

# THE DEVELOPMENT OF RELATIONS BETWEEN MAN AND LANDSCAPE IN A HISTORICAL MOUNTAIN AGRICULTURAL LANDSCAPE OF SLOVAKIA

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## Abstract

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The aim of the presented paper is to define the main landscape-ecological factors of rise, development and behaviour of agricultural elements of the mountain (today historical) cultural landscape of the model areas in the municipalities Liptovská Teplička (Nízke Tatry Mts), Osturňa and Malá Franková (Spišská Magura Mts) by interdisciplinary approach. Because of the general intensification of agriculture in the second half of the 20<sup>th</sup> century and forests succession in unused mountain regions there are only few of these areas in Slovakia as well as in Europe. We tried to specify the connections, feedbacks and key positions of the functioning of the system man - landscape by elaboration of the word database explaining the influence of natural factors and spatial database clarifying the effect of natural factors by the statistical method “*logistic regressive analysis*”.

*Key words:* landscape-ecological factors, agricultural landscape, interdisciplinary approach, statistical method

## Introduction

Landscape elements can be characterized as landscape phenomena arisen by the interaction of man and natural factors on landscape components. Natural factors are natural rules directed by planetary and interplanetary (solar) phenomena. In a cultural landscape there appear also the factors of social and economic character (Ružička et al., 1978). Natural and socio-economic factors can be specified as landscape-ecological factors (LEF). They are characterized by certain qualitative and quantitative relations to single landscape elements.

In the landscape-ecological literature more intensive attention is paid to the processes going on in social and psychical sphere (Ružička et al., 1982). It is necessary to pay attention and, if it is possible, to integrate also the results and methods of different branches of social sciences into the landscape-ecological research. According to Ružička (1985) overlapping of the rules of nature and society development, interactions of man and nature have not been clarified and they need a concentrated effort. Therefore it is necessary to elaborate the system of applied multidisciplinary scientific methods aimed at obtainment of new quality of knowledge. Also Brandt et al. (1999) and Baudry et al. (1999) call attention to the need of a multidisciplinary and complex approach. According to Mikulík (1999) the knowledge of reality of social and regional development is problematic and therefore a synthetical scientific knowledge is unavoidable. It can save us from light-minded decisions in land use.

### **Characteristics of the area**

The studied villages are situated in northern Slovakia. In their areas the model areas were selected on the basis of the most conserved historical agricultural landscape elements. They can be characterized by a dense raster of oblong and square formations of arable land and permanent agricultural crops (Štefunková, Dobrovodská, 1997). They are diversified by old field pathways, ridges, streams, forms of agricultural anthropogenic relief (AFR), traditional architecture together with line and small-scale tree vegetation. In a part of the area is a reclaimed intensively used agricultural land as a consequence of the socialist collectivization going on in the second half of the 20<sup>th</sup> century.

*Liptovská Teplička* is situated under the side ridge of the crystalline mountain range of the Nízke Tatry Mts in the catchment of the Čierny Váh river in the altitude of 846–1429 m. The whole area belongs to the cool climatic zone. Its area is 9868 ha, the model area is of 842 ha.

*Osturňa* and *Malá Franková* are situated in the valleys of the Osturniansky and Frankovský potok stream in the flysh area of the Spišská Magura Mts, in the cool climatic zone. The altitude of Malá Franková is 710–1155 m, Osturňa is 645–1295 m. The whole area of Osturňa is 4124 ha, the model area has 454 ha. The area of Malá Franková is 1080 ha, the model area is 815 ha.

### **Material and methods**

The field research of the present landscape structure of the model areas was realized in 1995–1997 in the scale of 1 : 10 000. In mapping of landscape elements we paid attention to *land use forms, its area dimension, shape and intensity of use, type of agroecosystem and AFR*. The historical secondary landscape structure was reconstructed due to available maps, literary data and our own research carried out in the form of discussions with local people.

To determine the scale of adequate landscape-ecological factors was possible only after a detailed evaluation of natural conditions and development of socio-economic conditions of the studied villages. The following scale of landscape-ecological factors (Dobrovodská, 2000) was created: **Natural factors** – *geological substratum, relief form, soil subtype, potential water erosion, altitude, direct solar radiation, relief inclination*. These factors can be spatially expressed. **Socio-economic factors** – *wider social-historical conditions, land law, settlement and its character, character of agricultural production, character of dwelling, local social life, demographic conditions, availability of landscape element*. These factors cannot be spatially expressed except of the factor *availability of landscape element*.

Main socio-economic factors for agricultural land of the studied villages were specified by verbal assessment of background materials. Main natural factors and socio-economic factors of availability of landscape element were specified by the statistical method “*logistic regressive analysis*” (Šidlo, 1999) and computer elaboration using the software JMP 4.02 Statistical Discovery Software. The evaluation sets out from landscape-ecological complexes – homogeneous areas created from the elements of the present landscape structure, natural LEF and the factor of availability of landscape element by the softver Arc/View in GIS. Into the relation was introduced the complex of parameters  $C_p$  of independent variables – factors  $X_k$  with dependent variable  $D_i$  - agricultural elements of present landscape structure. In results are mentioned only the landscape elements which can be statistically evaluated according to their area and abundance.

## Results

The results were elaborated according to the paper of Dobrovodská (2003). The development of secondary landscape structure of the study area is documented in Table 1, agricultural relief forms (AFR) are expressed in Table 2. Fig. 1 presents the segments from the maps of the contemporary landscape structure in the areas of the studied villages.

### *Socio-economic factors*

It is difficult to express them spatially, they influence the whole system of agricultural production and appear in a relatively isolated and closed space of the area.

**Liptovská Teplička.** The village was founded in 1634 by “goral” settlement on the “Valach” rights – blocks of soil were distributed among colonizers. Up to 1947 in the process of heritage they were divided into strip plots therefore some of them are only 2–3 m wide, but sometimes 100 m long. Attention was paid mainly to arable land because the feudals pursued cereal production. On higher situated plots were pastures for sheep breeding. In the 18<sup>th</sup> century appeared new crops (potato, clover) that caused the spread of live-stock breeding and the higher situated plots of arable land were changed to one-mown meadows. In the 19<sup>th</sup> century there were built some hundreds haylofts. In the 18<sup>th</sup> century in accordance with the decree of Maria Theresa live-stock grazed in common herds. Due to the use of tools of higher quality the farming on arable land became more intensive. Gradually were formed AFR. In the period from the end of the 19<sup>th</sup> century up to the half of the 20<sup>th</sup> century the economic crisis, decrease of number of inhabitants and new sources of income outside the village caused that certain less productive arable lands are abandoned and grassed. In the neighbourhood of the built up area these areas are used as intensive pastures or twice-mown meadows. The use of artificial fertilizers started. During the period

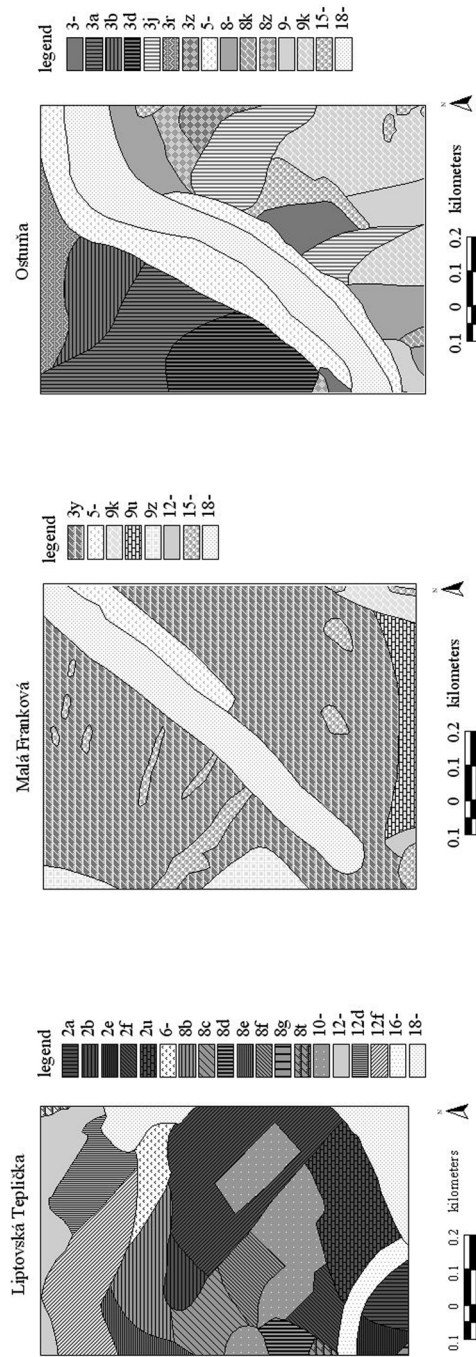


Fig. 1 Contemporary landscape structure in the studied areas in the municipalities Liptovská Teplička, Malá Franková and Ostuhňa in 1997 (map section). Legend: Landscape elements: 2 - mosaic of extensively used small-block arable land and meadows, 3 - mosaic of extensively used small-block arable land, meadows and fallows, 5 - mildly wet semi-intensively used near-by-house meadows, 6 - extensively used wet meadows and pastures, 8 - extensively used semi-natural meadows, 9 - occasionally used mildly acid meadows and pastures, 10 - intensively used large-block meadows, 12 - extensively used poor matgrass pastures and fallows, 15 - natural or semi-natural stands of tree vegetation, 16 - degraded areas, 18 - built-up areas

Forms of agricultural anthropogenic relief: a - earthy terraces oriented along gradient lines, b - earthy terraces oriented along contour lines, c - earthy terraces in diagonal direction to contour lines, d - earthy-stony terraces oriented along gradient lines, e - earthy-stony terraces oriented along contour lines, f - earthy-stony terraces in diagonal direction to contour lines, g - loamified stony terraces oriented along gradient lines, j - earthy terraces oriented along gradient lines with gathered stones in the form of heaps and mounds, k - earthy terraces oriented along contour lines with gathered stones in the form of heaps and mounds, r - earthy terraced balks oriented along contour lines, t - earthy-stony mounds oriented along gradient lines, u - loamified stony mounds oriented along gradient lines, z - loamified stony heaps, y - complex of loamified stony mounds oriented along gradient lines and earthy terraced balks in diagonal direction to contour lines with gathered stones in the form of heaps and mounds

Table 1. Development of secondary landscape structure in the studied areas of the municipalities Liptovská Teplička, Osturňa and Malá Franková

Landscape element	Municipality	Liptovská Teplička				Osturňa				Malá Franková			
		1883	1962	1997	1997	1957	1986	1997	1997	1878	1957	1986	1997
Arable land	Code	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]
Small-block semi-intensively used arable land	1	637	77	533	75	318	70	—	—	413	51	295	36
Mosaic of extensively used small-block arable land and meadows	2	—	—	65	8	—	—	—	—	—	—	—	—
Mosaic of extensively used small-block arable land, meadows and fallows	3	—	—	—	—	—	183	40	123	27	—	—	—
Large-block intensively used arable land	4	—	—	89	11	—	—	—	—	—	—	—	—
Permanent grass stands	5	—	—	—	—	—	28	6	28	6	—	—	8
Mildly wet semi-intensively used near-by-house meadows	6	8	1	11	14	2	—	—	—	—	—	—	—
Extensively used wet meadows and pastures	7	—	34	4	—	52	12	66	15	—	51	6	56
Extensively to semi-intensively used seminatural meadows	8	—	—	208	25	—	—	—	125	28	—	—	—
Occasionally used mildly acid meadows and pastures	9	—	—	—	—	—	93	21	90	20	—	—	173
Intensively used large-block meadows	10	—	—	80	9	—	—	—	—	—	—	—	—
Unused, overgrown poor matgrass pastures	11	—	—	—	—	—	6	1	3	0,5	—	—	—
Extensively used to unused poor matgrass pastures and fallows	12	—	—	99	12	—	—	—	—	—	—	—	143
Semi-intensively used pastures	13	—	58	7	4	1	38	8	—	—	29	4	313
Intensively used pastures	14	—	—	—	—	—	—	—	—	—	—	—	61
Other areas	15	144	18	147	8	178	21	11	2	43	9	50	11
Natural or semi-natural stands of tree vegetation	16	—	—	5	1	—	—	—	—	—	—	—	—
Degraded areas	17	—	—	3	0,5	—	—	—	—	—	—	—	—
Subjects of water resources and their protective zones of I. stage	18	35	4	41	5	79	10	35	8	35	8	25	3
Built-up areas	19	824	100	824	100	454	100	454	100	454	100	815	100
Total	20	824	100	824	100	454	100	454	100	454	100	815	100

Table 2. Forms of agricultural anthropogenic relief in the studied areas of the municipalities Liptovská Teplička, Osturňa and Malá Franková

Form of the agricultural anthropogenic relief	Municipality	Liptovská Teplička		Osturňa		Malá Franková	
	Code	[ ha]	[ %]	[ ha]	[ %]	[ ha]	[ %]
Earthy terraces oriented along gradient lines	a	5	2	11	5	–	–
Earthy terraces oriented along contour lines	b	18	6	5	2	–	–
Earthy terraces in diagonal direction to contour lines	c	44	15	–	–	–	–
Earthy-stony terraces oriented along gradient lines	d	20	8	10	5	–	–
Earthy-stony terraces oriented along contour lines	e	14	5	–	–	–	–
Earthy-stony terraces in diagonal direction to contour lines	f	39	13	–	–	–	–
Loamified stony terraces oriented along gradient lines	g	13	4	–	–	–	–
Loamified stony terraces oriented along contour lines	h	3	1	–	–	–	–
Loamified stony terraces in diagonal direction to contour lines	i	16	5	–	–	–	–
Earthy terraces oriented along gradient lines with gathered stones in the form of heaps and mounds	j	–	–	21	9	–	–
Earthy terraces oriented along contour lines with gathered stones in the form of heaps and mounds	k	–	–	49	22	114	39
Earthy terraces in diagonal direction to contour lines with gathered stones in the form of heaps and mounds	l	3	1	–	–	–	–
Earthy-stony terraces oriented along gradient lines with gathered stones in the form of heaps and mounds	m	3	1	–	–	–	–
Earthy-stony terraces oriented along contour lines with gathered stones in the form of heaps and mounds	n	5	2	4	2	–	–
Earthy-stony terraces in diagonal direction to contour lines with gathered stones in the form of heaps and mounds	o	4	1	–	–	–	–
Loamified stony terraces oriented along gradient lines with gathered stones in the form of heaps and mounds	p	4	1	–	–	–	–
Earthy terraced balks oriented along contour lines	r	–	–	21	10	–	–
Earthy terraced balks oriented along contour lines with gathered stones in the form of heaps and mounds	s	–	–	21	10	–	–
Earthy-stony mounds oriented along gradient lines	t	22	8	–	–	–	–
Loamified stony mounds oriented along gradient lines	u	75	26	–	–	16	5
Loamified stony mounds in diagonal direction to contour lines	v	1	0,5	–	–	–	–
Loamified stony heaps	z	–	–	77	35	46	16
Stony heaps and mounds oriented along gradient lines	x	4	1	–	–	–	–
Complex of loamified stony mounds oriented along gradient lines and earthy terraced balks in diagonal direction to contour lines with gathered stones in the form of heaps and mounds	y	–	–	–	–	115	40
Total		293	100	219	100	291	100

of socialism the way of use of agricultural land is less-more conserved, but there are introduced some accomplishments of technics and chemistry. The intravillain increases to the detriment of arable land, intensity of utilization decreases as the result of improved communication and new sources of income outside the village. Change in use appeared in the period of collectivization of the agriculture when a part of arable land was reclaimed (AFR were ploughed-up) and changed into intensively used pastures and arable land. A smaller part of unreclaimed arable land is used also today as private plots. The larger part was grassed and changed to extensively used pastures and one-mown grasslands. Hay-loft meadows have been changed to pastures.

**Osturňa.** It arises by mountain settlement colonization in the second half of the 16<sup>th</sup> century – the valley of the Osturniansky potok stream was divided into equally wide plots (110–130 m) and distributed among 52 settlers. By inheritance proceedings they have been divided longitudinally. From the very beginning of the settlement the agricultural system developed in a close connection with individual or group sheep grazing allowed especially in the villages of the region of Spiš. At the bottom of the valley (in the central part of the plot) the moderately wet grasslands around the houses were used in the most intensive way. Above them was a strip of arable land which was in every second year left fallow and grazed by sheep. Above this strip were one-mown grasslands and above them small pastures. AFR were created as a consequence of ploughing and soil devitrification. With the increasing interest in cattle breeding at the end of the 19<sup>th</sup> century attention was paid to grassland management. The areas of less fertile arable land are grassed, intensity of management is decreased as a consequence of the economic crisis and fall of population. Artificial fertilizers are introduced. After the 2<sup>nd</sup> World War was an increase of inhabitants, increase of the area of arable land to the detriment of grass stands and increase of intensity of soil cultivation. In the conditions of socialism comes a decrease of private agriculture as the consequence of worsening of the social and demographic structure. Less productive arable land has been abandoned and grassed. After the year 1970 comes the greatest decrease, when the great part of arable land is abandoned, grass stands are used only occasionally – they are less fertilized, sometimes grazed and mown.

**Malá Franková.** The village arises by mountain settlement colonization in 1611. 20 settlers settled in the valley of the Frankovský potok stream and they divided the area of the village into 17 ha (fields) strips. In contradiction to Osturňa the original fields were divided mainly transversely and so in many places was conserved their original width. Up to end of the 19<sup>th</sup> century the system of agricultural production was similar as in Osturňa. The intensification in cattle breeding caused a significant increase of pastures to the detriment of arable land, meadows and forest stands. After the 2<sup>nd</sup> World War started the development in management of arable land and a complex revival of agricultural production. A radical stop in this evolution was caused by the collectivization in the eighties of the last century, when private management was totally ceased. Arable land was grassed, a part was recultivated and changed to intensively used pastures. Unrecultivated areas sometimes were grazed by the cooperative livestock. Only some plots were sporadically used for grazing by local people. Also the higher situated meadows were similarly used. The restoration of



management by mosaic use with a share of fallow lands appeared after 1989 when some abandoned arable lands have been given back to their former owners with all proprietary rights.

### *Natural factors*

#### Liptovská Teplička

- *Mosaic of extensively used small-block arable land and meadows*

The occurrence of the given element is specified by optimum natural and socio-economic conditions for agricultural production - *the lowest values of altitude and high values of direct sun radiation* (factors influencing the mesoclimatic conditions), *most productive and productive soils* in the area and *the most rapid accessibility of the landscape element*.

- *Large-block intensively used arable land*

For this element were determining the *lowest values of relief inclination* (factor conditioning the soil cultivability by heavy mechanisms) and *potentially low soil damage by water erosion*. *Geological substratum, accessibility of landscape element, altitude and direct sun radiation* were partially significant.

- *Extensively used semi-natural meadows*

The results showed that *hardlier accessibility* in combination with the worsening mesoclimatic conditions (*increasing altitude and decreasing intensity of sun radiation*), in comparison of the conditions of the occurrence of mosaic small-block grasslands and fields indicate the motives of land owners to the mood of use.

- *Intensively used large-block meadows*

It can be stated, that giving preferences to *lower relief inclinations* (easier cultivation by heavy mechanisms) is identified with large-block arable land. High probability of occurrence in the areas with *very high potential erosion, very low degree of accessibility and less productive methods* explains the preference of grassland stands in reclaimed areas potentially suitable as arable land.

- *Extensively used and unused poor matgrass pastures and fallows*

According to the results of statistical evaluation the extensive use of these areas as pastures or their occasionally use does not show lower requirements on mesoclimatic conditions in comparison with mown semi-natural meadows on self-grassed fields. Probably the *high and very high values of potential erosion, very steep relief and prevalence of minerally poor geological substratum* were the cause of the unuse of these sites as arable land or grasslands after the collectivization.

#### Osturňa

- *Mosaic of extensively used small-block arable land, meadows and fallows*

Cutting dissection of the area in the period of settlement and the further division of plots in inheritance proceedings does not respect soil endangerment by *high, very high and*



*medium high potential water erosion.* Cultivation of this element is now presumably specified by the *lowest values of relief inclination*, optimum mesoclimatic conditions (*very low altitude* and rather *higher values of direct sun radiation*). Considering the occurrence of temperature inversions and mists the most probable occurrence of it in the 2<sup>nd</sup> degree of altitude is understandable. This fact is probably connected also with preference of sites with *wrong accessibility*.

- *Mildly wet semi-intensively used near-by-house meadows*

The occurrence of this landscape element in the village Osturňa is connected with the existence of small water springs with local influence on waterlogging of plots in valley inversions with mists. With this fact is connected the *quickest accessibility of the element*.

- *Extensively used semi-natural meadows*

Abandonment and grassing of arable land is primarily connected by *decreasing of accessibility of the element*, with worsening mesoclimatic conditions (*higher altitude and very low and lowest values of direct sun radiation*), with more difficult cultivation because of the *larger relief inclinations* and in certain places with the *catastrophic endangerment by potential water erosion*.

- *Occasionally used mildly acid meadows and pastures*

The temporal use of these grass stands is connected with the *steep and very much steep relief inclination and significant catastrophic values of potential water erosion*.

#### Malá Franková

- *Mosaic of extensively used small-block arable land, meadows and fallows*

Considering the existence of temperature inversions and mists the probability of the occurrence of this element in optimum mesoclimatic conditions (*the not lowest altitudes and very high sun radiation*) and *in easily accessible areas* is the highest. The occurrence is improbable in the areas *with less productive soils*.

- *Mildly wet semi-intensively used near-by-house meadows*

The occurrence of this element is conditioned by underground springs causing local waterlogging. According to the results of statistical evaluation the occurrence of this element is the most probable in valley inversions (*the quickest accessibility of the element*).

- *Occasionally used mildly acid meadows and pastures*

The most important factor of abandonment of arable land and its grassing was the low air temperature with regard to the altitude (*medium and higher altitude*) and more difficult cultivation connected with *steep and very steep relief inclination*.

- *Extensively used and unused poor matgrass pastures and fallows*

The main reason of their occurrence in the past was the very difficulty cultivated *very steep and steep relief* in the areas with slow accessibility and low air temperature (*very high values of altitude*).

- *Intensively used pastures*

They occur in *rapidly and very rapidly accessible areas*, rather in *lower altitudes*, on *steep as well as slightly steep relief*. They are situated in the lower part of the village in the

Table 3. Share of agricultural landscape elements influenced by statistically valuated landscape-ecological factors in the studied areas of the municipalities Liptovská Teplička, Osturňa and Malá Franková

Municipality Landscape-ecological factor	Liptovská Teplička		Osturňa		Malá Franková		Total	
	Number of elements	[%]	Number of elements	[%]	Number of elements	[%]	Number of elements	[%]
Geological substratum	4	57	0	0	0	0	4	24
Relief form	1	14	0	0	0	0	1	6
Soil subtype	2	29	0	0	2	40	4	24
Altitude	4	57	4	80	4	80	12	71
Relief inclination	4	57	5	100	4	80	13	76
Direct solar radiation	6	86	4	80	4	80	14	82
Potential water erosion	5	71	4	80	0	0	9	53
Accessibility of landscape element	5	71	4	80	5	100	14	82

neighbourhood of the Cooperative farm Veľká Franková carried out the grass stand management.

Table 3 expresses the percentual share of agricultural landscape elements influenced by statistically valuated factors.

## Conclusion

All studied landscape-ecological factors interacting in the landscape in time and space in different combinations but within the borders given by natural features of the given landscape. In certain periods of the existence of the studied villages the socio-economic factors with revolutionary influences and effort to overstep the natural limits. The given periods alternate with the stages of more significant observation and adaptation to natural conditions that have rather evolutionary character. This fact points at unavoidability of interdisciplinary approach and multicriterial evaluation, if we want to understand the basis of a such complex subject of investigation as the landscape used by man is. A common effort in the mentioned three valuable areas ought to be the reducing of overgrowth by forests. This could mean the extinction of this valuable archaic landscape type. It is unavoidable to put attention also to the representatives of traditions and local landscape user – local people. Their “agricultural and ecological” awareness, social wellbeing and economical safety can significantly facilitate the process of protection of this landscape type. Also observation of the principle of multifunctional landscape use (nature protection – protection of cultural monu-

ments – agriculture – forest management – recreation) is seemed to be optimal in comparison with the principle of application of segregated interests of single activities or principles of extensification of utilization.

*Transalted by K. Kis-Csáji*

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## Dobrovodská M.: **Vývoj vzťahov medzi krajinou a človekom v historickej horskej poľnohospodárskej krajine Slovenska.**

Cieľom predkladanej práce bolo použitím interdisciplinárneho prístupu určiť vedúce krajinnoekologické faktory vzniku, vývoja a správania sa poľnohospodárskych prvkov horskej, dnes už historickej kultúrnej krajiny modelových území v katastroch obcí Liptovská Teplička (Nízke Tatry), Osturňa a Malá Franková (Spišská Magura). Spracovaním slovnej databázy, ktoré vysvetľuje pôsobenie socio-ekonomických faktorov a priestorovej databázy, objasňujúcej vplyv prírodných faktorov pomocou štatistickej metódy „*logistická regresná analýza*“, sme sa pokúsili identifikovať súvislosti, spätné väzby a kľúčové miesta fungovania systému človek–krajina. Všetky sledované krajinnoekologické faktory spolupôsobia v krajine v čase a v priestore v rôznej vzájomnej kombinácii, no v hraniciach určených prírodnými danosťami tej-ktorej krajiny. V určitých obdobiach existencie skúmaných obcí mali prevahu socio-ekonomické faktory s revolučným priebehom ich vplyvu a so snahou prekonať prírodné limity. Dané obdobia sa striedali s etapami výraznejšieho rešpektovania a prispôbovania sa prírodným podmienkam, ktoré malo skôr evolučný charakter. Toto poznanie poukazuje na nevyhnutnosť interdisciplinárneho prístupu a multikriteriálneho hodnotenia, ak chceme pochopiť podstatu tak zložitého objektu skúmania, ako je krajina využívaná človekom.