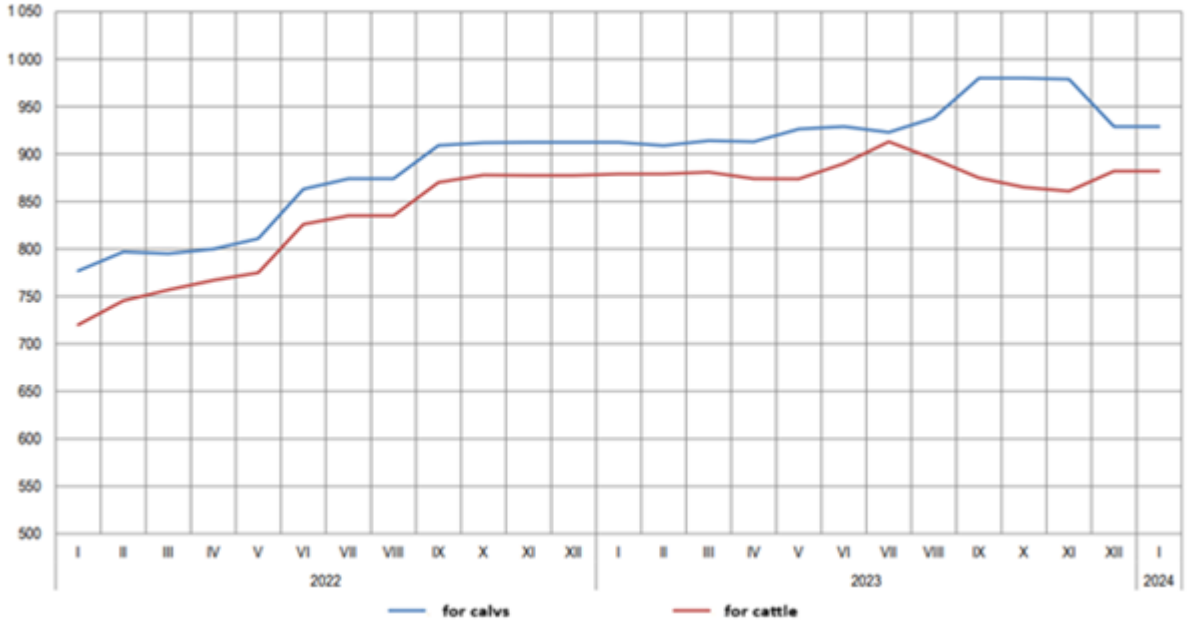

Fig. 3. Wholesale price of compound feed in Bulgarian lev per ton (1 Euro = 1.95583 BGN, or 1 BGN = 0.51 Euro)
Source: Ministry of Agriculture and Food Industry, Agrostatistics, SAPI [8].

The increase in material prices has led to the underlined importance of better resource management on a farm level. Some producers have chosen to implement digital tools to help them optimize their feed stocks and adjust faster to market fluctuations.

In 2019, within the financial support framework of the Horizon 2020 program, AgroHub.BG was started in Bulgaria. The main objectives of this organisation are the digitization of Bulgarian agriculture and rural areas in cooperation with Bulgarian stakeholders in order to assess their needs of digital skills and ensure access to them (Kostadinova, 2021) [6].

Agroberichten Buitenland (2022) [1] emphasized the need of reforms and investments in the digitalization and innovation of agriculture within Bulgaria's National Recovery Resilience Plan, destined to extend various technological stages based on digitalization (feeding, milking, watering and cleaning, management and monitoring of livestock farms, fertilization, GPS systems for identifying permanent grass areas, drones, etc.
Petkov and Dimov (2022) developed a mathematical model for estimation of the digitalization of the production structure in animal husbandry [10].
Data-driven solutions within the supply chain are now seamlessly integrated through the utilization of tools and methodologies developed by big data analysts. Enhanced and expedited solutions aid businesses in analysing and comprehending real-time outcomes pertaining to extensive data sets, encompassing aspects like integrity, volume, variety, and velocity (Alkahtani, M., et al. 2021 [2]; Stoyanov et al. (2021) [12].
Organizations can enhance their supply chain by curbing costs and mitigating risks. The amalgamation of data technologies and agri-food initiatives is pivotal in fostering novel insights by broadening farmers' data accessibility, advancing services, refining processes, and software. It also contributes to the evolution of future factories and the adoption of information and communication technologies alongside pertinent agricultural and big data frameworks.
Cutting-edge innovations in warehouse logistics and automation, encompassing digital and robotic solutions, are revolutionizing contemporary warehouses from traditional physical entities into interconnected and intelligently operating ecosystems. Amidst the era of global connectivity, e-commerce, and online retail, the supply chain landscape has grown exceedingly intricate, leading major corporations to establish and manage warehouses and distribution centres across diverse and remote geographic locations. Various challenges confront the effective management of modern farm warehouses, yet they often find a common resolution in automation. Visionary technological concepts such as IoT (Mo, 2011) [9], Big Data, artificial intelligence, mobile robotics, specialized warehouse management software, and others empower facility managers within the realms of warehousing and logistics to not only synchronize with the dynamic nature of the supply chain but also secure competitive advantages. These advantages encompass improved efficiency, security, and safety, expedited and more precise order processing, and increased capacity. Furthermore, the automation of operational tasks like packing, sorting, and tracking liberates intellectual resources, redirecting them towards critical, tactical and strategic endeavours (Büyüközkan and Göçer, 2018) [3].
Stoeva et al. (2021) pointed out that digitalization in Bulgarian agriculture will increase the branch competitiveness [11].

CONCLUSIONS

The digitalization of cattle farms is a slow and undergoing process with some farmers already having RMS products introduced and supported by local companies. The overall level of automation is still low as farmers choose to react to market changes as they happen and not have systems that can react on their behalf.
The main causes for disruption in the farm’s feed supply can be the poor organization of the procurement process - delayed delivery, the inability of the contractor to fulfil supply obligations for objective reasons - production causes, accidents, etc., logistical issues and the increase of purchase prices. All of these issues can be combated with a large-scale digitalization of the sector with the introduction of a large number of data collection points on production and the automated supply of market date to the managers.

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