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ENVIRONMENTAL IMPACTS AND FUTURE CHALLENGES OF LIVESTOCK SECTOR IN HUNGARY

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Abstract
In developed countries, livestock farming faces significant global challenges, including adverse environmental impacts such as greenhouse gas (GHG) emissions and pollution from industrial animal husbandry. These negative processes were accompanied by the disappearance of livestock breeding from backyards and small farms' demise in recent decades. As a result, the sector's significance in rural communities has decreased, causing challenges for rural development. This research investigates these processes on the example of the Hungarian livestock sector from the 1990s to recent years, with statistical and policy document analysis, literature review, and interviews in Hungary's Southern Great Plain. The results show that the number of animals kept in rural settlements has decreased significantly in the last three decades. The established large-scale industrial animal husbandry is a negative environmental burden without positive externalities. In conclusion, the disappearance of the backyard and small-scale livestock farms from the Hungarian countryside has resulted in the loss of multifunctionality and social exclusion. A diversified farming system and a more balanced policy preference toward civic agriculture and small-scale animal husbandry can bring many environmental, economic, and social benefits to rural Hungary.

1 Introduction

Between 1961 and 2021, global meat production increased from 69 million tonnes to 354 million tones and raw milk production from 344 million tonnes to 918 million tonnes. Such a surge in production has been accompanied by a significant increase in livestock numbers: these processes have led to both increased environmental pressures, including greenhouse gas emissions [1,9], and intensive agricultural concentration processes, with various negative impacts on rural communities [17].

In terms of environmental impacts, according to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) [11], the agricultural sector, including livestock production, is responsible for about 22% of global greenhouse gas (GHG) emissions from human activities. The UN Food and Agriculture Organization (FAO) estimates that the livestock sector is

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responsible for about 14.5% of global GHG emissions, which is equivalent to the entire transport sector [5].

In addition to environmental impacts, livestock production also requires significant resources. Global livestock production accounts for 70% of agricultural land use [1]. In addition, the sector plays a crucial role in deforestation in Latin America and degradation of grasslands in arid areas due to overgrazing [1]. Water use in livestock farming also represents a significant environmental burden, both locally and globally [12]. According to Mekonnen and Hoekstra [13], one kg of beef production requires on average 15 400 litres of water, while 1 kg of sheep production requires 10 400 litres of water, of which feed production accounts for about 99%.

As a result of these processes, a number of studies have highlighted the serious sustainability problems associated with livestock production [4,7,8,10,14,16,18]. For this reason, researchers have recommended reducing livestock production and the consumption of milk and meat [8,18]. In addition, many recognize that reducing meat consumption can have a positive impact on the fight against climate change. This trend is in line with research findings that call for a reduction in meat-centred diets and the promotion of consumption regulation [2,7,16].

The aim of our research is to examine the concentration and industrialization processes that have taken place in Hungarian livestock production over the past three decades and to explore the significant environmental, economic and social consequences. We also conducted interviews with young livestock farmers to gain insights into their experiences and challenges in setting up and managing their businesses. Our analysis contributes to the understanding of how current trends in livestock production have resulted in sustainability challenges and how they have influenced the development of rural areas in Hungary.

2 Material and methods

We used several data sources in our research, including agricultural data from Eurostat and the Hungarian Central Statistical Office (HCSO). Agricultural census data highlight the decline in household and small-scale livestock production in the 2000s. The National Food Chain Safety Office's database of producer and establishment registers was also examined to obtain further information on the concentration of farms.

For the analysis of the environmental impact of livestock production, our research used data from the National Environmental Information System (NEIS), which allows the assessment of waste and pollutant emissions at different spatial levels. For greenhouse gas emissions, we relied on data from the National Inventory Report of the United Nations Framework Convention on Climate Change (UNFCCC) [15]. To illustrate biodiversity loss, we used the bird population database of the Hungarian Ornithological and Nature Conservation Society. We selected bird species whose habitat has been reduced due to intensive agriculture [19]. To illustrate landscape degradation processes, we investigated the spread of invasive species using the National GIS Database of Invasive Species created and maintained by the Department of Geoinformatics of the University of Szeged [20].

Quantitative analysis of data from the agricultural and livestock sectors was used to monitor macro trends and changes in production patterns. As we focused mainly on rural areas, only data from municipalities with less than 10 000 inhabitants were analysed in the descriptive statistical analysis.

In order to investigate the micro-level situation of small farms, we interviewed young farmers in the Danube-Tisza Interfluve. The area covers more than 100 000 hectares of grassland, which represents 12% of the total area. The livestock population is also significant, with 117 000 cattle, 223 000 pigs and 4.5 million poultry. Although there is a noticeable concentration of farms, small farms are still present, with around 5600 young farmers. In addition, the region is environmentally sensitive and highly exposed to the negative effects of climate change, making sustainable management of the area critical.

The interviews were conducted in two phases between January 2017 and March 2018 and between December 2021 and January 2022. 124 farmers under 40 years of age who were self-employed were interviewed. Of the respondents, 50% (62 farmers) were exclusively involved in crop production, 46.8% in livestock and crop production and 3.2% (4 farmers) in livestock production only. In this article, only the responses of 66 farmers involved in livestock production are used. A snowball

method was used to select the respondents. This methodology can be used for the purpose of exploring causes [3], which was our primary objective.

3 Results

3.1 Decline in livestock production in Hungarian rural areas

We can see a drastic decline in livestock sector between 2000 and 2020 (Table 1.).

Table 1. Change of livestock population between 2000 and 2020

Livestock	*2000*	*2010*	*2020*	*Change (%)*
Pigs	3 854 428	2 453 426	2 506 409	-34,97
Cows	659 433	518 895	745 613	13,07
Sheep	1 019 526	963 919	796 905	-21,84
Chickens	33 116 311	27 307 460	25 917 932	-21,74

Source: Agricultural Census of 2000, 2010, and 2020, HCSO

The only exception to the general downward trend is cattle farming, which increased by 32% between 2010 and 2020 (from 706 000 to 933 000 heads), mainly thanks to subsidies.

The decline in livestock and farm numbers has also been accompanied by a concentration process, with an increasing share of livestock in the hands of large-scale farmers. According to the 2020 Census of Agriculture, farmers with more than 100 livestock units held 1.47 million animals (77%) out of 1.9 million livestock units. At the same time, the number of holdings with fewer than five livestock units fell from 227 000 in 2010 to 93 000 in 2020. In addition, their livestock numbers in livestock units fell from 220 000 to 94 000.

These trends have led to a significant decline in livestock production on small and backyard farms over the last 30 years.

3.2 Environmental impacts of livestock and food production

According to the National Environmental Information System (NEIS), in 2020, 290 000 tonnes of waste were generated in the crop and livestock sector and 421 000 tonnes in the food industry (711 000 tonnes combined), representing 5.8% of the total annual waste generated by all economic sectors. Nearly 90% of the waste (260 000 tonnes) is slurry and a further 9 000 tonnes is animal tissues.

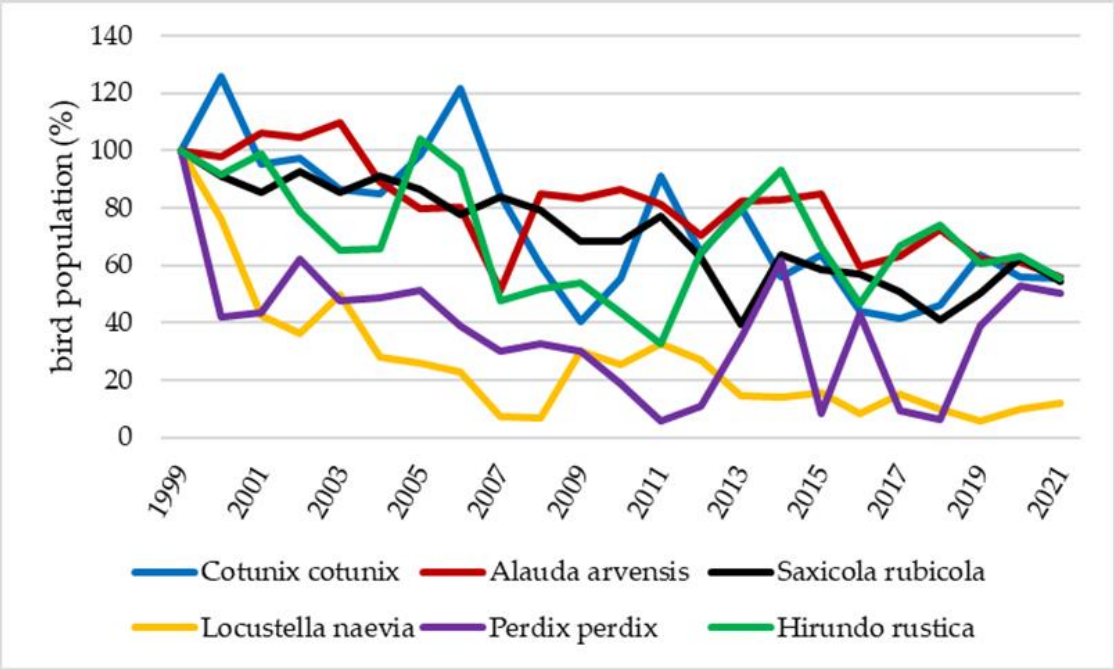
The above data on waste from agriculture and food industry indicate that waste and pollutant emissions are significant. Among the various pollutants, greenhouse gas emissions are particularly important. According to the National Inventory Report 1985-2019 [15], Hungarian agriculture contributed 11% of the country's total greenhouse gas emissions in 2019. Emissions of methane and nitrous oxide from cattle rearing and from manure management are the most significant contributors. The beef cattle sector accounts for 75% of total methane emissions from agriculture and the pig sector accounts for 13% [17].

Ammonia is the largest pollutant emission of animal origin. According to the NEIS database (combined data for poultry, pig and beef cattle farms), annual ammonia emissions decreased from 746 thousand kg/year to 304 thousand kg/year, which is in line with the change in livestock numbers in 2014. In contrast to methane emissions, where the cattle sector plays the leading role, ammonia emissions are mainly related to pig production, followed by poultry and cattle production in equal proportions. Ammonia, as a pollutant, contributes to soil acidification, eutrophication and forest degradation through its toxic effects on plants, leading to a loss of biodiversity [6].

In addition to ammonia, intensive livestock production also emits other pollutants, mainly in the form of nitrogen oxides and CO_2, due to the use of nitrogen fertilisers and the operation of equipment and machinery.

Extensive livestock farming has declined significantly in the Central European countries, and the vegetation of these areas has been transformed as a consequence. The spread of invasive plant species, such as *Asclepias syriaca*, is particularly striking, according to the National Spatial Data Base on Invasive Plant Species (http://www.geo.u-szeged.hu/invasive). Forests and woody shrubs eventually occupy abandoned pastures, but their species composition often includes invasive plants such as *Robinia pseudoacacia, Elaeagnus angustifolia*, or *Ailanthus altissima*. Degraded grasslands lead to a loss of biodiversity and cause environmental problems, such as an increase in allergic diseases.

According to data from the Hungarian Ornithological and Nature Conservation Society, bird populations in agricultural areas in Hungary have declined by around 30% in the last 15 years. This decline is essentially linked to the widespread expansion of large-scale agriculture. Among the declining populations, *Perdix perdix*, which is strongly linked to agricultural areas, stands out. Its population had declined by 91% by 2018, as had *Locustella naevia*. In addition, *Saxicola rubicola, Alauda arvensis, Cotunix cotunix* and *Hirundo rustica* have also declined significantly, with the rate of decline for each species being around 50% between 1999 and 2021 (Figure 1).



Source: https://www.mme.hu/magyarorszagmadarai/madaradatbazis

Figure 1: Changes in bird populations between 1999 and 2021, as a percentage of the 1999 level

3.3 The problems of young farmers

The ageing population in Europe and Hungary is also leading to an ageing farming community. One third of farmers in the European Union are over 65 and more than 50% are over 55. By contrast, farmers under 35 account for just under 6% of the total. In Hungary, the share of farms managed by people aged 65 and over was 28% in 2010, rising to 35% by 2020. The latest agricultural census in 2020 showed that 70% of farm managers are aged between 45 and 74, while only 9.9% are under 40.

Looking at the livestock sector, the 2020 agricultural census data shows that those under 40 own only 13% of all livestock (11.84% of pigs, 14.79% of cattle, 13.73% of sheep and 12.54% of poultry).

In our research, we found that young farmers engaged in livestock or mixed farming in the Southern Great Plain identified difficulties in purchasing arable land as a long-standing problem. Another long-standing problem is the aridification of the Homokhátság, but this problem affects almost all agricultural areas in Hungary to a lesser extent due to climate change. Due to relatively

frequent droughts, there are significant fluctuations in crop yields, resulting in fluctuations in feed and crop prices, which negatively affect all livestock farms.

The issue of environmental sustainability is particularly important for young farmers in the Southern Great Plain region due to water scarcity. However, this is difficult to keep in mind in livestock farming. In cattle farming, for example, work processes can be well mechanised, so that manual labour requirements can be kept relatively low, for example with milking robots, but they require significant water use to keep them clean (500 l/day for a robot milking 75 cows).

Unemployment is high in the Southern Great Plain, but young farmers also reported labour shortages of both skilled and unskilled seasonal workers. As a result, they have been forced to turn to mechanisation and robotisation, the costs of which are prohibitive even for larger farms. Therefore, many farmers believe that the unresolved problem of labour shortages could lead to further farm closures in labour-intensive sectors such as livestock.

4 Conclusions

The results of our research show that livestock production in Hungary is also a significant contributor to environmental pollution and climate change. In addition, since the change of regime, the Hungarian livestock sector has been facing a permanent crisis, accompanied by an intensive concentration of livestock production. The reasons for this are manifold, ranging from the privatisation of the food industry to changes in the regulatory environment.

Our interviews with young farmers show that there are currently a number of obstacles to boosting livestock production, such as shortages of land, labour and capital. Although a community of young farmers is in place, it is not effective enough in overcoming these obstacles, which in this way hinders generational change. There is therefore a need to implement supportive policies that generally facilitate the creation of agricultural enterprises for individuals outside the agricultural sector. One such solution could be to support backyard farming, which requires fewer resources due to its smaller scale.

In order to set agriculture, including livestock farming, on a new path, new policy instruments and approaches need to be adopted in Hungarian policy making, such as Diversified Farming System (DFS), community agriculture or the new agrarian paradigm. These changes are essential for the development of an environmentally and economically sustainable and socially just food system that ensures the country's food security.

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