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ИНТЕНЗИВНОСТ НА ФЕРМИ С НИСКИ ВЛОЖЕНИЯ И СЪЗДАВАНЕ НА ИНДИКАТОРИ ЗА БИОРАЗНООБРАЗИЕ
INTENSITY IN LOW-INPUT FARMS AND DEVELOPMENT OF INDICATORS FOR BIODIVERSITY

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Резюме

Съхранението на биоразнообразието е неотложна задача за нашето общество с особено значение за пасищните територии. Европейският проект БиоБио по Седма рамкова програма – *Индикатори за биоразнообразие във фермерски системи за биологично и с ниски вложения земеделие*, има за цел да разработи научно обосновани, приложими и атрактивни индикатори за биоразнообразие в Европа във ферми за биологично и с ниски вложения земеделие. Районът за изследване в България е представен с фермерство с ниски вложения в пасища в Родопите. Проведено е предварително селекциониране на 16 ферми с ниски вложения за детайлно изследване на индикаторите за биоразнообразие. За да се намери подходяща скала, която да обхване фермите, са очертани социално-икономически компоненти, фактори на средата и отчасти интензивност на използване. Използвани са три основни групи от фактори и условия, за да се създаде подходящ модел и определяне на скала: общи социално-икономически фактори, социално-икономически условия, независещи от собственика, зависещи от собственика социално-икономически условия. Сумарното влияние на оценените фактори и условия е представено с индекс за интензивност на фермата. Разработеният модел позволява предварително разделяне на фермите в три групи по интензивност. Научно се потвърждава разпределението на фермите в подходяща скала преди определянето на индикаторите за биоразнообразие в пасища с ниски вложения.

Abstract

Biodiversity conservation is an urgent task for our society with special attention for grassland areas. The EU FP7 research project BIOBIO - *INDICATORS FOR BIODIVERSITY IN ORGANIC AND LOW-INPUT FARMING SYSTEMS* aims at developing scientifically sound, useful and attractive biodiversity indicators for organic and low-input farming in Europe. The Bulgarian case study region in the project is presented by low-input farming in grasslands in the Rhodopi mountains. Preliminary selection of 16 low-input farms in Bulgaria for a detailed assessment of biodiversity indicators is carried out. The socio-economic components, environmental factors and partially management intensity have been outlined in order to find farms covering a reliable scale of low-input farming. Three main groups of factors and conditions are implemented for developing an appropriate model for scaling: general socio-economic factors, non-enterprise specific socio-economic conditions, enterprise specific socio-economic conditions. The summarized effect of evaluated factors and conditions is presented by the farm intensity index. The developed model allows preliminary differentiation of farms in three main groups of intensity. A reliable scaling of farms prior to detailed assessment of indicators for biodiversity in low-input grasslands has been confirmed scientifically.

Ключови думи: биоразнообразие, пасища, ниски вложения, ферми, интензивност.
Key words: biodiversity, grasslands, low-input, farms, intensity.

INTRODUCTION

Biodiversity conservation – preserving species and their genetic variability, ecological communities, and landscape variety – is an urgent task for our society. Compared to other community types, European grasslands have a rich flora and they may develop a very high small-scale species density (Pärtel et al., 2005).

High grassland biodiversity is generally associated with low-input livestock systems that support less than 1LU (livestock unit) per ha (Duru and Hubert, 2003). Today biodiverse grasslands only survive where economic drivers towards intensification cannot operate (e.g. due to climatic or topographic constraints) or where there is adequate compensation against intensification via agro environment subsidies (Hodson et al., 2005). Biodiversity rich areas are often characterized by marked differences in management between fields that reflect topographic and environmental differences. Although grassland biodiversity may provide numerous potential utilization functions (Swift et al., 2004) at an ecosystem or landscape level, to livestock farmers the essential function is to feed herbivores.

The EU FP7 research project BIOBIO - *Indicators for biodiversity in organic and low-input farming systems* aims at developing scientifically sound, useful and attractive biodiversity indicators for organic and low-input farming in Europe. In the first project phase, possible indicators for genetic, species and habitat diversity as well as for farm management practices were screened for their scientific soundness and ranked by stakeholders for their usefulness and attractiveness in WP2 (BIOBIO Deliverable 2.1, Dennis et al., 2009). Developing biodiversity indicators for organic and low-input farming systems is the overall research objective for BioBio. Low-input farming systems (LIFS) are found all across Europe. "LIFS can be defined as a way to optimise the management and use of internal production inputs (i.e., on-farm resources) ... and to minimise the use of production inputs (i.e., off-farm resources), such as purchased fertilisers and pesticides, wherever and whenever feasible and practicable, to lower production costs, to avoid pollution of surface and groundwater, to reduce pesticide residues in food, to reduce a farmer's overall risk, and to increase both short- and long- term farm profitability" (Parr et al. 1990). LIFS are often located in marginal areas or in areas which are at risk of marginalisation due to unfavourable natural conditions for agriculture. Frequently LIFS in Europe are grazing systems. The second report (BIOBIO Deliverable D3.1, Arndorfer et al., 2010) summarises the characteristics of the case study regions and documents the process of selecting BioBio case study farms in each region. Eventually 10 to 20 farms per region were identified for a detailed assessment of biodiversity indicators in 2010.

The Bulgarian case study region in the BioBio project consists of low-input farming in grasslands of the Rhodope mountains. The most valuable ecosystems in Bulgaria are part of the agricultural landscape. About 350,000 ha of natural and semi-natural grazing habitats in the country are important for protection of biodiversity (Meshinev et al., 2005). They include diverse types of meadows and pastures that cover about 30% of the agricultural land of Bulgaria (Meshinev et al., 2005). The grazing habitats are considered being of high natural value (HNV) because of rich biodiversity that includes 51.5% of the Bulgarian flora. The agricultural land with HNV can be classified into 17 habitat types habitats included in Directive 92/43 (EC). Large parts of mentioned ecosystems are maintained predominantly by extensive agriculture – grazing for domestic animals and haymaking.

As part of this project the preliminary selection of 16 low-input farms in Bulgaria for a detailed assessment of biodiversity indicators is presented. This paper outlines the socio-economic components, environmental factors and partially management intensity for seeking farms covering a gradient of farming intensity. To this end an intensity index I is proposed.

MATERIALS AND METHODS

Preconditions for selecting farms were discussed during BioBio Workshop in Vienna in 2009 (Arndorfer et al., 2010). To ensure a sufficiently homogenous sample, two sets of potentially confounding factors can be identified: 1) Environmental conditions: biogeographical region, geomorphologic and soil features, landscape situation, altitude; 2) Farm characteristics: type of farm production.

In Bulgaria the Smolyan region was selected as 'Case Study Region' on the basis of the above mentioned BioBio selection criteria and public information on geographic and socio-economic conditions (Anonymous, 2009). The landscape is mountainous with grasslands and woodlands (predominantly coniferous) prevailing. Variation in altitude: 900 m to 1400 m; Soil: predominantly brown forest soils; Climate: Contingent on the relief and altitude. The average annual temperature in the region varies between 5°C and 10°C. The average annual rainfall is between 750 mm and 1100 mm. The average duration of snow cover is between 3 and 6 months.

Tourism is the priority branch in the regional economy which influences production area, ecology, sociology and cultural traditions of the region. Cattle-breeding and sheep-breeding are the basis for production of various original dairy products. The farm type could be described as „low-input farming system because of the limited (or non existing) use of fertilizers and pesticides in grasslands. About 30% of the Smolyan region is included in NATURA 2000 – bird protected areas.

Preliminary information on farms was collected by direct contact with farmers during three missions carried out in July-October 2009. This information was implemented

for selection of case study farms. Because of confidentiality requirements in EC research projects, the place of farms and name of farmers are not presented. Farms are designated by numbers 1-16.

RESULTS AND DISCUSSION

Preliminary information on farms includes: name of the farmer, address and contacts, area of pastures and meadows (own and rented); species and number of livestock; other economic activities that could support the farmer's household - eco-tourism, rest house keeping, food production, bee keeping, etc. (Table 1). Forty two farms were involved in total, of which 34 confirmed their interest in the project BIOBIO. The number of case study farms was reduced to 32 because 2 of the interviewed farmers subsequently stopped farming. Among all 32 farms of the preliminary farm screening, 16 were selected randomly. The geographical distribution of selected farms in the frame of Smolian region is illustrated in Figure 1.

The socio-economic and ecological principles play an important role in grassland management and land-use practices (Mayer and Wytrzens, 1998; Duru and Hubert, 2003). On the basis of similar arguments we suggest that socio-economic and ecological factors (and the complex interactions between the two) are responsible for the differences in grassland management intensities. Recently it was reported that farm size and farming intensity are not related (Herzog et al., 2006). However we used farm size indirectly for calculation of livestock units per area. Creation of models is widely used for detecting differences in farm intensity (Mayer and Wytrzens, 1998; Trisorio et al., 2008; 2010; Reidisma et al., 2007). In this study we implement modeling approach for pre-selecting farms to ensure the needed pattern of variance for further evaluation of biodiversity indicators in farms. For scaling low-input farms a model design was developed using three main groups of factors and conditions: (1) general farm characteristics, (2) socio-economic framework conditions, (3) socio-economic farm characteristics (Table 2).

The general farm characteristics (1.1-1.3) remain constant across an enterprise or a group of enterprises including:

- LU per farm area – presented like '*conventional animal unit per ha' (CLU)*; Earlier this unit is described as 0.5 cattle per ha or 5 sheep per ha for mountainous grasslands (Bondev, 1991; Georgiev and Christov, 1944; Yancheva et al., 2002; Cheshmedzhiev, 1980; Christov, 1961). According to the last regulation of the Ministry of agriculture (RD-09-116/21.02.2011) is recommended the minimum grassland area per livestock unit (MGA): 0,6 ha for cattle, 0,1ha for sheep/goat, 0,6 ha for horse. This recommendation is used for calculation of conventional LU/ha in the present study;
- Road accessibility to the farm: track - 1; country road - 2; asphalt road - 3;
- Ownership: rented land for one up to three years - 1; governmental (long-term use) - 2; own – 3. The assumption that the rented land (1-3 years)

Table 1. Preliminary information for pre-selected low-input farms

	Farm characteristic	Number of farms involved	Mean value	Minimum value	Maximum value
1.	Utilized agricultural area, ha	32	43,96	4,8	120
2.	Type and number of livestocks				
	Sheep	28	321	5	800
	Cattle	5	35	2	120
	Goats	4	39	4	120
	Horses	6	45	1	200
	Ancien breed *Rhodope short horn cattle*	1	13	13	13
3.	Other economic acivities				
	Bee keeping (number of bee hives)	4	-	1	25
	Dog breeding *Bulgarian shepherd dog* (number of dogs for work and for breeding)	32	-	2	11
	Dairy products on farm production	10	-	-	-
	Rest house keeping	2	-	-	-

Fig. 1. *Place of case study farms in Smolian region shown with red shade in the market area*

is not so intensively used comparing to long-term rented is based on the findings for grassland maintenance. Supporting practices for cleaning, pruning or uproot of harmful plants in short-term rented lands are implemented seldom than in long-term rented or own lands.

The socio-economic framework conditions refer to potential supporting factors like: market for dairy products processed on farm, grants and subsidies and other incomes outside agriculture (2.1-2.3). These factors could be associated more convincing with farm sustainability than with farm intensity (Olale, 2011). However in our case should be pointed that incomes outside agriculture in visited farms more often are used for farm intensification including: enlargement of flocks, more resources for concentrated fodder instead of hay locally produced and investments for mechanization. As presented in other studies the regional agricultural policy for farming is based on standard incomes in farms where direct payment of subsidies relates to more intensive non-HNV farming (Trisorio et al., 2008; 2010). As opposite the same authors suggest that the economic support measures to prevent abandonment and payments to prevent intensification or land conversion could be the proper tool targeted on less intensive HNV farming. In our study agricultural subsidies include mostly direct payment per agricultural area but not for low-intensive farming and could be suggested as conductive to farm intensity. This group of conditions depends more often on administrative criteria and limits in the region for farming. Their evaluation in the scale yes/no is described respectively by 1/0.

The socio-economic farm conditions in a farm are specific and vary considerably (3.1.-3.6). The overall conditions together with local socio-economic conditions prevailing in individual farms lead to a large gradient with respect to: farming method; farm employment status; production factors; equipment and mechanization; food processing on farm and guest-house maintenance; education of the farmer. These conditions are described in a scale of 1 to 3 (Table 2). The relation of farming method to farm intensity is widely recognized (Kleijn et al., 2009). The grading of this factor is described on the basis of information for inputs use – fertilizers and pesticides. There should be pointed that the acting of other factors described above (3.2 – 3.6) on the level of intensity is suggested indirectly on the basis of other studies (Reidisma et al., 2007; Trisorio et al., 2008; 2010). Farm employment or 'work units' is described as important variable in economic analyses and modeling of European farms (Reidisma et al., 2007). In the present study the scaling of this factor is described with 1 to 3 depending to the number of employed. Factors 3.3, 3.4 and 3.5 illustrate the technical conditions for farming and their scaling is created on cumulative principle as shown in Table 2. The factor 'education of farmer' affects technology adoption and concerns farmers' characteristics for detailed surveys (Reidisma et al., 2007). The conditions in this group are very specific. However they represent the real situation at enterprise level and illustrate the differences of pre-selected farms.

Using the described modeling approach the pattern of socio-economic conditions within 16 low-input farms in

Table 2. Model design describing the scale in grassland management of low-input farms

	Factors and conditions	Description	Scale
1.General Socio-Economic Factors	1.1. LU density per area and Conventional Animal Unit per ha	CAU=LU X MGA Where MGA = 0,6 ha for cattle; 0,1ha for sheep/goat; 0,6 ha for horse	
	1.2. Accessibility	track country road asphalt road	1 2 3
	1.3. Ownership	rented land 1-3 years governmental (long-term use) own	1 2 3
2. Not Enterprise Specific Socio-Economic Conditions	2.1. Market for dairy products on farm processed	yes; no	1; 0
	2.2. Grants and subsidies	yes; no	1; 0
	2.3. Potential sources of incomes outside agriculture	yes; no	1; 0
3.Enterprise Specific Socio-Economic Conditions	3.1. Farming method	-low-inputs (no fertilizers or pesticides used) -reduced input use (organic fertilizers used on some parts of grasslands) - artificial fertilizers used, no pesticides)	1 2 3
	3.2. Farm employment status	- farmer's family (1-2 persons) - farmer's family plus 1-3 employed - farmer's family plus more than 3 employed	1 2 3
	3.3. Availability of production factors	- own land - own land + workers - own land + workers + technical equipment	1 2 3
	3.4. Availability of farming equipment	- stables/pens - stables/pens plus fodder storage capacity - stables/pens plus fodder storage capacity inside mechanization (milker, sterilizer, milk cooling bath, storage cold room)	1 2 3
	3.5. Food processing and farmhouse holydays	yes; no	1; 0
	3.6. Education of farmer	- secondary school - specialized/college education; - university education	1 2 3

Rhodope mountains is observed (Table 3). Three indices are described with respect to above mentioned groups: I_1 – using the general farm characteristics (1.1-1.3); I_2 – based to the socio-economic framework conditions (2.1-2.3); I_3 – as result of the specific socio-economic farm characteristics (3.1.-3.6). The summarized effect of all described factors and conditions is presented by the farm intensity index:

$$I = I_1 + I_2 + I_3$$

The intensity index for preliminary scaling of farms is used to detect more scientifically sound arguments for farms differentiation. This modeling approach is illustrated in the diagram (Fig. 2). Three groups of low-input farms with respect to intensity index (I) are clear distinguished:

- Low-intensive with I < 15 (Farm 3; Farm 4; Farm 8; Farm 9; Farm10; Farm 13)
- Medium intensive where 15 < I < 20 (Farm 2; Farm 5; Farm 12; Farm 15)
- Relatively intensive where I > 20 (Farm 1; Farm 6; Farm 7; Farm 11; Farm 14; Farm 16).

The suggested scaling of farm intensity allows a differentiation of the farms before the comprehensive study of biodiversity indicators. It describes that, although the

Table 3. Pattern of socio-economic conditions within 16 low-input farms in Rhodope mountains

FACTORS/CONDITIONS	FARM NUMBER															
	B01	*B02*	*B03*	*B04*	*B05*	*B06*	*B07*	*B08*	*B09*	*B10*	*B11*	*B12*	*B13*	*B14*	*B15*	*B16*
1. Socio-Economic Factors																
Farm size, ha	30	4	6	9	42	36	37	7	18	9	49	7	9	34	32	60
Livestock Units:																
Sheep/Goat (0,1)	260		170	240	260	250	680	160	410	150	300	250		540	180	700
Cattle (0,6)		14				99							14			
Horse (0,8)					8									210		
1.1. Conventional animal unit per ha	0,9	2,1	2,8	2,6	0,8	2,3	1,8	2,3	2,3	1,7	0,6	3,5	0,9	6,5	0,6	1,2
1.2. Accessibility	3	1	1	2	2	3	2	2	1	2	3	1	1	2	1	3
1.3. Ownership	3	3	1	3	3	2	3	1	1	1	3	3	3	1	3	1
Index 1	6,9	6,1	4,8	7,6	5,8	7,3	6,8	5,3	4,3	4,7	6,6	7,5	4,9	9,5	4,6	5,2
2. Not Enterprise Specific Socio-Economic Conditions																
2.1. Market for dairy products on farm processed	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0
2.2. Grants and subsidies	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
2.3. Potential sources of incomes outside agriculture	1	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1
Index 2	3	2	2	0	2	3	2	1	1	1	2	2	1	2	2	2
3. Enterprise Specific Socio-Economic Conditions																
3.1. Farming method	2	2	1	1	1	3	2	1	1	1	1	1	1	2	1	2
3.2. Farm employment status	2	1	2	2	1	3	3	1	1	1	2	2	2	3	2	3
3.3. Availability of production factors	3	2	1	2	2	3	3	1	1	1	3	2	1	3	2	3
3.4. Availability of farming equipment	3	2	1	1	2	3	3	1	1	1	2	1	1	3	1	3
3.5. Food processing and farmhouse holydays	1	1	0	0	1	1	1	0	0	0	1	0	0	1	1	1
3.6. Education of farmer	1	3	1	1	1	3	1	3	2	1	3	2	3	2	2	2
Index 3	12	11	6	7	8	16	13	7	6	5	12	8	8	14	9	14

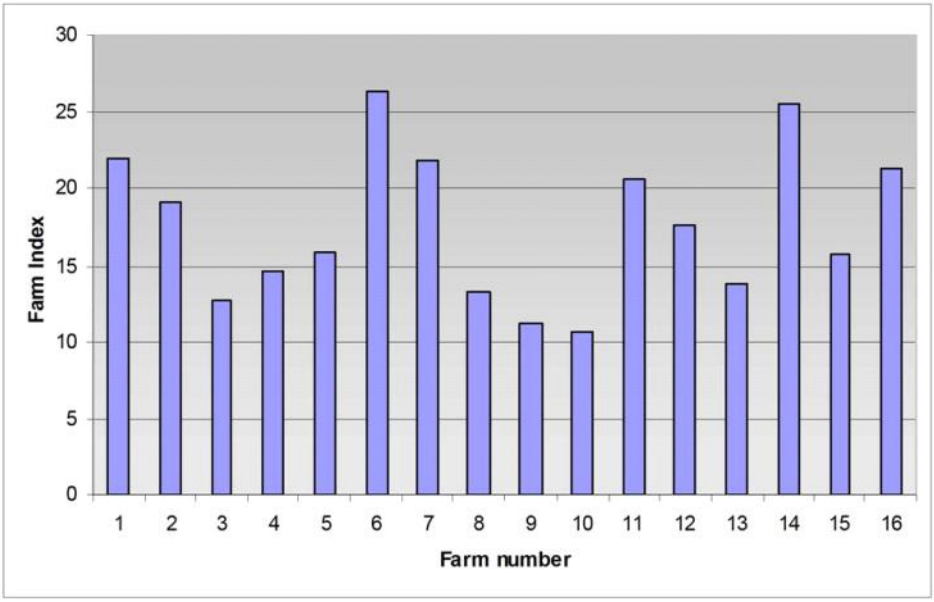

Fig. 2. *The Intensity Index Scale for graduation of 16 farms for low-input farming in Rhodope mountains: $I = I_1 + I_2 + I_3$*
Low-intensive (I < 15): Farm 3; Farm 4; Farm 8; Farm 9; Farm10; Farm 13;
Medium intensive (15 < I < 20): Farm 2; Farm 5; Farm 12; Farm 15;
Relatively intensive (I > 20): Farm 1; Farm 6; Farm 7; Farm 11; Farm 14; Farm

farms were randomly selected, they span a gradient of intensity based on socio-economic factors and conditions.

CONCLUSIONS

The socio-economic components, environmental factors and partially farm management could be used to create a scale of low-input farms by their intensity. Three main groups of factors and conditions are implemented for development of appropriate model for scaling: (1) general socio-economic factors, (2) specific socio-economic conditions non-enterprise related, (3) enterprise specific socio-economic conditions. The total effect of evaluated factors and conditions is presented by the farm intensity index. This index allows preliminary scaling of farms for detection of more scientifically sound arguments for farms differentiation in three groups of intensity: low-intensive, medium intensive and relatively intensive.

The presented model confirms a reliable scale for farm differentiation before detailed assessment of indicators for biodiversity in low-input grasslands.

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