Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 2, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CHALLENGES AND ALTERNATIVES ON THE FORAGES RESOURCES PROVIDING UNDER CURRENT ENVIRONMENTAL AND CLIMATE CONDITIONS

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Abstract

Forages resources represent the vector between vegetal production and animal production, constituting, at the same time, the category of essential inputs for obtaining favourable technical-economic results in the animal breeding sector. The paper analysis the challenges and risks faced by these fodder resources in the context of environmental and climate changes, also presenting substitution alternatives, in case of deficit situations. As research methods used, descriptive and comparative analysis can be listed, along with correlations and analysis of statistical indicators, based on available official data. The analysis highlights the fact that, in the conditions of climate changes, ensuring the fodder for animal farms can present certain risks and, consequently, it is necessary to take managerial decisions to improve efficiency and reorientation in the structure of fodder crops, considering their nutritional qualities.

Key words*: *fodder, challenges, environment, climate

INTRODUCTION

Agriculture is essential for food security under future climate conditions. In this context, the quantity and quality of fodder is an important criterion for ensuring plant and animal production [2].

Agriculture is the first element in nature most affected by climate change [1].

The variability of natural and climatic factors acts complexly and directly on the vegetation, determining the quantity, quality, and rhythm of plant production. The climate is of particular importance for agricultural production, determining the large areas of vegetation and the possible area for the spread of crops. The frequency and duration of annual drought periods, as well as the frequency of years with low precipitation, annual and seasonal temperature values, precipitation amounts and their distribution, solar radiation influence the level, quality and rhythmicity in fodder production, the length of the growing season, respectively feeding with green forages, the variety of crops, the organization system of the green conveyor, etc. In warmer areas with sufficient rainfall, the duration of vegetation is longer, the period of feeding animals with green fodder longer, a richer variety of fodder crops [13].

The forage productivity is affected by environmental factors, which can lead to nutritional problems for animals [9].

The change in climatic and environmental conditions has as consequence the modification of the nutritional composition of the forages and their digestibility [10].

Global warming may, also, limit the expansion of animal husbandry in warmer, drier regions if there are significant losses in the efficiency of animal production [8].

Water storage solutions can help mitigate the effects of drought, but if irrigation is not available, the soil moisture deficit increases, with repercussions on forage production. The use of new varieties, resistant to drought, is one of the solutions for adapting to climate change [3].

In the current environmental and climate conditions, the culture of forage plants must aim at their tolerance to acute stress, more than to the long-term climate [7].

Such information is needed by producers, decision makers, processors, to adapt agricultural systems and practices to become more resilient to climate variability and extreme weather events [14].

In this context, the paper aimed to analyze the challenges and risks regarding fodder resources under the climate and environment change and to propose new forage alternatives when animal farms could face with deficit.

MATERIALS AND METHODS

As research methods, there were used descriptive and comparative analysis, correlations and analysis of statistical indicators, regression functions, R square, graphical design, based on available official data from National Institute of Statistics (NIS) [11] and National Meteorology Administration (NMA) [12].

Also, to estimate the size of a crop's risk based on a data from a series of the last 10 years, it was used the formula described by [13] (Formula 1).

$$Rk = ((QN \times 100)/(DY \times P)) \times (DY / TY) = (QN \times 100)/(P \times TY) \quad (1)$$

where:

Rk = the crop risk (%) of the average production achieved per period analysed;

QN = the quantity not realized in deficit years, compared to the average of the period;

P = average production per hectare achieved in the period analysed;

DY = number of deficit years;

TY = total number of years per period.

RESULTS AND DISCUSSIONS

According to data for Romania from the European Drought Observatory, for the first decade of 2024, the combined drought index at country level was 25%, with 3.5% degree of vegetation damage (obviously low, not being a vegetation period).

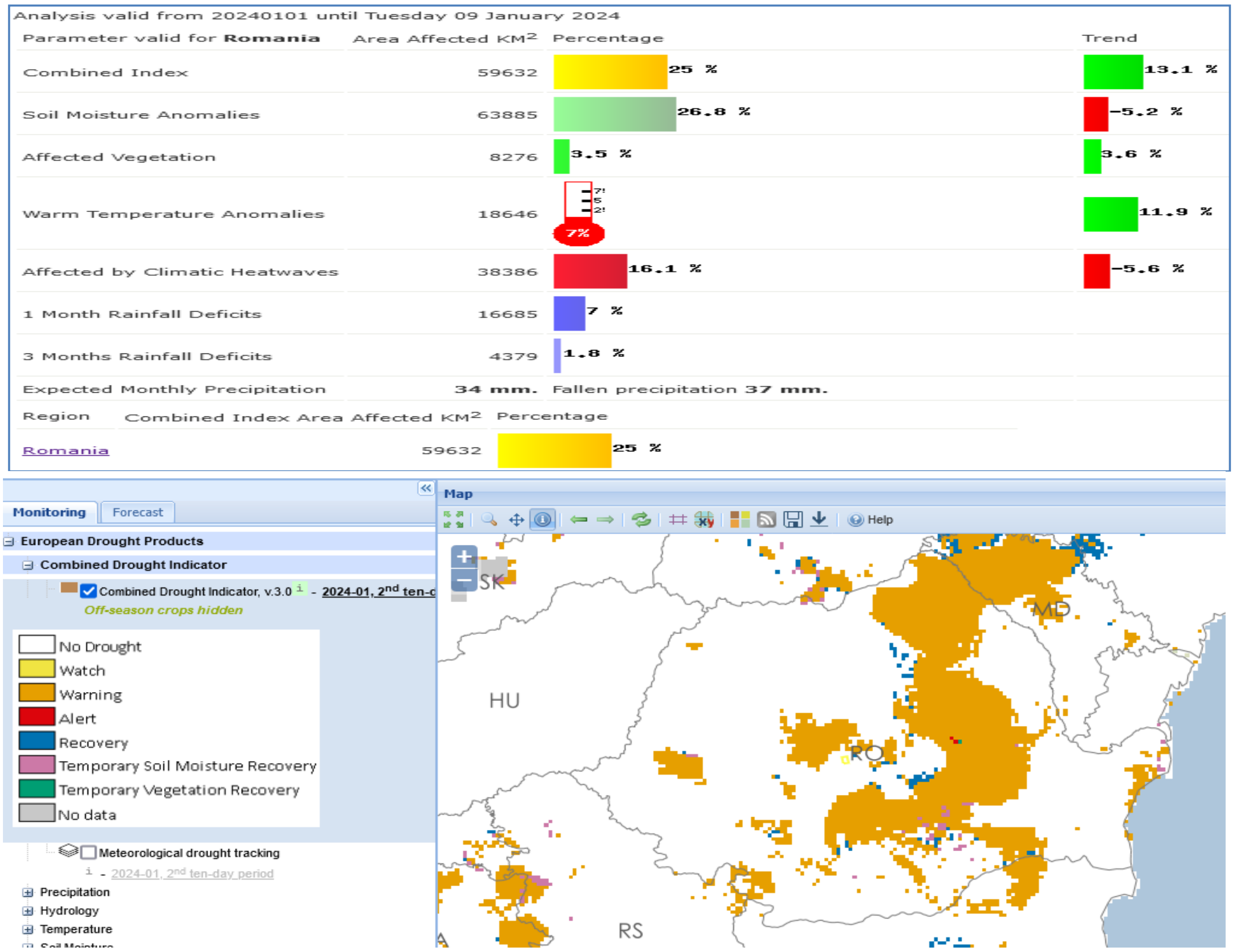

Fig. 1. Drought Dashboard for Romania
Source: European Drought Observatory [5].

The level of the drought is in the "warning" stage, affecting mainly the east, southeast, south, and partially the centre of Romania (Figure 1).

Prolonged droughts lead to the reduction of livestock, constituting calamities with serious economic repercussions. The climate factor determines to a certain extent both the volume and the quality of the fodder. Knowing the production potential and the nature of the fodder, is of particular importance for the rational organization of the forage's resources and animal production.

The Pearson correlation coefficient of 0.44 calculated between the amount of average annual precipitation from 2012-2022 and the average production of green alfalfa indicates an acceptable correlation between the two variables, and the coefficient of determination R^2 shows that 18.97% of the production average of alfalfa can be explained by the linear relationship with the amount of average annual precipitation (Figure 2).

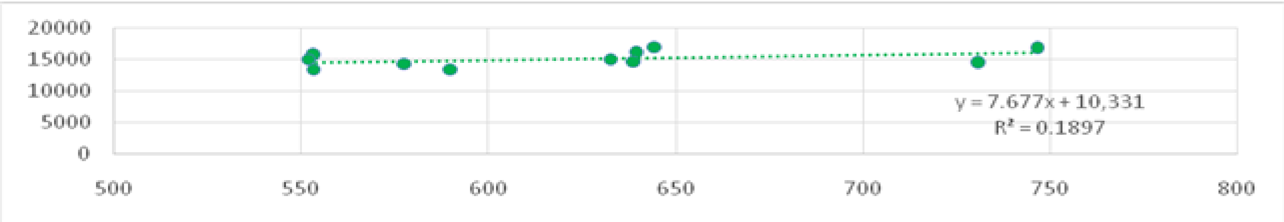

Fig. 2. Correlation between 2012-2022 average annual rainfall and average green alfalfa production
Source: own calculations based on NIS [11] and NMA data [12].

Regarding the behaviour of forage plants in the current environmental and climate conditions, they have different requirements and different degrees of adaptation. Alfalfa is highly drought tolerant and heat loving. Also, *Onobrychis viciifolia*, *Lotus corniculatus*, *Agropyrum cristatum*, *Bromus inermis*, autumn vetch, peas, Sudan grass, sorghum are drought-resistant forage plants. The Pearson coefficient of 0.52 between the amount of average annual precipitation from 2012-2022 and the average production of perennial forages indicates a good correlation, and R^2 shows that 26.58% of the average production of perennial forages can be explained by the linear relationship with the amount of average annual precipitation (Figure 3).

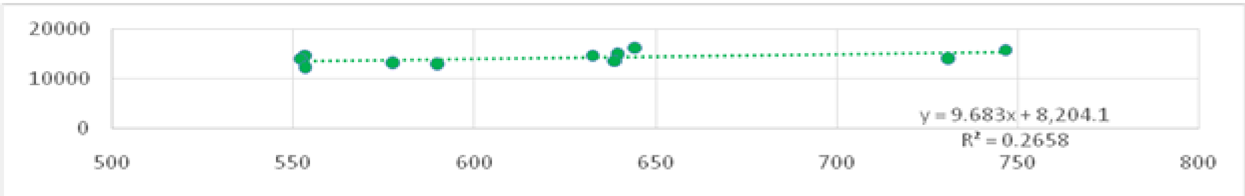

Fig. 3. Correlation between 2012-2022 average annual rainfall and average perennial forages production
Source: own calculations based on NIS [11] and NMA data [12].

So, natural meadows and hayfields are affected by the continuous lack of rainfall, reducing their yields, quality, and structure, and depriving them of the nutrients so necessary for the large and small ruminants that practice grazing. Plain and hilly areas are characterized by a high participation of concentrated fodder, especially corn, as well as green forages, which offer the possibility of developing ruminant farms - cattle and sheep. On the other hand, concentrates offer the possibility of developing pig and poultry farms, for which this type of feed is essential. And in the hilly areas, there is a greater participation of green forages, followed by succulents, concentrates and hay, and in the mountainous area, green forages and hay are found in higher proportions, the other categories (succulents, concentrates, straw) being in smaller proportions. The Pearson coefficient of 0.30 between the amount of annual average precipitation from 2012-2022 and the average production of green maize indicates an acceptable correlation, and R^2 shows that 8.97% of the average production of green corn can be explained by the linear relationship with the amount of average annual precipitation (Figure 4).

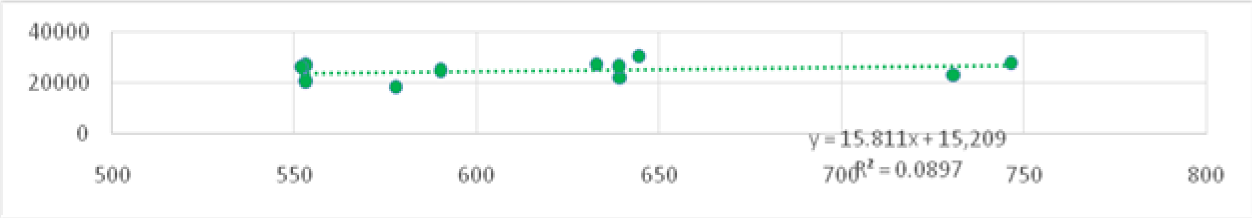

Fig. 4. Correlation between 2012-2022 average annual rainfall and average production of green maize
Source: own calculations based on NIS [11] and NMA data [12].

Mitigating the effects of drought can be achieved by irrigating the crop areas and by organizing fodder reserves, which size depends on the risk and fluctuation of the respective harvests. The risk's size of a crop can be expressed by multiplying the frequency of years in which the harvest deviates in the minus during the studied period, and the amount of these deviations, in relation to the average production per hectare achieved during the period (Nica V. & collab.). The risk's size of a crop is an important criterion for determining the size of the reserves. Also, larger reserves must be provided for dairy cows and young bulls than for sheep, because the numbers of the latter are restored more easily, and sheep can exploit grazing from resources other than those from fodder production. According to statistical data, the average production per hectare for green alfalfa in the last 10 years was 15.2 tons (Figure 5).

Dividing the sum of the unrealized quantities to the number of deficit years from the period under study (years with production under average), the result is a non-realization coefficient of 0.8 tons/ha (meaning 5.3%). Applying the crop risk formula to alfalfa yields, results a frequency of 60% deficit years and a crop risk of 3.17%.

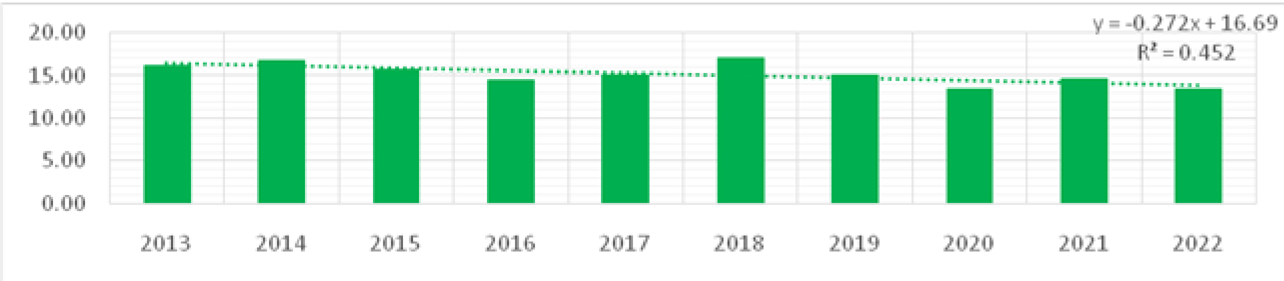

Fig. 5. The evolution of the average production per hectare for green alfalfa
Source: own representation based on NIS data [11].

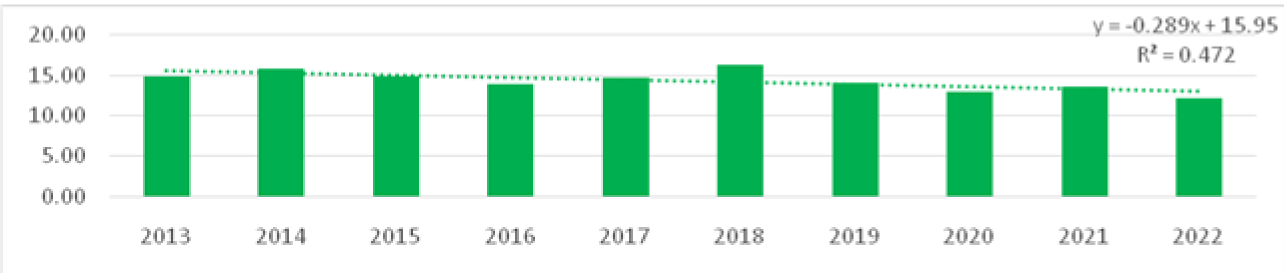

Fig. 6. The evolution of the average production per hectare for perennial forages
Source: own representation based on NIS data [11].

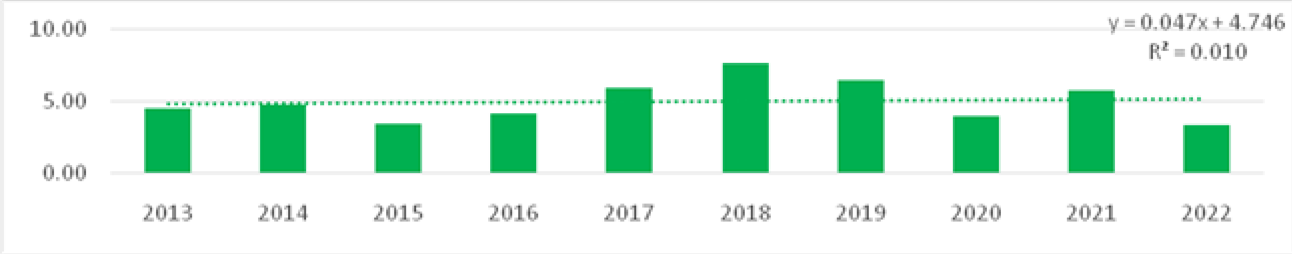

Fig. 7. The evolution of the average production per hectare for corn grains
Source: own representation based on NIS data [11].

For perennial forages, the average production per hectare in the last 10 years was 14.36 tons (Figure 6). The non-realization coefficient was of 0.99 tons/ha (meaning 6.9%), the frequency of deficit years was 50% and the crop risk of 3.46%. For corn grains, the average production per hectare in the last 10 years was 5.01 tons (Figure 7).

The non-realization coefficient was of 0.98 tons/ha (meaning 19.6%), the frequency of deficit years was 60% and the crop risk of 11.75%.

For the substitution of feeds, it is necessary to know their nutritional value. Thus, hay can be replaced by cereal and leguminous straw, corn cobs, reed, chaff, sunflower etc. Cereals can be replaced by potatoes, turnips, wild chestnuts, residues from oil mills, sugar beet noodles, etc. For the most economical use of substitute feeds, it is necessary to prepare them before they are introduced into animal feed. Thus, coarse fodder (straw, corn cobs, reeds) will be chopped, ground, or can be ensiled. To improve the taste, they can be mixed with succulent fodder. Forage rations must be balanced in terms of nutritional units and protein, ensuring a specific consumption as low as possible. Fodder substitutions are made in years when natural calamities occur (drought, floods, hail), which reduce or suppress the production of valuable fodder, which are normally used in animal feed. In the recent years, sorghum culture has grown due to its resistance to drought and high temperatures [4], which is why it is also called the "vegetal camel", being able to replace the maize in dry years, as it has close nutritional value. Also, production costs are lower than maize, it has a low need for inputs, especially fertilizers, and the disease resistance is high. To obtain high yields in sorghum, crop rotation is recommended, providing forerunner plants such as cereals, sunflowers, sugar beets, or maize [15].

W. J. Fulkerson et al. (2008) showed that sorghum has significantly higher metabolizable protein content than perennial ryegrass [6]. For sorghum, the average production per hectare in the last 10 years was 3.35 tons (Figure 8). The non-realization coefficient was of 0.68 tons/ha (meaning 20,3%), the frequency of deficit years was 50% and the crop risk of 12.18%.

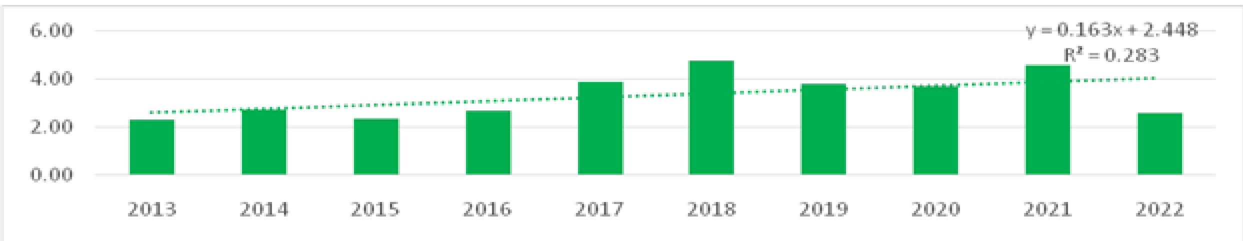

Fig. 8. The evolution of the average production per hectare for sorghum
Source: own representation based on NIS data [11].

CONCLUSIONS

The variability of environmental factors has a direct and even limiting action on feed production, which, in turn, determines the level of development of livestock production. Knowledge of these determinants is necessary throughout the production chain, both to be able to intervene with methods to reduce negative effects, and for long-term adaptation to similar adverse conditions. This means tracking the risk of different forage crops used in animal feed, in the area where the farm is located, as well as finding solutions to replace the forage reserves under the greatest risk, so as not to jeopardize the continuity of the farm's production flows.

ACKNOWLEDGEMENTS

The work is part of the ADER Project 22.1.2, Phase 2 - „Technical-economic models of sustainable agricultural management of forage crops in dairy cows and young bull farms for fattening, in the conditions of climate change", financed by the Ministry of Agriculture and Rural Development.

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