# ZOOPASTORAL INDICES FOR EVALUATION AND CONVERSION OF PLANT PRODUCTION INTO ANIMAL PRODUCTION IN CATTLE DURING THE GRAZING SEASON

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**Abstract.** *The paper includes several zoopastoral indices determined according to the climatic values and the floristic composition of the grassy carpet of permanent grasslands established in air temperature measurements and long-term animal experiments. The duration of the optimal grazing season is equal to the daily duration of the average air temperature between 10-20 0 C and decreases at altitude between 500-2,500 m with a gradient of 7.5 days / 100 m. The production of green mass (GM) evaluated based on the floristic survey of extensively used permanent grasslands is 0.2-31.5 t/ha and the pastoral value index (PV) is 0-100. The consumption of GM for one liter of cow's milk depending on PV is between 4-9 kg GM and for 1 kg of weight gain in young bulls is 50-100 kg GM. The total production per hectare of milk or weight gain is calculated by dividing the production of GM (kg/ha) by the average consumption of GM (kg) for 1 liter or 1 kg of animal product. By dividing the evaluated production of GM (kg/ha) by the daily requirement of GM / LU of 65 kg multiplied by the duration of the grazing season (days), the optimal loading per hectare is calculated.*

**Keywords:** zoopastoral indices, grazing season duration, milk production, weight gain, cattle

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## 1. Introduction

Determining livestock production during the grazing season is a very important operation for the pastoral economy.

To establish milk production, live weight gain, wool, etc., rigorous, complicated and expensive experiments are required on an extremely wide diversity of grassland types from plains, hills to high mountains [10].

Determining through experimentation the production of green mass and its quality, milk production or live weight gain in young animals on the dozens of types of grasslands used for grazing in Romania is almost impossible to achieve.

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Zoopastoral indices established in experiments with animals on pastures in different seasonal and grassland vegetation conditions were used.

The paper presents the main zoopastoral indices that refer to the duration of the grazing season depending on altitude, average air temperature and precipitation, the evaluation of green mass production and its quality, the optimal animal load per hectare, the feed-animal product conversion per hectare and their economic value.

## 2. Material and methods

Main zoopastoral indicator was the optimal duration of the grazing season for which the average daily temperatures of 5, 10, 15 and 20 degrees per altitude and the average decadal precipitation from the work Clima României [16] were taken into analysis.

Using altitudinal gradients of temperature and precipitation between 100-500 m and 500-2,500 m, the optimal duration of the grazing season was evaluated [6].

The production of green fodder mass and pastoral value were determined using a new method based on the floristic survey of grasslands with indices of their fodder value [1, 2, 3, 7, 13] and green mass [9].

Following this method, the plant productivity of numerous photo-sociological associations and alliances, types and habitats of grasslands, also published in the present Annals of the AOŞ-R, was evaluated.

In order to evaluate livestock production per hectare during the grazing season, it was necessary to establish feed-to-milk and feed-to-liveweight conversion indices based on rigorous experimentation with animals in different seasonal conditions and types of grasslands.

For milk production, the long-term experience with cows from Blana-Bucegi [8] and from Măgurele-Braşov [15] was taken into account.

For the conversion indices into live weight gain, namely the amount of feed per 1 kg gain, numerous experiments with young female breeding bulls carried out in Vlădeni (1972-72), Măgurele-Braşov (1974-77; 1980-82), Sighet-MM (1981-83) and others were taken into analysis [5].

On sown grasslands of high forage value in these experiments with animals fertilized at an average level of 200 kg/ha N; 23 kg/ha $P_2O_5$ and 44 kg/ha $K_2O$, 8.49 t/ha dry matter (DM), 1,740 kg/ha crude protein (CP) were obtained, which ensured 810 kg/ha live weight gain in young cattle with a consumption of 10.48 kg DM/ 1 kg weight gain [5].

Transforming SU production into green mass (GM) by multiplying by the coefficient 5 results in 52.4 kg GMS for 1 kg of weight gain [14].

These experiments were carried out on temporary (sown) grasslands after the restoration of the degraded *Nardus stricta* grassland at Vlădeni and Sighetul Marmației (Agriș) or on arable land at Măgurele-Brașov and Sighetul Marmației (Stațiune) [5].

At Vlădeni-BV [4] and Agriș-MM [12], conversion into live weight gain in young cattle was established and in the case of improving degraded grasslands, only through fertilization with chemical fertilizers.

On these permanent grasslands with spontaneous flora vegetation, at Agriș-MM 7.92 t/ha SU was obtained and in animals 340 kg/ha live weight gain with 23.3 kg SU/1 kg gain and at Vlădeni-BV the average consumption was 11.20 kg SU/kg gain, resulting in an average of 17.25 kg SU/kg gain, respectively 86 kg GM/kg gain, under conditions of proper fertilization and use.

## 3. Results and discussions

First zoopastoral indicator was the duration of the optimal grazing season depending on the duration of the average air temperature between 10 $^0$C and 20 $^0$C, existing between 100-500 m altitude in the plain and hilly area and above 500 m in the mountainous area (Table 1).

**Table 1.** Optimal period for grazing animals in grasslands [6, 11]

| Altitude difference | Duration | | Optimal duration (days) | |
|---|---|---|---|---|
| | Adt ≥ 10 $^0$C (days) | Adt ≥ 20 $^0$C (days) | Normal climate conditions | Ensured humidity conditions |
| 2,500 | 25 | 0 | 25 | 25 |
| 2,200 – 2,400 | 40 | 0 | 40 | 40 |
| 2,000 – 2,200 | 55 | 0 | 55 | 55 |
| 1,800 – 2,000 | 70 | 0 | 70 | 70 |
| 1,600 – 1,800 | 85 | 0 | 85 | 85 |
| 1,400 – 1,600 | 100 | 0 | 100 | 100 |
| 1,200 – 1,400 | 115 | 0 | 115 | 115 |
| 1,000 – 1,200 | 130 | 0 | 130 | 130 |
| 800 – 1,000 | 145 | 0 | 145 | 145 |
| 600 - 800 | 160 | 0 | 160 | 160 |
| 400 - 600 | 175 | 0 | 175 | 175 |
| 200 – 400 | 190 | 45 | 145 | 190 |
| 0 – 200 | 205 | 90 | 115 | 205 |
| **Gradients for 100 m alt.** | **- 7.5 days (0 – 2,500m)** | **- 22.5 days (0 - 500m)** | **+ 15 days (0 - 500m) - 7.5 days (500 – 2,500m)** | **- 7.5 days (0 – 2,500m)** |

From these data it results that the duration of the grazing season between 100-500 m altitude increases with a gradient of 15 days / 100 m (115-175 days) after which between 500-2,500 m alt. it decreases by 7.5 days / 100 m (175-25 days).

The calculation formulas were as follows:

**G.s.d (100-500 m alt.) = 100 x 0.15 x Alt.**

in which:
G.s.d = duration of grazing season (days)
Alt. = altitude (m)

**G.s.d (500-2,500 m alt.) =212 – 0.075 x Alt.**

The determination of green mass production and pastoral value of a permanent grassland exploited by animal grazing was based on floristic surveys [9].

The evaluation of green fodder production was done according to the formulas:

**GMI= 4 x P(%) ind. 4...+ 9 x P(%) ind. 9/100**

in which:
GMI = average green forage mass index
P (%) = species participation in the grassy carpet
Ind. 4....9 = mass assessment notes for fodder species

The list of species mass assessment notes is very long, it is presented in widely circulated works [9].

The average green mass index (IGM) is multiplied by a coefficient of transformation into green mass production (t/ha) (Table 2).

The pastoral value (PV) of a permanent grassland is determined by the formula:

**PV = Σ P (%) x F / 9**

in which:
P (%) = participation of the forage species in the grassy carpet
F = feed quality index, with the notations:
1 = toxic to animals and humans;
2 = harmful to animal products;
3 = harmful to the grass carpet;
4 = poor forage (ballast);
5 = mediocre forage (formerly F1);

6 = medium fodder (formerly F2);
7 = good fodder (formerly F3);
8 = very good fodder (formerly F4);
9 = excellent forage (formerly F5);
X = species with unknown forage value.

Similarly, indices of forage quality of species in the grassy carpet of a grassland, due to lack of space, are presented in other previous works [9].

After calculations, the PV of a grassland is estimated as follows:

0-5 severely degraded
5-15 very weak
15-25 weak
25-40 mediocre
40-60 medium
60-80 good
80-100 very good

**Table 2.** Production indices for forage species and estimation of useful production per hectare of unfertilized permanent grassland [9]

| Average green mass production indices for forage species (M) | Transformation coefficients in green mass production (GM) | Estimated green mass production (GM) (t/ha) | Production value appreciation |
|---|---|---|---|
| 0.1 – 0.5<br>0.5 – 1.0 | x 1.8<br>x 1.9 | 0.2 – 0.9<br>1.0 – 1.9 | Very Low |
| 1.0 – 1.5<br>1.5 – 2.0 | x2.0<br>x2.1 | 2.0 – 3.0<br>3.2 – 4.2 | Low |
| 2.0 – 2.5<br>2.5 – 3.0 | x 2.2<br>x 2.3 | 4.4 – 5.5<br>5.8 – 6.9 | Low-Medium |
| 3.0 – 3.5<br>3.5 – 4.0 | x 2.4<br>x 2.5 | 7.2 – 8.4<br>8.8 – 10.0 | Medium |
| 4.0 – 4.5<br>4.5 – 5.0 | x 2.6<br>x 2.7 | 10.4 – 11.7<br>12.2 – 13.5 | Medium-Good |
| 5.0 – 5.5<br>5.5 – 6.0 | x 2.8<br>x 2.9 | 14.0 – 15.4<br>16.0 – 17.4 | Good |
| 6.0 – 6.5<br>6.5 – 7.0 | x3.0<br>x3.1 | 18.0 – 19.5<br>20.2 – 21.7 | Good-Very good |
| 7.0 – 7.5<br>7.5 – 8.0 | x 3.2<br>x 3.3 | 22.4 – 24.0<br>24.8 – 26.4 | Very good |
| 8.0 – 8.5<br>8.5 – 9.0 | x 3.4<br>x 3.5 | 27.2 – 28.9<br>29.8 – 31.5 | Excellent |

The optimal loading and grazing capacity of a pasture is determined by the formula:

**GC (LU/ha) = GM Production (kg/ha) / G.s.d x 65**

GC = grazing capacity (animal load)
LU = large cattle unit
GM = green fodder mass
G.s.d = grazing season duration
65 = amount of GM (kg) required for 1 LU/day (50 kg+30% annual and seasonal fluctuations of GM)

Another calculation formula for evaluating grazing capacity (CP) is:

**GC = PV x C (LU/ha)**

where „ C″ is an altitude-varying capacity coefficient. (Table 3).

**Table 3**. Grazing capacity coefficient value (C)

| Altitude (m) | Grazing season (days) | Coefficient (C) for pastures | |
|---|---|---|---|
| | | Unfertilized | Medium level fertilization |
| 2,200-2,400 | 40 | 0.010 | - |
| 2,000-2,200 | 55 | 0.014 | - |
| 1,800-2,000 | 70 | 0.018 | - |
| 1,600-1,800 | 85 | 0.022 | 0.052 |
| 1,400-1,600 | 100 | 0.026 | 0.058 |
| 1,200 -1,400 | 115 | 0.030 | 0.064 |
| 1,000-1,200 | 130 | 0.034 | 0.070 |
| 800-1,000 | 145 | 0.038 | 0.076 |
| 600-800 | 160 | 0.042 | 0.082 |
| 400-600 | 175 | 0.046 | 0.088 |
| 200-400 | 190 * | 0.050 | 0.094 |
| 0-200 | 205 * | 0.054 | 0.100 |
| **Gradients for 100 m altitude** | **-7.5 days** | **- 0.002** | **- 0.003** |

*) in river grasslands and irrigation conditions

Of particular importance are the conversion coefficients of green mass production into animal production, which are based on consumption indices for 1 liter of milk or 1 kg of live weight gain in cattle.

The green fodder consumption index for 1 liter (L) of milk was calculated using the formula:

**GM consumption (kg) for 1 L milk = 9.5 – 0.05 x PV**

in which:

GM (kg) = green fodder mass

PV (ind.) = pastoral value

This GM consumption for 1 liter of milk varies between 9 kg GM for those with very low PV to 4 kg GM for a PV index of 100.

Cow milk production per hectare was calculated using the formula:

**Milk production (L/ha) = GM (kg/ha) / GM consumption (kg) for 1 L**

In the case of intensive fertilization and use of grasslands, the formula will apply:

**Milk production (L/ha) = Milk production (L/ha) = PV x Dsp x 0.6 [8]**

in which:

PV= pastoral value index

Dsp = duration of grazing season (days)

0.6= feed-to-milk conversion coefficient determined in long-term experiments

with cows in the pasture

The GM consumption index (kg) for 1 kg of live weight gain in young cattle was calculated according to the formula:

**GM consumption (kg) for 1kg gain = 100 – 0.5 x PV**

Similarly, the consumption of GM for 1 kg of live weight gain varies between 50 kg GM for the maximum PV index of 100 to 100 kg GM for the lowest PV index.

The production of growth (meat) in young cattle per hectare is calculated according to the formula:

**Crop production (kg/ha) = GM (kg/ha) / GM consumption (kg) for 1 kg crop**

After these calculations, depending on the category of cattle existing in the grazing season, dairy cows or young cattle, the economic value of a pasture can be assessed by multiplying milk production by 0.5 €/Liter and weight gain by 3.2

€/kg, final indicators necessary for calculating the economic efficiency of raising these animals [MADR 2026].

## Conclusions

(1). Climatic data (air temperature, precipitation regime), floristic surveys of the grassy carpet and long-term experimental results with animals during the grazing season can be taken into account for establishing zoopastoral indices.

(2). Zoopastoral indices are very important for establishing the optimal duration of the grazing season, grazing capacity, green mass consumption for 1 liter of cow's milk or 1 kg of live weight gain in young cattle, livestock production per hectare and other economic data.

(3). The duration of the grazing season increases between 100-500 m alt. (115-175 days) by 15 days / 100 m altitude and decreases at 500-2,500 (175-25 days) with a gradient of 7.5 days / 100 m altitude.

(4). The average consumption of GM for 1 liter of milk is between 4-9 kg GM and that for 1 kg of live weight gain between 50-100 kg GM depending on the value of the PV index.

(5). The final production of milk with a cost at European level of 0.5 Euro / kg and that of live weight gain of 3.2 Euro / 1 kg more accurately expresses the economic value of a permanent pasture.

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