LUCRĂRI ŞTIINŢIFICE, SERIA I, VOL. XI (1)

THE EVALUATION OF THE AGRO-ECOLOGICAL SUSTAINABILITY OF AGRICULTURAL HOLDINGS USING IDEA METHOD

EVALUAREA SUSTENABILITĂŢII AGRO-ECOLOGICE DIN CADRUL HOLDINGURILOR AGRICOLE UTILIZÂND METODA IDEA

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The paper presents partial results of a large empirical study of the sustainability of Romanian agricultural holdings. The farm sustainable development potential is measured on the basis of IDEA method (Indicators of Agricultural Holding Sustainability). This method comprises 10 sustainability components, grouped by three levels: agro-ecological, socio-territorial and socio-economic. Of all 400 farms inclued in the sample, 20 groupings of farms were made according to different combined homogeneity criteria: legal status, activity profile etc., and the first level – agro-ecological level of sustaiability has been evaluated.

Key words: *sustainability indicators, agro-ecologic components, agricultural holdings*

The paper is presenting partial results of a large research program, funded by CNCSIS, and called „Complex research models and methods for sustainable rural development in Romania”. A survey has been conducted in 2008 in 400 agricultural holdings, all over Romania. Although non statistically representative[**], it covered all regions, geographical areas (plains, hills, mountains), legal statuses, activity profiles, in order to provide the best possible image of the current situation.

The farm sustainable development potential is measured on the basis of IDEA method (Indicators of Agricultural Holding Sustainability),

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[**] A statistically representative survey would have required a much larger sample of agricultural holdings, far beyond the financial means of the project.

developed by the French researchers at INRA. This method comprises 10 sustainability components, grouped by three levels: agro-ecological, socio-territorial and socio-economic, summing up 41 complex indicators, consisting of over 100 aggregate indicators.

The agro-ecological sustainability components that have been investigated in the selected sample are: (a) agricultural biodiversity; (b) agricultural territory organization; (c) agricultural practices used.

In the study conducted on the 400 agricultural holdings, each indicator was calculated at the level of each holding included in the sample, according to the methodology. The methodology is described in detail in another paper[*]. The individual results regarding the estimation of agro-ecological sustainability are relevant only by their returning to each farmer in part.

The results reveal a very high variability of the sustainability scores on the population of tested agricultural holdings.

In the studied sample, the agro-ecologic sustainability score ranges from 25 to 69 out of the "100 ideal points".

In the research conducted by the project team, 20 groupings of farms were made according to different combined homogeneity criteria: legal status, activity profile (crop production, livestock production), agricultural area, relief units, crop mix and species and categories of animals, etc. Slight variability could be noticed even inside each group, therefore the results by each group were calculated as weighted averages.

In order to assess and score the diversity of crops and animal species, the Hirfindahl- Hirschmann diversity index (IHH) was used:

$$\sum_{c=1}^{n}\left[\left(\frac{Ac1}{UAA}\right)^2+.....+\left(\frac{Acn}{UAA}\right)^2\right]=HHI_{Cr}$$

$$\sum_{c=1}^{n}\left[\left(\frac{AHsp_1}{TLLU}\right)^2+.....+\left(\frac{AHsp_n}{TLLU}\right)^2\right]=HHI_{Lv}$$

where:

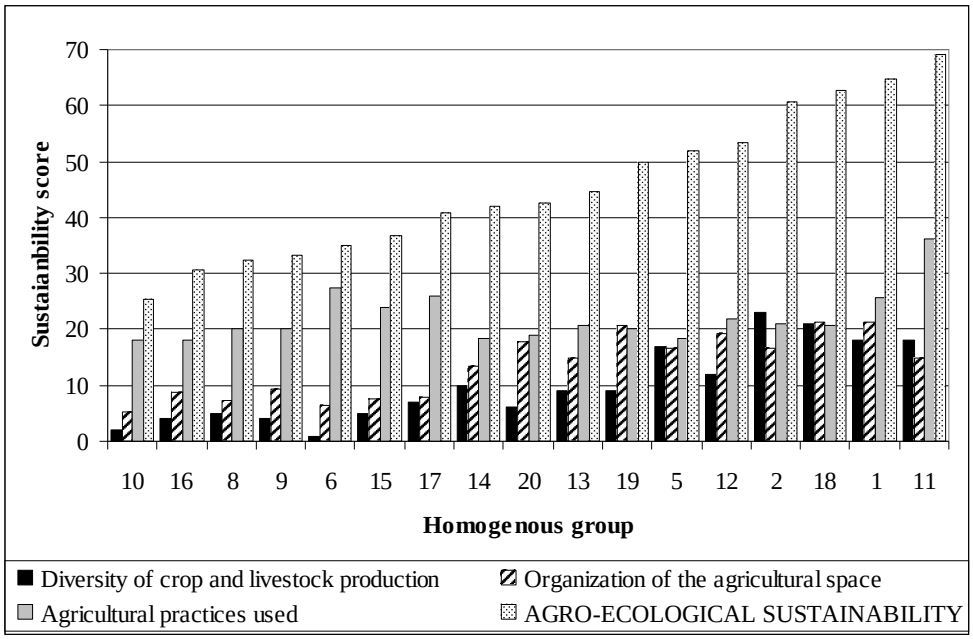
Ac_n = agricultural area of the crop n (hectares);

[*] Toma C., Gavrilescu C., Turtoi, C. (2009) - *The IDEA method for the evaluation of the agro-ecological sustainability of agricultural holdings.*

UAA= utilized agricultural area;
$AHsp_n$ = animal herds expressed in large livestock units (UVM) from the species n;
TLLU = total livestock herds on the farm, expressed in large livestock units (LLU).

The graphic representation is relevant for the large variation of homogeneous groupings:

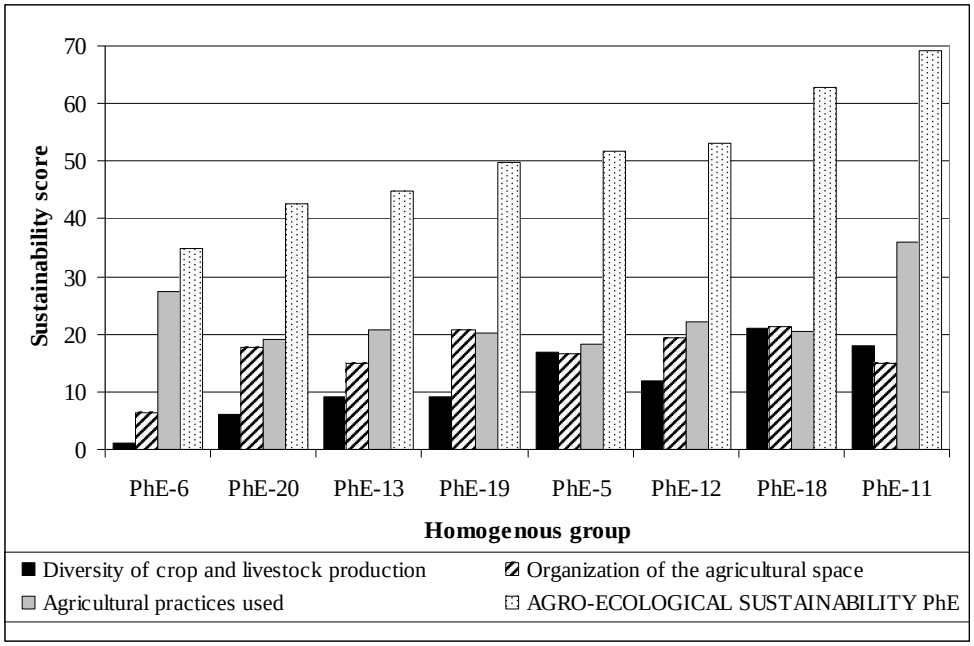
Graph 1. Homogeneous groups of agricultural holdings classified according to the weighted average scores of the agro-ecological sustainability components



According to the criteria and pre-established norms for each agro-ecological sustainability indicator, the groups of holdings "physical entities" *(graph 2)* are the most sustainable, with scores ranging from 35 to 69, compared to the legal entities *(graph 3)*, which obtained scores ranging from 26 to 65.

By components, "the agricultural territory organization" and "agricultural biodiversity" are better represented in the case of physical entities, with higher scores, compared to the legal entity farms, where the sustainability indicators of the "agricultural practices" obtained higher sustainability scores.

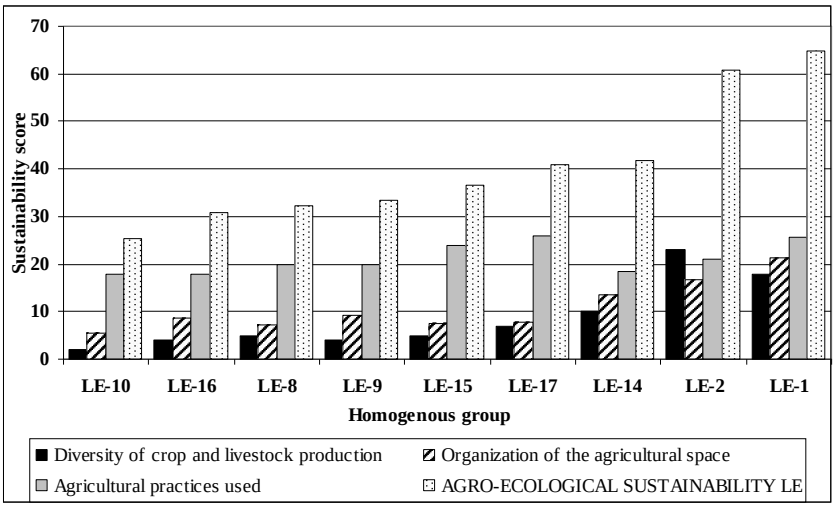
Graph 2. Homogeneous groups of agricultural holdings "Physical entities"classified according to the weighted average scores of the agro-ecological sustainability components



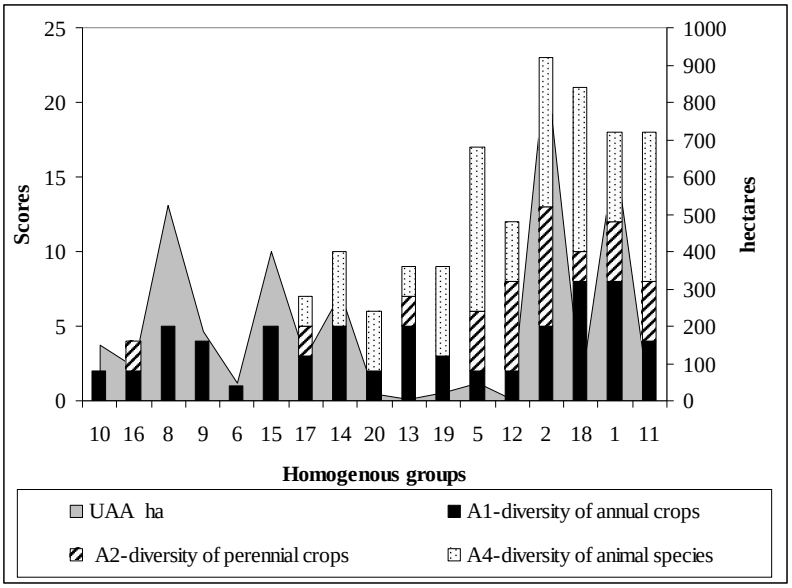
We can conclude that there is a better balance among the agro-ecological sustainability components in the case of family holdings compared to the legal entities.

The 20 homogeneous groups were analyzed in detail by the indicators of the three sustainability components and utilized agricultural area: (a) agricultural biodiversity (graph 4); (b) agricultural territory organization (graph 5); and (c) agricultural practices used (graph 6).

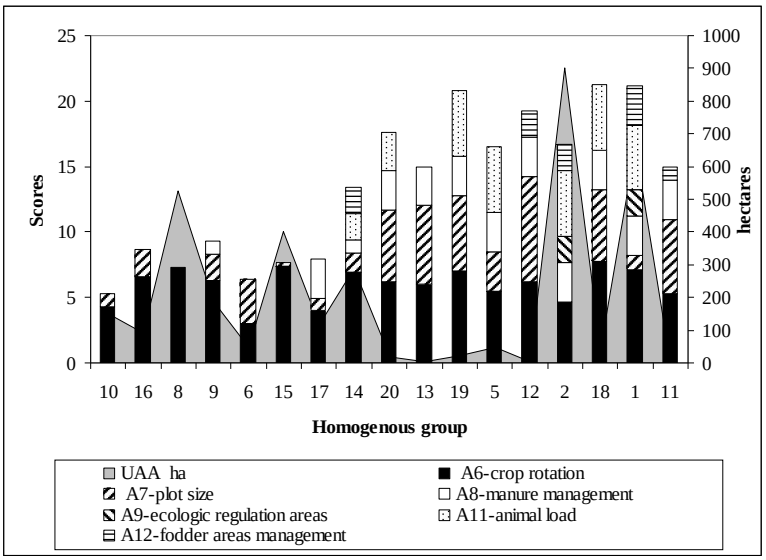
Graph 3. Homogeneous groups of agricultural holdings "Legal entities"classified according to the weighted average scores of the agro-ecological sustainability components



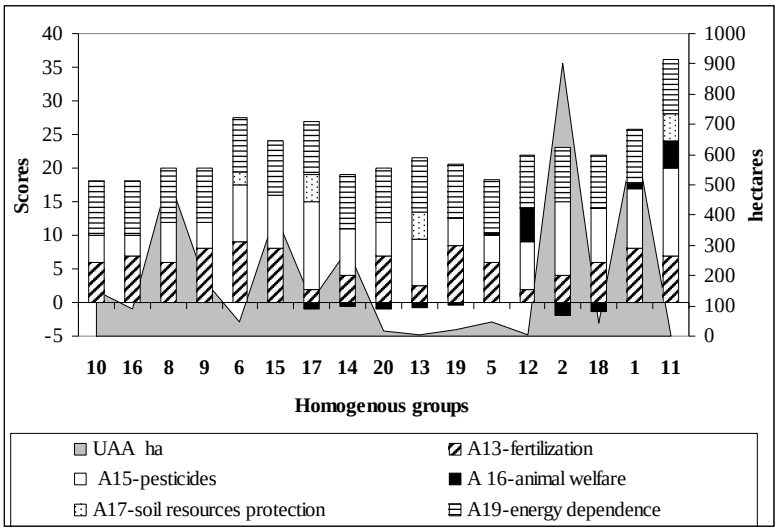
Graph 4. Indicators calculated by the sustainability component „agricultural biodiversity" and weighted average UAA by the 20 identified homogeneous groups



Graph 5. Indicators calculated by the sustainability component „agricultural territory organization" and weighted average UAA by the 20 identified homogeneous groups



Graph 6. Indicators calculated by the sustainability component „agricultural practices used" and weighted average UAA by the 20 identified homogeneous groups



The first 6 groups (labeled 10, 16, 8, 9, 6 and 15) are groups of holdings with crop production activity, while the other groups are groups of holdings with mixed activity (crop and livestock production, in different combinations and shares of animal species).

From the analysis of group 11 with 69 points, which reveals the highest agro-ecological sustainability level in the evaluated sample, we find out that the highest share is held by the "agricultural territory organization" component, characterized by:

- a maximum score of the indicator referring to pesticide use, which means that few pesticides are used;
- a maximum score of the "energy dependence" indicator (less than 200 liters diesel equivalent per hectare, by summing up the energy consumptions of diesel oil, chemical fertilizers and electric power);
- ensuring an adequate space for farm animals shelters, which contributes to animal welfare;
- the combination of winter crops, spring crops, perennial and permanent crops in a reasonable proportion under the crop rotation ensures the smallest area possible of unprotected soil over the winter, contributing to soil resources conservation;
- the fertilization with chemical and organic fertilizers, up to 120-130 kg of nitrogen active substance per hectare.

The second component, according to the obtained scores, is "agricultural biodiversity", which is mainly obtained by the presence of a significant number of species and categories of animals on the farm; the third component, according to its share, is represented by the "utilized agricultural practices" where the farm cumulated a relatively small number, due to the large load of animals by main fodder area (over 2 LLU/ha) for which it obtained the score zero.

Overall, group 11 is compared to the sample average and the maximum score thresholds for the agro-ecological sustainability *(Graph 7*).

For exemplification purposes, two groups of agricultural holdings from Braşov county were selected. Table 2 presents a few general characteristics of the group with crop production activity profile:

Graph 7. Comparison of the maximum agro-ecological sustainability, sample sustainability and sustainability of group with the highest score

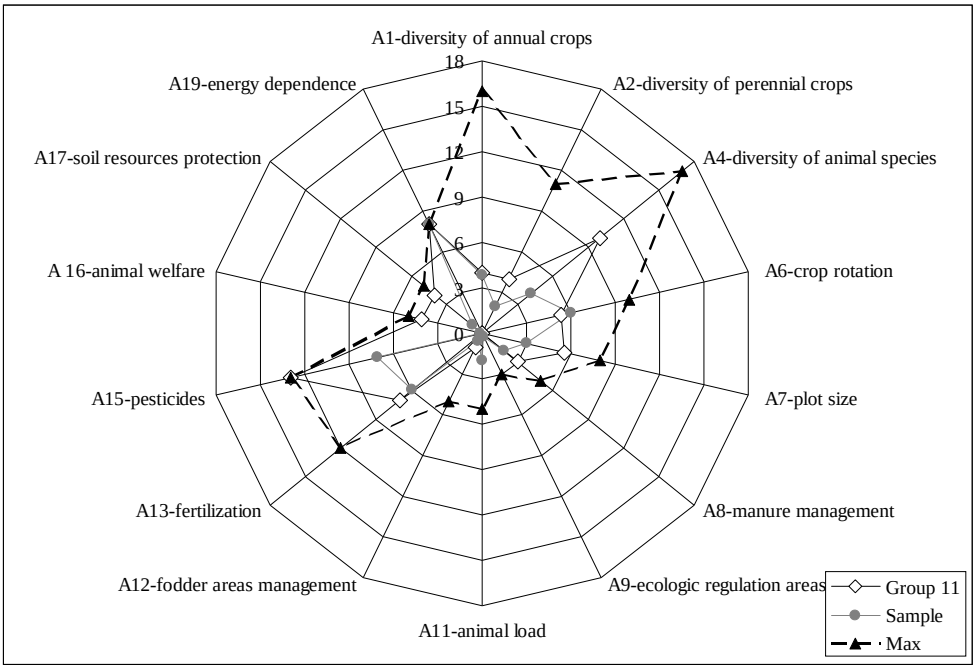
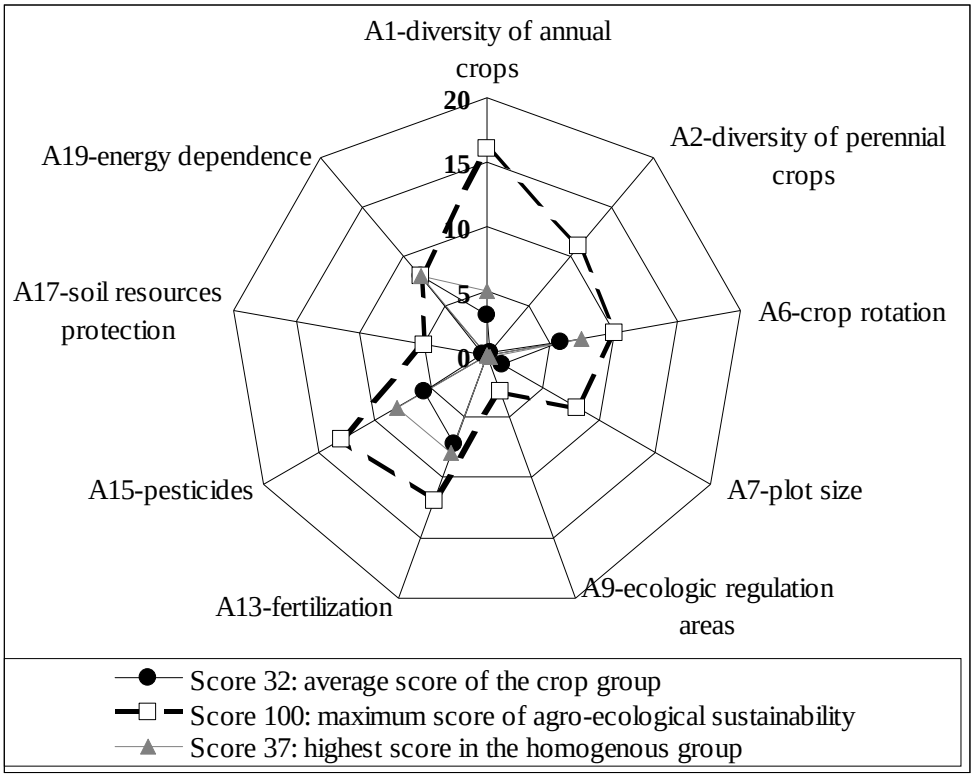


Table 2. Characterization of the group of holdings specialized in crop production from Braşov county

Number of agricultural holdings by legal status	Area - ha	Share of species cultivated on arable land	Group score
Physical entities - 3,4% Legal entities - 96,6%	40 - 500 ha	cereals - 65% potatoes - 20% sugar beet - 8% alfalfa - 1% other crops - 1% arable idle - 5%	32/100

The average agro-ecological sustainability score, as well as the highest in the group do not exceed 40 points, which reveals a low technical sustainability level (graph 8):

Graph 8. Agro-ecological sustainability of the group of holdings specialized in crop production from Braşov county



- the holdings have significant agricultural areas;

- a relatively low diversity of crops in crop rotation, even though there are more than 4 crops, was assigned a lower score due to the large disproportions between the cultivated areas, which does not ensure an adequate rotation of crops in crop rotation;

- the size of land areas cultivated with the same crop is very large or very small (from the sustainability point of view);

- the fertilization level is medium (for the maximum score 12, the amount of nitrogen inputs do not exceed 70 kg per hectare);

- the amounts of pesticides applied are significant, mainly in the case of potatoes and sugar beet;

- the protection of soil resources is weak, the spring crops prevailing.

- the energy dependence is good, the amount of Diesel oil per hectare being in the limits of specific consumptions. In the investigated group of holdings, the share of new tractors and equipment from import is high, which ensures significant savings in the case of fuel consumption.

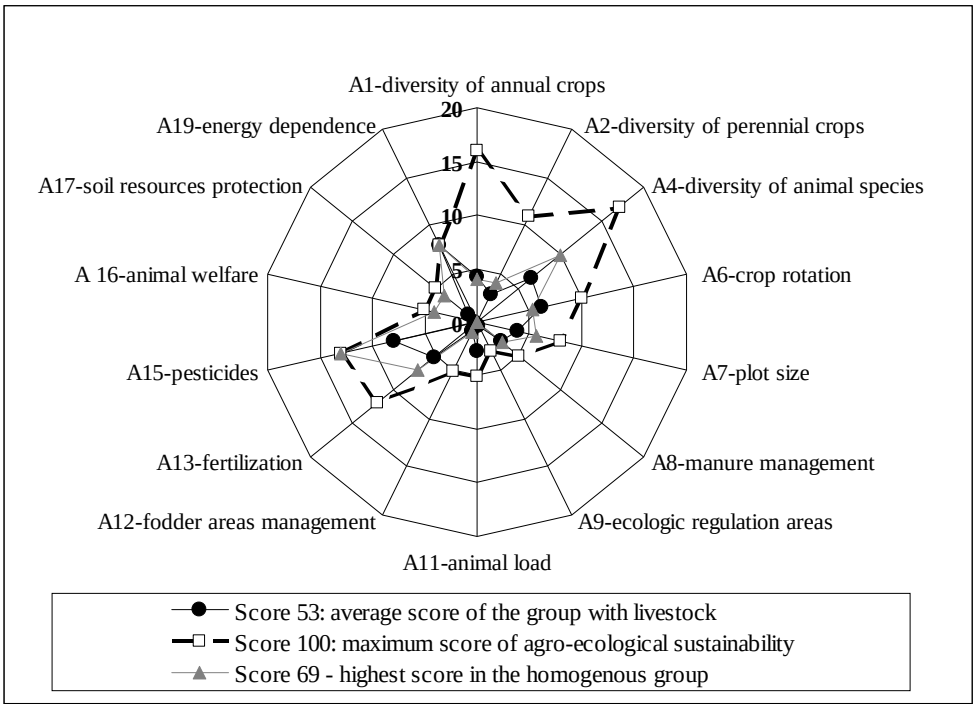
Table 3 presents a few characteristics of the group of mixed holdings from the Braşov county. This group is non-homogeneous from the point of view of the operated agricultural area. Yet, according to the other criteria, it features homogeneity from the point of view of the structure of crops and animal species specific to the pedo-climatic and suitability area.

Table 3. Characterization of the group of holdings specialized in mixed crop and livestock production in Braşov county

Number of agricultural holdings by legal status	Area - ha	Share of species cultivated on arable land	Share of animal species in total LLU	Group score
• Physical entities: 13% • Legal entities: 87%	3 - 660 ha	• cereals - 36% • potatoes - 6% • sugar beet - 11% • fodder crops - 32% • private pastures and hayfields - 13% • *communal pastures 16% of total utilized area*	• bovines - 48% • *of which dairy cows - 54%* • sheep+goats - 48% • pigs - 3% • poultry - 0.2% • horses - 1%	54/100

The indicators specific to crop production generally have similar characteristics to those from the group of holdings specialized only in crop production. On the average, in the group, the animal welfare and soil resources protection indicators have low scores of agro-ecological sustainability; these results bear the negative influence of the presence in the group of certain farms raising and fattening young cattle under industrial system, which do not ensure an optimum built-up space, according to the ecological sustainability standards, and a spring crop mix that leaves the land unprotected over the cold season (graph 9).

Graph 9. Agro-ecological sustainability of the group of holdings specialized in crop and livestock production from Braşov county



CONCLUSIONS

The first results obtained from this study provided an imperfect yet realistic picture of the agro-ecological sustainability of a relatively large number of Romanian holdings. The system of indicators from the IDEA method represented the main diagnosis instrument of the agricultural holding. At present, this method is among the few instruments that propose a set of coordinated indicators characteristic to a certain concept of sustainable agriculture, considered ecologically healthy, socially fair and economically viable.

A starting hypothesis was based upon the idea that the agricultural sustainability of a territory is equal to the sustainability average of each agricultural holding from this territory. Farm sustainability at national level or at regional and county level would be thus generally analyzed by the

juxtaposition and cumulating of production systems by weighting. This was only a working hypothesis, as in reality many positive or negative effects were found, resulting from the local variability; in the territory many indicators are compensated and are attenuated into an average value that makes the analysis too general. The more the analysis is at a larger scale, the more deformed the picture is.

Thus, after a first stage, when the indicators were tested in the field, we proceeded to the correction of certain problems that appeared, namely the review of the scoring scale, of the collected information nature, modifying certain parameters, adapted to the realities of the Romanian agriculture. In spite of this, there are certain indicators that are less accurate, which can be still improved by changing the score thresholds, share or calculation modality, which could be used into a global assessment in this way. At the same time, the method has another weakness, with regard to the pedal-climatic factors, which are not included in the agro-ecological sustainability analysis.

In spite of these small inaccuracies of methodological nature, these indicators can serve to the identification of the "most sustainable" production systems from the agro-ecological point of view. The analysis of their characteristics should contribute to a better understanding of the determinants and mechanisms to be used in an approach promoting sustainable agriculture.

The IDEA method represents a new possible field of investigation that is opened and provides new perspectives and new levers to facilitate the evolution to sustainable agriculture.

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