AGRICULTURE AND PROTECTION OF LANDSCAPE AREA OF THE WHITE CARPATHIANS

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ABSTRACT

The protected landscape area of the White Carpathians in Czech Republic is confronted with several threats. The protection of the landscape involves instituted policies and restrictions on production. Due to the approaching EU accession and the possible subsequent institutional changes, there is an increased demand for knowledge on production opportunities and threats. In addition there are immediate concerns on the relation between agricultural production and the environment. One major concern is the abandonment of agricultural land. In this article the combination of production elements and protection is described. Factor analyses are used to identify groups of farms with similarities in production structure and organisation. The results of the factor analysis are compared to typology achieved by interviews. Some important elements with policy and research implications are derived.

Keywords; factor analysis, landscape protection, livestock production, policies, institutions

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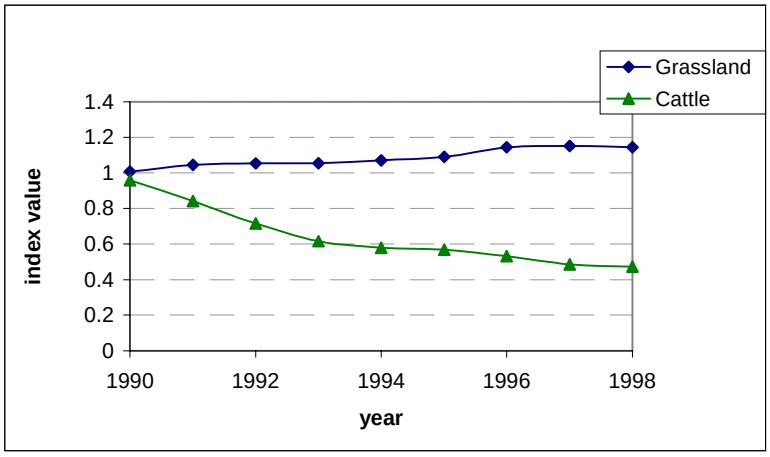
1. INTRODUCTION

The purpose of this study is to investigate opportunities for maintaining and improving the values of the protected landscape area of the White Carphatians with existing policies and institutions. The protected area of the White Carpathians is located in the south Eastern part of Czech Republic along the border of Slovakia. A description of the combination of protection, policies, costs of production and technologies is necessary in order to increase the understanding of existing farming systems and their sensitivity and capability to changes.

The transition of the economic environment in Czech Republic towards a market economy started more than ten years ago. It has been a process of changing policies and institutional arrangements with a consequent impact both on agriculture and environment. The total area of agricultural land is about 4.2 million ha making a share of about 54 percent in the total land area. In former times, the agricultural landscape was subject to high intensification of production that frequently did not comply with natural conditions. A high proportion of arable land (75 percent of the total agricultural land in 1990) was considered to cause environmental problems largely due to soil erosion[1]. During transition, environmental pressure has decreased mainly because of a significant decline in livestock production and reduced application rates of organic and mineral fertilisers[2]. These trends have been particularly evident in mountain and sub-mountain areas due to less productive and marginal soils and higher unit production costs especially for arable crops.

Agricultural policies intended to restructure farming by encouraging conversion of arable land into grassland. As compared to 1989, the total grassland area increased by 30 percent in most mountainous districts, while cattle production went down by 50 percent. The nation-wide trends of grassland farming and cattle production are presented in Figure 1.

Figure 1. Indices of grassland farming and cattle production in Czech Republic from 1989 to 1998 (1989 base year = 1).



Source: Own calculations based on data from Czech Statistical Yearbooks (1991-99).

[1] In Czech Republic more than 40 percent of agricultural land is highly or very highly vulnerable to soil erosion.

[2] For instance, the number of dairy cows dropped by about 50 percent and the total amount of NPK fertiliser application declined from 223 kg/ha in 1989 to 76 kg/ha in 2000

Development of animal production resulted in rather extensive use of grassland and it was accompanied by land abandonment or set aside of production areas[3]. Leaving grassland uncultivated creates environmental and social problems. The general assumption exists that there is an environmental need to decrease high proportions of arable land (in 1999: 73 percent) by conversion to grassland or forest. Market incentives are not strong enough to stimulate conversion of arable land into grassland and the conversion to forest is too costly. From the social point of view, the Czech society prefers open landscape and cultivated land and is willing to pay for landscape maintenance (Krumalová and Prazan, 2002). Simultaneously, Czech policy does not allow any degradation of agricultural land (enacted by Law No. 334/92, amended by Law No. 231/99), which evidently occurs when land is not cultivated.

Land abandonment is a new environmental threat that has emerged during transition. It endangers valuable habitats to get degraded. Particularly biodiversity of semi-natural grasslands seems to be mostly affected by this kind of degradation (land abandonment issues in CEECs are discussed by Baldock and Tar, 2002).

The biological consequences of land abandonment are discussed, e. g., by Klimes et al. (2000) analysing long-term trials on rich species meadows in White Carpathians. They point out that in abandoned grasslands nutrients are not removed by harvesting. Consequently, plants are better supplied with nutrients and their aboveground biomass increases. As a result, only few plants start to dominate the grassland. In the south part of White Carpathians, litter accumulation reduces species richness of meadows by a factor of 10. According to long-term trials, regular moving of previously abandoned meadows proved to be the best practice for restoration. On the total of investigated plots, the number of species increased from 13 to 46 equaling 30 species per m^2 (an increase by the factor 4) during the 1989–1997 period (Klimes et al., 2000). However, the number of species in surrounding rich species meadows ranged between 60 and 70 species per m^2. Klimes and some other authors also estimated that the expected species richness in meadows could be restored by a natural way in 50 years or more.

Krumalová and Ratinger (2001a, b), Ratinger and Krumalová (2002a) investigated the problem of land abandonment. The White Carpathians protected landscape area (PLA) was selected as a case for the study. The study by the Czech researchers concentrated on two dimensions: agri-environmental policies and institutions. The research done by Ratinger and Krumalová (2002b) resulted in three institutional options. The first option was that the state represented by Local Authority of Protected Landscape Area (LA PLA) takes over the ownership and management of all the land that is the most valuable from the conservation point of view. As second option the authors propose that the environmental and agricultural policies are integrated and farmers are contracted to provide nature and landscape values. Policies and their implementation would not change under this option, although a single funding mode could be established for the contracts for the agri-environmental services. In spite of this, the choice and targeting of the measures would be decided in close consultation with LA PLA. The third option is to deliver agri-environmental policies through local partnerships. For instance, communities initiate the setting-up and/or maintenance of environmental co-operatives. This option represents a significant shift in the current institutional and political arrangements.

[3] There are no actual statistical data about the extent of land abandonment. Estimates are about 300 000 ha, that is 7 percent of the total agricultural area (Ministry of Agriculture, 2001).

In this report, the purpose is to analyse the existing structures and organisational forms of agriculture and nature protection in the White Carpathians. Due to the approaching EU accession and the possible subsequent institutional changes, there is an increased demand for knowledge on production opportunities and threats. In addition, there are immediate concerns about the relation between agricultural production and the environment. In this article, the combination of production elements and protection will be described. This information is useful for further design of policies and research about the topic.

This report starts with the description of policies and changes in policies giving an overview of the central elements of protection of the landscape area and the elements of zoning. Thereafter, factor analysis methodology is briefly described and the data and results of this analysis are presented. Finally, some careful conclusions are made based on the results from the analysis.

2. INSTITUTED POLICIES

The policies in Czech Republic dealing with landscape and wildlife conservation were changed and/or established mainly during the 90s. Regarding landscape and biodiversity and farming, some relevant laws were enacted in the beginning of 1990s: Law on Nature and Landscape Conservation No. 114/92 and Law on Protection of Agricultural Land No. 334/92, later amended by Law No. 231/99. The first law mentioned put significant restrictions on farming in designated areas of environmental interest. The relevant designated areas were national parks and protected landscape areas (PLA). PLAs[4] have been enacted by governmental decrees since 1954, most of them during the 1970–1980 period or around 1990. A PLA is a valuable area from a natural, historical and landscape point of view, its borders are precisely delineated. The overall area is divided into four zones of conservation according to a value of the defined area. Zone I is the most valuable area mainly from the natural point of view. Zone IV is usually called buffer area and legislation for such zone is rather similar to that for landscape areas outside PLAs. Law No. 114/92 newly specified restrictions to activities in PLAs, including farming. Some relevant restrictions to farming obligatory for all PLAs are presented in appendix 1. The restrictions and recommendations according to the management plan of the White Carpathians are given in Table 1.

[4] The Czech Republic has a total of 24 PLAs and 4 national parks. These areas are generally called Large-size Specially Protected Areas and they come under special institutional arrangements.

Table 1. Restrictions and recommendations for conservation zones

Zone	Restrictions to and recommendations for farming
I	*Goal: preserve and restore ecosystems on agricultural land by extensive hay and pasture management of grasslands or by alternative farming systems.* • Conversion of grasslands to arable land, gardens or orchards is not allowed. • Renewal of grasslands is allowed only by add-sowing of patches and only by regional grass varieties. • Application of any fertilisers, slurry, other farm wastes, pesticides and other chemical substances is not allowed. • Technologies that do not damage the green sward are required. • Time of grass harvesting or grazing must be agreed with local authorities[5]. • Moved grass has to be taken off the meadows. • Change of water regime is not allowed. • Grazing and its technical provision require approval by local authorities. • During grazing water streams must be protected from livestock damage.
II	Goal: *preserve great diversity of ecosystems on agricultural land and improve the natural state of ecosystems by semi-extensive hay and pasture management and also by conversion of arable land to grassland.* • Conversion of grasslands to arable land is not allowed. • Wide-row crops (e.g. maize) must not be grown on arable land. • Land size should be diminished according to soil vulnerability to erosion. • Change of water regime is not allowed. • Renewal of grassland by re-ploughing is not allowed. • Technologies that do not damage green sward are required. • Slurry and other liquid farm wastes must not be applied. • Mowed grass must be removed from the meadow. • Grazing and its technical provision require approval by the LA PLA. Grazing should comply with the natural grassland condition (maximum livestock density should be 1 LU/ha). • During grazing water streams must be protected from livestock damage.
III and IV	Goal: *maintain farming with partially decreased intensity*. • When renewing grassland, add-sowing with local species should be preferred. • When applying chemicals, possible negative impacts on nature should be considered by minimising the application or using integrated plant protection. Preventive agri-technical and manual weed control should be used. • Organic nutrients should be preferred, mineral fertilisers should be used mainly as complements.

Source: Local Administration of Protected Landscape Area (LA PLA) White Carpathians (1997)

Agricultural policies create the basic institutional and economic environment for farming. In the beginning of transition, major attention was given to property rights restoration and transformation of former state farms and co-operatives. Later, new support programmes were introduced focussing on direct production support as well as "additional" forms of support.

[5] LA PLA (Local Authority of PLA) is a governmental body of the Ministry of Environment.

Farming, especially in the extensive areas, was affected by changing the "additional" support programmes after these programmes had been established[6]. In 1999, as much as 77 percent of total agricultural land was included. Since 1997, annual support (enacted in a support decree) was rendered for so-called multifunctional agriculture including organic farming. The introduced payments were characterised particularly by:

- Classical contract type: one-year contract.
- Payments per hectare.
- Score system of payment levels: each programme was rated by scores in a support decree (enacted annually). However, the actual value of a score was agreed upon at the end of the support year. This system created high uncertainty for farmers. Score levels corresponded with prices of land: levels of payments were in many cases differentiated according to official land prices (more scores for cheaper land).
- Maintenance of less favoured areas was mixed with measures of agri-environmental character.
- No regional differences: designed criteria (management prescriptions) were not differentiated according to regional needs.

In 2000, the character of the support system changed. The score system was replaced by fixed payments per hectare and maintenance of less favoured areas was separated from agri-environmental measures. Although support measures have mainly focused on grassland maintenance, previous and actual support programmes have included only few agri-environmental measures with weak management prescriptions. In addition, payment calculations for the agri-environmental measures have not corresponded to EU principles. Higher payment has been provided for higher intensity, for instance higher number of livestock units per hectare of grassland.

3. METHOD

In this study, the farming systems approach is used to investigate the cause and effect of protection of landscape area on agriculture. The farming systems approach involves the participatory approach of actors as a main element. However, due to limited funds, this report is mainly based on information earlier gathered from interviews. The flexibility of the farming systems approach warrants this procedure, as farming in the area is restricted by regulations and support mechanisms. Furthermore there are annual changes in policies and so far only one year of observations is available. This means the response to changes of policies and production restrictions cannot be answered empirically. The farming systems approach can be rather holistic and can recognise the local activities and their direct causalities with environment. Instead of a dynamic analysis, the static analysis is improved by including elements from indicators of pressures.

The first step in the farming systems approach (FSA) is to use a descriptive analysis to define farm types and farming activities of concern. Thereafter the causes and effects are investigated. Factors that affect the incentives and restrictions of the decision-makers are identified through the process. Promoted and desired environmental, social and economic outcomes are tested on these pre-assumptions. These results are then possible to use for recommendations on changes in policies and institutions.

[6] Law No. 257/1997 on Agriculture allowed and established framework for support of multifunctional agriculture.

The different farming activities create a multivariate data set. This requires the use of a multivariate method to simplify and generalise the information included. After simplifying it is possible to further explore the data against possible hypotheses. Therefore in our case a variable-directed analysis is beneficial. The types of farms and the combinations of circumstances of the farms are subjected to factor analyses. The latter serve to identify the numbers of different dimensions that explains the variation in the data. Factor analysis is especially useful to identify variation between variables (Thurstone, 1947; Harman, 1960; Cooley and Lohnes, 1962).

The basic factorisation model by principal component is,

$$\begin{bmatrix} X_1 \\ X_2 \\ X_p \end{bmatrix} = \begin{bmatrix} a_{11}F_1 & a_{12}F_2 & a_{1m}F_m \\ a_{21}F_1 & a_{22}F_2 & a_{2m}F_m \\ a_{p1}F_1 & a_{p2}F_2 & a_{pm}F_m \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_p \end{bmatrix} \qquad (1)$$

X are normalised variables, a are factor loadings and F are common factors with no correlation between each other, e are variations not explained by the factors. The m numbers of factors is decided by

$$\lambda_i > 1 \text{ where} \qquad (2)$$

$$\lambda_i = a_{1i}^2 + a_{2i}^2 + ... + a_{mi}^2 \qquad (3)$$

The achieved factors can thereafter be changed by rotation (Varimax, Statgraphics Plus) to further simplify the explanation of the different factors. The factor analyses are used to group the variables with high correlation. The factor scores are thereafter analysed and compared with other typology according to technology and organisational forms given by the interviews.

4. DATA

The data are based on interviews that were organised for preparation of a SAPARD measure. The interviewed farmers came from chosen municipalities[7] of following sub-regions of the protected landscape of the White Carpathians: Hornacko, Moravske Kopanice and Valassko. The Valassko subregion is situated in the northern part of the protected area of the White Carpathians, the Moravske Kopanice is in the central and Hornacko in the southern part. Table 2 presents some basic information about the municipalities (in total for each sub-region):

[7] The municipalities were chosen as suitable ones for the SAPARD measure "Environmentally Friendly Practises in Agriculture" (corresponding to agri-environmental measure due to Regulation (EC) 2078/92). Data about land cover and population are from 1996.

Table 2. Information of the sub-regions and data selection

	Hornacko	Moravske Kopanice	Valassko	Total
Chosen municipalities (No.)	7	6	8	21
Total area (ha)	13505	6423	10210	30138
Total agricultural land (ha)	8183	3363	4528	16074
Arable land (ha)	4593	902	1829	7324
Meadows (ha)	2188	909	1616	4713
Pastures (ha)	1049	1269	902	3220
Orchards and gardens (ha)	353	285	181	819
Total population (No.)	8050	2939	12652	23641
Population trend (%)	-12	-27	-2	
Unemployment rate (%)	10	16	12	
Travelling to work (%)	70	71	69	
Interviewed farmers (No.)	6	7	9	22

Source: Own calculations based on data from Research Institute of Agricultural Economics, Prague

The farm survey was made in 1999 covering 22 farms among which 16 were family farms and 6 farm companies. They operated a total of 9408 ha of agricultural land, with 4840 ha being located in the PLA. Further details about the structure of production (arable land, livestock, grassland) runs of observations, distribution of farm areas according to nature conservation zones, etc., are found in Appendix II.

The investigated farms were mainly operating grassland (Table 3). Family farms were relatively large averaging 99 ha (the average in Czech Republic is 28.2 ha according to the Ministry of Agriculture, 2001) and the value of median was 41 ha (right side distribution of values). The farms had a high amount of meadow and pasture. That makes these farms bigger than Czech farms on average. The White Carpathians region does not provide very good condition for farming. Most of soils (75 percent) are of a cambisol type that is not a very fertile soil (only the southern border part of the PLA is rather fertile). Additionally, the whole area is vulnerable to soil erosion by water and is also affected by wind erosion.

Table 3. Information about interviewed farms in White Carpathians region

	Companies	Family farms	All in average
Average ha	1325	99	434
Average Arable land ha	436	14	129
Average LU cattle	323	17	100
Average LU/ha	0.33	0.33	0.33
Average % in PLA	51	59	57
Average % grass in I,II z	25	45	40

Source: Own calculations based on data from Research Institute of Agricultural Economics, Prague

The structure of agricultural production and activities shows that grassland, meadows and pastures are dominating in the area. Livestock production is predominant in combination with grassland management. The field conditions vary from steep slopes to rather plain areas in the case of larger farms.

Table 4. Average cropping structure (ha) according to farm type

Crop	Companies	Family farms
Meadows	542	63
Pastures	327	46
Other perennial crops (forage crops)	222	
Winter wheat	156	7
Silage maize	141	
Oilseed rape (winter rape)	118	
Winter wheat – fodder	67	8
Mixed forage crops	64	
Hay clover	58	2
Hay of other perennial crops	50	
Oats	50	3
Clover	45	13
Hay lucerne	41	
Other crops	207	26

Source: Own calculations based on data from Research Institute of Agricultural Economics, Prague

Meadows and pastures play an important role for the farms in the region (Table 4). The most important arable crop is winter wheat and for the farm companies silage maize and oilseed rape. In general, the cropping structure is quite differentiated.

5. RESULTS

The main farming activity of interest from the nature protection perspective is the use of meadows and pastures. Cattle production has been the main type of livestock production, while sheep production plays a very limited role. In the area, heterogeneity is found in choice of technologies. The harvesting technology varies from cutting by hand to intensive silage making technologies. The costs of production vary, as regulations and natural conditions restrict the application of particular technologies. Conversion of grassland to arable land is principally allowed if the responsible authority gives permission, but it is rather restricted in the protected areas. In zones I and II of the investigated PLA, the conversion is not allowed at all (see Table 1).

Two factor analyses were performed. One was made with the whole sample identifying dependencies between the investigated variables: cows (except dairy cows) per hectare of agricultural land, cow feeding costs per day, percentage of total agricultural land in PLA, share of grassland in PLA, meadow costs per hectare. The second factor analysis served to investigate the relation between protected area, yields, unit costs and animal density for grazed cattle. The results of factor analysis were correlated with the farm types and their type of operation, i.e. organic or conventional farms.

Factor loading (Table 5) picks up the “Structural components” (Factor 1) and “PLA and cattle extensity” (Factor 2). The two factors included by the criterion of eigen-values < 1 represent 74 percent of the variability.

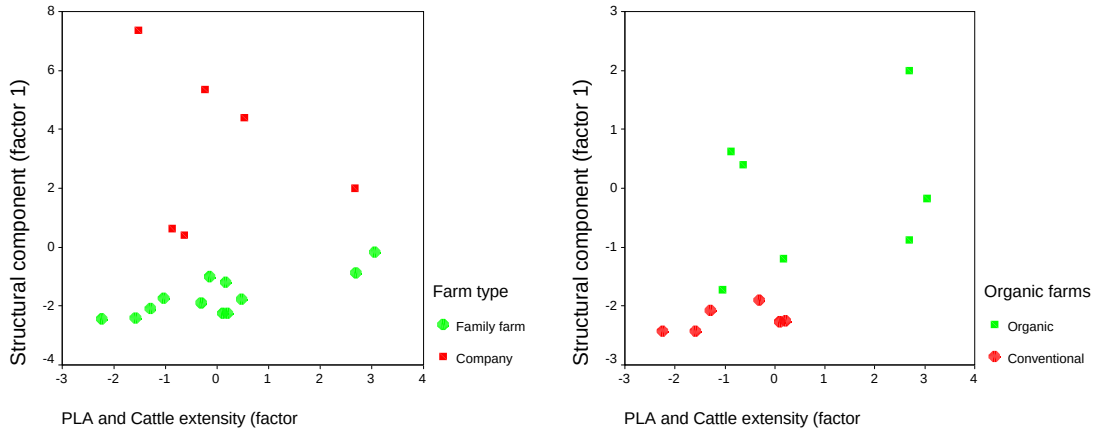
Table 5. Factor loading for selected variables of two factors from the overall sample after Varimax rotation

	“Structural components”	“PLA and cattle extensity”
Total LU	0.92	-0.18
Meadows ha	0.81	0.17
Meadows costs ha	0.73	0.40
Cattle / Grassland ha	-0.04	-0.76
Share of area in PLA	-0.05	0.80
Arable land ha	0.94	-0.21

Source: Own calculations

There is a clear relation between the farm types, the structural components, share of PLA and cattle extensity (Table 6). The first factor “Structural components” picks up all the companies. This indicates high amounts of livestock, meadows and arable land. The second factor included “PLA and cattle extensity” representing mainly organic farms with only one of those being a farm company while the others are all family farms. This indicates that these farms have a high share of PLA and low intensity of cattle production (here related to grasslands).

Figures 2 and 3. Factor scores vs. typology of sample



Source: Own calculations

It is evident that there are structural differences between the organisational types of the farms (Figures 2 and 3). All the farms with high scores for "structural components" are of company type and no family farm is included here. The highest scores for "cattle extensity and PLA share" are all obtained by organic farms.

Table 6. Factor scores and farm typology of overall sample

Observation run	Structural component (factor 1)	PLA and cattle extensity (factor 2)	Farm type*	Operational farm type**
1	**7.37**	-1.53	1	
2	**1.99**	**2.68**	1	1
3	**5.34**	-0.24	1	
4	-2.26	0.10	2	0
5	-2.25	0.20	2	0
6	-1.90	-0.31	2	0
7	-2.08	-1.30	2	0
8	**0.40**	-0.63	1	1
9	-2.43	-2.24	2	0
10	-2.42	-1.59	2	0
11	-1.72	-1.04	2	1
12	**4.39**	0.53	1	
16	**0.62**	-0.87	1	1
17	-0.18	**3.05**	2	1
18	-1.20	0.17	2	1
19	-0.99	-0.15	2	
20	-1.78	0.48	2	
22	-0.88	**2.69**	2	1

*Farm type 1 is farm company, 2 is family farm

**Type 1 are organic farms, type 0 are conventional farms

Source: Own calculations

If looking closer at the farms that have **grazing cattle** we can make some generalisations. The unit costs of hay from meadows and the share of PLA are interconnected (Table 7). High shares of land in PLA seem to correlate with low yields and high unit costs (Production costs and PLA factor).

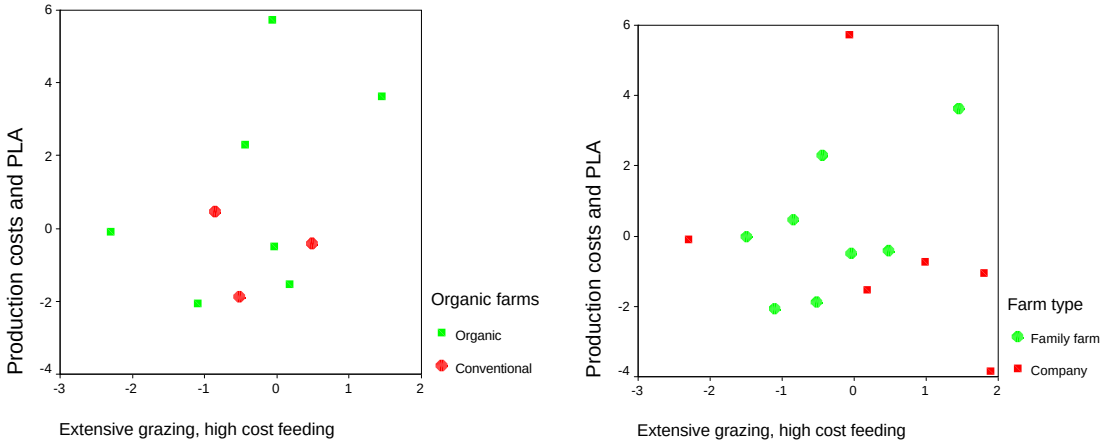
Table 7. Factor loading of selected variables of two factors from the grazing cattle sample after Varimax rotation

	Production costs and PLA	Extensive grazing, high cost feeding
Cows / ha	-0.18	-0.93
Costs / f.d.	-0.57	0.57
Unit cost meadows	0.86	0.13
Yield of meadows	-0.81	0.17
PLA %	0.84	0.14

Source: Own calculations

There is a trade-off between animal density and costs per feeding day. This is captured by the "Extensive grazing, high cost feeding" factor. Lower cattle densities imply higher costs per feeding day.

Figures 4 and 5. Factor scores of grazing cattle sample



Source: Own calculations

The strongest factor scores for factor 1 on the production costs where organic farms (Table 8). Only one of these farms is of farm company type. The "Extensive grazing, high cost feeding factor" picks up a mix of different farm types (Figures 4 and 5).

Table 8. Factor scores and farm types in grazing cattle sample

Observation runs	Production costs and PLA	Extensive grazing, high cost feeding	Farm type	Organic farms
1	-1.05	1.81	1	
2	5.73	-0.06	1	1
3	-0.73	0.99	1	
4	-0.42	0.48	2	0
5	0.46	-0.85	2	0
6	-1.88	-0.52	2	0
7	-1.53	0.18	1	1
8	-2.06	-1.10	2	1
9	-3.84	1.89	1	
11	-0.10	-2.30	1	1
12	3.63	1.45	2	1
13	-0.49	-0.04	2	1
14	-0.02	-1.50	2	
16	2.30	-0.44	2	1

Source: Own calculations

The correlation of the results of the factor analysis with the different farm types shows some very clear patterns described above. The results of this one-year sample, however, cannot clearly distinguish between cause and effects. The causalities of natural conditions, nature protection and costs of production are interrelated with each other.

6. CONCLUSIONS

There are clear differences in structures between the farm companies and the family farms. The farm companies have higher livestock numbers and, in general, larger areas of agricultural land. It is necessary to investigate these farms separately to increase predictability and trust in the results of analysis. Aggregated results might give wrong indications, because of the structural differences. The organic farms appear to have a lower number of livestock, less cattle per grassland unit, less area of arable land and higher shares of protected land as compared to the conventional farms. Therefore, organic farms are rather attractive to involve in environmental protection schemes. In turn, the protection of nature and imposed restrictions probably may have effected the choice of production technology in favour of organic farming.

Policies and natural conditions restrict agricultural production in the protected area. In some of the areas it is not possible to make full use of technological developments. The cost of production is therefore relatively high and also varying amongst the farms. Many of the family farms operating in the area have switched to organic farming, which is closer to the restrictive legislation. The main advantage of switching to organic farming is the chance to get price premiums and additional state grants. However, the price premium is not relevant as most of the farmers in the area sell their products (beef, milk) to conventional slaughterhouses with an exception of beef cattle products. The maximising of supported income may reflect the instability of the support policies, which was confirmed by many interviewed farmers within the CEESA case study. The change of the support policy in 2000 imposing the minimum livestock units per supported area was due to the fact that the market signals could not keep the required intensity particularly in marginal areas. In spite of incomplete information about final production on the protected meadows (beef, milk), the supported income has to cover costs for maintaining farming activities on these protected areas. The costs per forage unit of the farms in PLAs are also higher as compared to the farms with lower shares of meadows in PLAs.

Alternative production forms like sheep production have not been investigated in detail, however, sheep production could be regarded as a possible useful alternative to be stimulated by improved market conditions and policies. The feeding costs in sheep production are lower. Such production could be beneficial for those farmers who need to maintain the meadows but cannot invest in expensive beef cattle production. Beef cattle production is, however, more profitable than sheep production.

In this study it was not possible to investigate the dynamic elements of farmers response to changing environmental conditions induced by changes in policies and institutions. A follow-up study of the same farms would be beneficial from this perspective. It could allow an analysis of both state and change indicators in analysis and reduce the reliance on pressure indicators. Empirical evidence is rather scarce and only very few attempts have been made so far to identify conditions for changing behaviour of farmers in transition economies.

Investigation of farming systems in marginal or less favoured areas, that are valuable for their nature amenities and hence strictly protected by law, deserves more attention to be integrated with studies of institutional and policy arrangements. It could be analysed whether and how much farming in those areas is more responsive to market ("prices") or political ("support") changes. This could also imply a question whether farming as defined by current agricultural policies is the only way for achieving sustainability in those areas.

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APPENDIX I

Restrictions of farming in the protected landscape areas according to Law No. 114/92

Zone	Restrictions to farming
All	Changing the preserved natural environment and its values is not allowed. A management plan of PLA as a primary planning document for the area has to be followed.
I and II	Use of intensive technologies, that could cause considerable changes in biodiversity, ecosystem function or could damage soils irrecoverably, is not allowed. Application of pesticides is not allowed. Changes of water regime or terrain modifications are not allowed. Introduction of intensive breeding is not allowed.
I	Changing actual land cover is not allowed if it is not required by a management plan of PLA. Application of any fertilisers, slurry and other farm wastes on soils is not allowed.
III	No special requirements.
IV	No special requirements.

Source: Law No. 114/92

APPENDIX II

Basic information about farming

Indicator	Family farms	Companies	All farms
Number of interviewed farms	16	6	22
Total Agricultural land (ha)	1588.6(16)	7951(6)	9540(22)
Total Arable land (ha)	228.6(16)	2615(6)	2844(22)
Total Grassland (ha)	1360(16)	5212(6)	6572(22)
Average farm size (ha)	99.3(16)	1325(6)	434(22)
Farm size (ha) - 1st quartile	26.3	633	35
Farm size (ha) - median	41	1257	76
Farm size (ha) - 3rd quartile	110.3	1889	453
Land in PLA (%)	80.9(16)	48.7(6)	54.1(22)
Grassland in zone I of PLA (ha)	46(13)	944(5)	990(18)
Total agricultural land in zone I of PLA (ha)			4028
Grassland in zone II of PLA (ha)	487(13)	1048(5)	1535(18)
Total agricultural land in zone II of PLA (ha)			5594
Grassland in zone III of PLA (ha)	383(13)	1710(4)	2093(17)
Grassland in zone IV of PLA (ha)	39(13)	616(4)	655(17)
Total livestock units (LU)	293.7(16)	2098.2(6)	2392(22)
Average livestock density (LU/ha)	0.33(16)	0.33(6)	0.33(22)
Average grazing density (LU/ha grass)	0.20(14)	0.28(6)	0.23(20)

(i) number of observations

Source: Own calculations based on data from Research Institute of Agricultural Economics, Prague

Structure of arable land (ha) in total

Crop	Family farms	Farm companies	All farms
Winter wheat	58.5(8)	782(5)	840.5(13)
Winter wheat - fodder	64.4(8)	133(2)	197.4(10)
Spring barley - fodder	14.3(6)	53.5(4)	67.8(10)
Winter barley - fodder		145(4)	145(4)
Potatoes	3.5(4)		3.5(4)
Caraway	5(1)	81(2)	86(3)
Oats	36(11)	199(4)	235(15)
Buckwheat	6(1)	15(2)	21(3)
Clover	27.7(3)	205.5(2)	233(5)
Lucerne	0.04(1)	137.5(2)	137.6(3)
Other forage crops		490	490
Other crops	13.2	373	386.2
Total arable land	228.64	2614.5	2843

(i) number of observations

Source: Own calculations based on data from Research Institute of Agricultural Economics, Prague