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CHANGE IN FUNCTIONAL THE LANDSCAPE STRUCTURE IN TIME HORIZON 1822-2012 IN THE RURAL SETTLEMENT OF JAKUBANY

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***Abstract**: The structure of cultural landscape is a result of long-lasting process of interaction between of humans and nature in the historical development. In the Slovakia the most intensive changes of the landscape structure were realized over the 40 - 50 years. A new wave of changes in the structure of cultural landscape was originated mainly over the last two decades, predominantly in foothill landscape. These changes are considered as positive from the aspect of ecological stability of landscape. Ecological stability has increased in the last two decade in relation to the stoppage of excessive use of chemical fertilizers, pesticides, herbicides and heavy mechanisms at tillage. Biodiversity and retentive ability of the landscape have increased and erosion of soil has decreased. The negative consequences were reflected into the visual form as abandonment of landscape the man. The aim of this paper is research changes of land cover and functional structure of the landscape in the rural settlement Jakubany in time horizon 1822 – 2012.*

***Key words**: land use, land cover changes, land utilization, rural settlement Jakubany*

INTRODUCTION

The village Jakubany was established on territory manor of Ľubovňa, which gave the administrator of region F. Drugeth in 1322 for the Stephen son of Peter from Lomnička. In this period was the manor of Ľubovňa inhabited by Slovaks and Germans (first written mention is from 1408). Since 1497 the village was populated based on the Wallachian law and from the aspect of the ethnic group it was the Rutheniansand Romanians, which we can characterize by the mode of life on the mountains chalets (salaše) and herding of cattle.Residents of the village dealt mainly with agriculture and pasturage, but had other sources of subsistence, e.g. in 1760 A.

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Probstner built in the village of blast furnace which worked here into 1870. Iron ore it imported from the area of Slovenské rudohorie (Mts.) and the main prerequisite for localization of the blast furnace was ample fuel for iron smelting wood charcoal manufactured in the forests around the Jakubany. In the year 1855 was produced 427 kg of iron.

Cadastral territory of Jakubany are located on contact zone of the Levočské vrchy (Mts.) and Spišsko-šarišské medzihorie (Mts.) in which occupy the western part of Jakubianska brázda (furrov) and small north-western part of Hromoš (Mts.). Greaterpart of the cadastral territory which was in the Levočské vrchy (Mts.) from January 1952 into December 2010 belonged to the former Military district of Javorina. Return of land and property settlement will be in Jakubany conducted end of year 2015. The aim of this paper is the research of land cover and functional structure of the landscape in the current cadastral territory of Jakubany. In this context, we cannot leave out the exceptional work of Michal Luknišabout the village Jakubiany, which was published in 1946. A rehashed term genius loci, which in present in our science is experiencing a kind of renaissance is the leitmotif this work and reached here the remarkable of perfection.

Genius loci - the spirit of the place Jakubany since 1946 have changed considerably in 1953, but not from a naturally, but with artificial intervention, especially the establishment of the Military circuit of Javorina (in 1953) on the most territory cadastre of village (military circuit lastedmore than 60 years, which can be considered much damage from the aspect of scientific researchthis specific place and your spirit). The military circuit was abolished by the Slovak Government in December 2010, but the plots have not yet been returned to the owners. Developments since 1953 can be considered a dramatic, full of contradictions different nature (Fig.1). For comparison we present in table 1 land management in 1946 (Lukniš 1946) and in 1953 and 2004.

Table 1 *Land Management in Jakubany in 1946, 1953, 2004*

Land Management 1946	Are in ha	%	Land Management 1953	Area in ha	%	Land Management 2004	Area in ha	%
Arable land	1 301	19,8	Arable land	1301	80,8	Arable land	138	8,2
Meadows	1709	26,0	Meadows	119	7,4	Meadows	1279	76,3
Pastures	577	8,7	Pastures	80	5,0	Pastures	-	-
Forests	2823	43,0	Forests	23	1,4	Forests	133	8,0
Garden	2	0,03	Garden	2	0,12	Garden	35	2,0
Barren area	165	2,2	Barren area	85	5,3	Barren area	90	5,3
Together	**6577**	100	**Together**	**1610**	100	**Together**	**1675**	100

Source: Lukniš 1946, ŠÚSR 2012

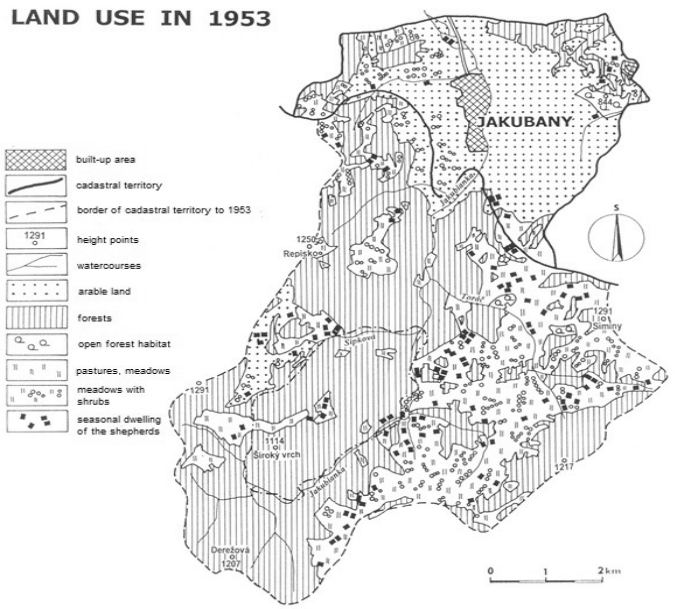

Fig.1 *Land Use within border of cadastral territory to 1953*

DATA AND METHODS

Data preparation was based from the main objective of the research taking on the analysis of land cover we used historical maps for the years 1822, 1979, and orthophotos of 2012. Through vectorization we created maps of the land cover classes for the fourth hierarchical level (Fig. 3, 4, 5). Into the linear elements of land cover classes were included transport communications and watercourses with a minimum width of 1 m. For maintain consistency of analysed documents we used topology control in the ArcMap application of the software of ArcGIS 10, which eliminated overlapping areas or absent areas. We have achieved so final size of investigated territory in all time horizons with the accurate to two decimal places. When identifying the land cover classes was necessary the legend of CORINE Land Cover (CLC) which is used for processing of data layers of the land cover classes for the entire territory of Slovakia (Bossard et al. 2000, Feranec and Oťaheľ 2001) adapt itself so that take account of the specificities of investigated region. From this aspect, we used CLC legend processed for the needs of landscape research in the scale of 1:50 000 for the PHARE countries (Feranec and Oťaheľ1999). On this basis each group classes of the land cover was divided after the fourth hierarchical level which is sufficient to work with the territory in a large map scale.The resulting maps of the identified land cover classes within the three time horizons were the basis to the statistical and spatial analysis land cover of the investigated territory.The land cover was analysed in chronological order from earliest the time horizon 1822 to the present (time horizon 2012). Subsequently were results compared and expressed in the transformation matrix of changes.

INVESTIGATED TERRITORY

The current cadastral territory settlement of Jakubany has an area of 1,675 ha (in year 1946 to 1953 it was 6 577 ha). Built-up area of the village lies at an altitude of 600 m and the lowest point is on the floodplain of river Jakubianka in altitude 590 m and the highest point (hill) is in altitude1064 m in the western part of the territory (Fig.2).

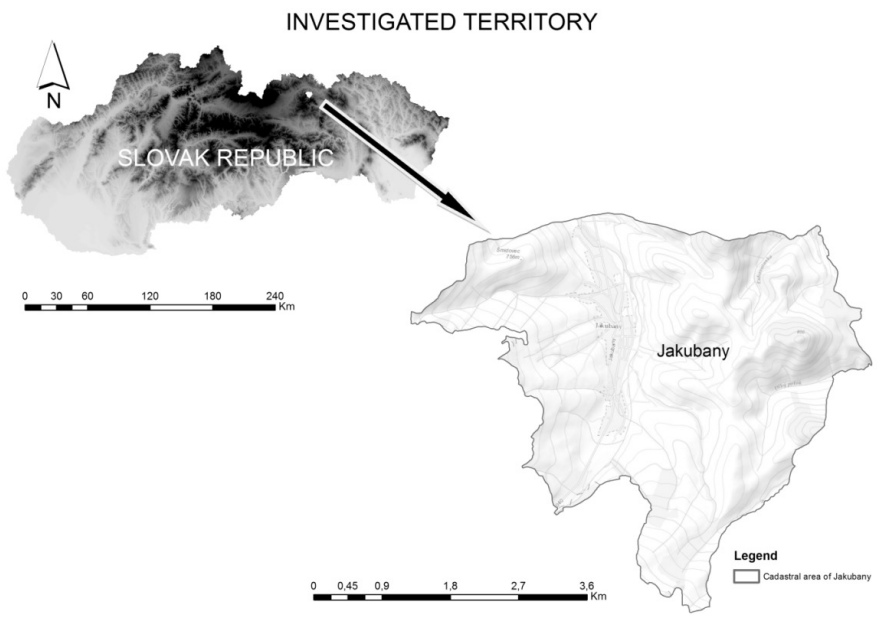

Fig. 2 *Location of the investigated territory*

Part on the footof Levočské vrchy (Mts.) in cadastral territory takes up Jakubianska brázda (furrov) which is closed between Levočskévrchy (Mts.) on the south - west and Hromovec (Mts.) on the north - east. Jakubianska brázda (furrow) is formed from the strata a little resistant claystones Inner-Carpathian Paleogene. The furrow was created in the processes of denudation on thelayers of claystone development. Amplitude of relief of slightly undulating hilly- country does not over 180 m relative height. Altitude is between 620 to 800 meters. Below 600 m altitude is only floodplain and terraces of river Jakubianka.

Territory belongs into the cold climate area district C1 which is slightly cold and very wet with average temperature of July 12 to 16° C (Lapin et al. 2002).

Surface water represents watercourse Jakubianka which from the both sides gaining tributaries,small nameless watercourses.Jakubianka flows into Poprad (river) in Stará Ľubovňa. Average annual flow in the Jakubany is 1.2 $m^3.s^{-1}$.In terms of underground water circulation and its collectors are the claystones layers in the Jakubianska brázda (furrow) rather isolators of underground water. The permeability of cracks binds only the cracks of tectonic origin, but the claystones are more or less plastic rocks, on which do not apply the effects of tectonics cracks conversely by the

breach the owns cracks concludes.The total throughput of layers is very small and the aquifers are weak. Circulation of underground water there is limited and spreading rate of water sources and amounts less than 0.1 l .s^{-1}.In the cover of soils dominated Eutric Cambisols with accompanying Stagni-Eutric Cambisols. On the foot of Levočskévrchy (Mts.) are developed Dystric Cambisols and Cambic Umbrisols. On the floodplain of river Jakubianka are located Litosols and Lithic Leptosols.

The Hromovec (Mts.) culminates in the point of the same name with altitude 895 m. The amplitude of the relief takes the value from 180 to 250 metres. Hromovec (Mts.) is built at Šambron layers of sandstones and calcareous sandstones and conglomerates of Inner-Carpathian Paleogene. Relief is sizeable broken and has typical character of highlands and the valleys of watercourses are deep and narrow, but the backs are shaping smoothly without major height differences. From mineral waters are significant mineral springs in Spa Nová Ľubovňa on the tectonic fault in the western part of Hromovec (Mts.). The soil cover constitute from Rendzinas and Cambisoils (Rendzic Leptosols and Eutric Cambisols).

Approximately three quarters the cadastral territory of village until 1953 was located in the Levočska vysočina (highlands) in the Levočské vrchy (Mts.). It is the highest and largest mountains subassembly of central part Levočskévrchy (Mts.). From the aspect of geological structure it is composed from massive Eocene sandstones Inner-Carpathian Paleogene. It is tectonically raised aligned surface which is disturbed of the tectonic faults with direction NW - SE and NE - SW, which is also reflected in the configuration of the ridges and valleys. Levočské vrchy (Mts.) are typical highlands, where most of ridges have the altitude more as 1100 m. The highest point in Jakubany village is the Siminy (hill) in 1 291 m altitude.Climatically belongs to a cold area, district C1 (as the entire territory). The surface water here represents the upper flow of Jakubianka (river) with four unnamed tributaries from the right and one from the left. Complex Eocene sandstones and conglomerates are characterized by permeability of cracks and pores. Aquifers are moderately significant and spreading rate springs is from 0.1 1to 0.5 l.s^{-1}. In the soil covers predominate Cambic podzols with associated types of Dystric Cambisols and Cambic Umbrisols. Originally vegetation cover accounted acidified beech and fir forests (with *Abies alba*) laced with red spruce (*Larix decidua*), today strongly anthropic modified. On broad mountains ridges are currently the grasslands.

FACTORS AND CONDITIONS WHICH AFFECTED THE CHANGES OF LAND COVER AND FUNCTIONAL STRUCTURE OF THE LANDSCAPE

The land cover changes in the cadastral territory of Jakubany same time indicate also on the changes in the functional structure of the territory i. e. the use of the landscape. In the context of the work Feranec and Oťaheľ (2001) the term the land cover is not identical to the term of land use of the landscape. In the term of land use are two aspects, namely: the character of the land cover and it function - the land utilization (Burley 1961, in: Feranec a Oťaheľ 2001). These two aspects have been in village Jakubany clearly distinguished until year 1953 (Lukniš 1946). Acreage cadastral area (Lukniš 1946) was at that time 6577 ha. According to Lukniš (1946) were divided into two parts, the fields part and mountains part. Division of territory to

that part closely connected with the way of life (pastoral way of life) of the population of the village and from economic activity - land use of the landscape. While in the upper part of the territory dominated forests (2,800 ha) and grasslands (mostly meadows 1,590 ha) and there are a variety of seasonal dwelling of the shepherds different quality (kram, cradle, chalet, chyžka), in the part of fields was prevailingly arable land (1,301 ha) on the cultivation of staple crops for subsistence population.

Fundamental changes in the structure of land use of the landscape caused institutional and political factors and conditions in the year 1953 (creation of the military space Javorina in Levočské vrchy (Mts.). From the cadastral territory into the military space the army took the more than 75% of the area (4967 ha). In the village was declared a build ban (construction without building permits were militarily liquidated and a similar fate befell the seasonal dwelling of the shepherds in Levočské vrchy (Mts.) Aim of communist state power was the liquidated the village and resettlements inhabitants into State flats in the several neighbouring municipality or town settlements. Also the Urbariat (management of local forests) ended their activities in the same year. The area was guarded by the military and the entrance to military area had only the employees of military forests or the persons which had a culverts. The residents of the village the culverts never received. By separating the mountainous part the cadastral territory of Jakubany has been a significant change in land use of landscape. Traditional shepherd-like way of life and land management was violently destroyed.

In the significantly smaller the cadastral territory of Jakubany (1,610 ha) has been predominance of the arable land without vegetation (1,301 ha), the acreage of grasslands was 200 ha and the forests were only marginally represented (23 ha). The areas unsuitable for agriculture (flood plain and gravel benches in the riverbed of Jakubianka) have occupied 85 ha. Despite this situation in the village Jakubany lasted of classic system of private farming until 1979. Sociological factors have played in this period an important role in the formation the structure of the landscape (Genius loci). The people from Jakubany as a social community had a remarkably deep attachment to land ownership. Was considered as an important source of livelihood and important material and spiritual wealth and they wanted to continue - (older generation) in the classic system of private farming on their land but lacked the will to the younger generation.

In 1979 the village was founded agricultural cooperative (JRD, first attempt was the establishment in 1948, but was unsuccessful). Creating a cooperative led to further changes in land use of the landscape. Most of the arable land was converted to grasslands (meadows, but especially pastures). From original acreage arable land (1,301 ha) remained only 138 ha and this proportion decreased further, what was associated with specialization of the cooperative in breeding cattle for milk and the second specialization is cultivation of medicinal plants for export.

The land use of landscape succumbed of significant transformation as a result of natural factors and conditions (climate, soil factors and conditions and geomorphological conditions, e. g. soil erosion and slope deformation). Climatic conditions in Jakubanyare less favourable. In the cover of soils from the aspect of agricultural soils predominate of less productive soils and less productive grasslands.

A large acreage occupies in the area of unsuitable for agricultural production on the flood-plain of Jakubianka in the cadastral territory. Approximately 80% the cover of soils have tendency to erosion and to landslides. The grassing of the territory after 1989 have alleviated soil erosion and to some extent stabilized of creeping subsurface movements and the processes of landslide.

Economic factors and conditions have caused other very notable changes in the land use of the landscape. After 1989, agricultural production from state-controlled and planned was transformed on the market economy. The reduction of agricultural subsidies had brought other changes in the land use of the landscape and its functional structure.

CHANGES OF LAND COVER AND FUNCTIONAL STRUCTURE OF THE LANDSCAPE

In the cadastral territory of Jakubany was in the time horizon 1822 of identified 13 land cover types with the largest surface areas of Grasslands with share of 648.74 ha (pastures and meadows) prevailingly without trees and shrubs.The smallest area was occupied the River banks. In the next time horizon in 1979 were identified 16 types classes of land cover. The largest area was represented of Grasslands (pastures and meadows) prevailingly without trees and shrubs (685.4 hectares). The most significant increase was recorded in broad-leaved forests with continuous canopy, not on mire (73.47 hectares) and Discontinuous built-up areas with family houses with garden (59.22 hectares). These areas were located mainly in the peripheral parts of the territory and the area Discontinuous built-up areas with family houses with garden within the built-up area of Jakubany.This effect is characteristic for the rural settlements in which increased the population and so has been thus extended built-up area at the expense of the surrounding areas. Marginal areas due to their non-use for agricultural purposes, they were either naturally or man-wooded. In the time horizon 2012 from the aspect of land cover we are recorded a large decline in the areas of Grassland (meadows and pastures) with trees and shrubs. As a result of the care about these areas have been increased share in the class of land cover in the category Grassland (meadows and pastures) prevailingly without trees and shrubs.The area of Arable land prevailingly without dispersed vegetation receded particularly for the mosaic structures.Comprehensive overview of the representations of different type classes of land cover in time horizons presents Table 2 and Fig. 3, 4, 5indicate the spatial distribution and abundance of land cover types.

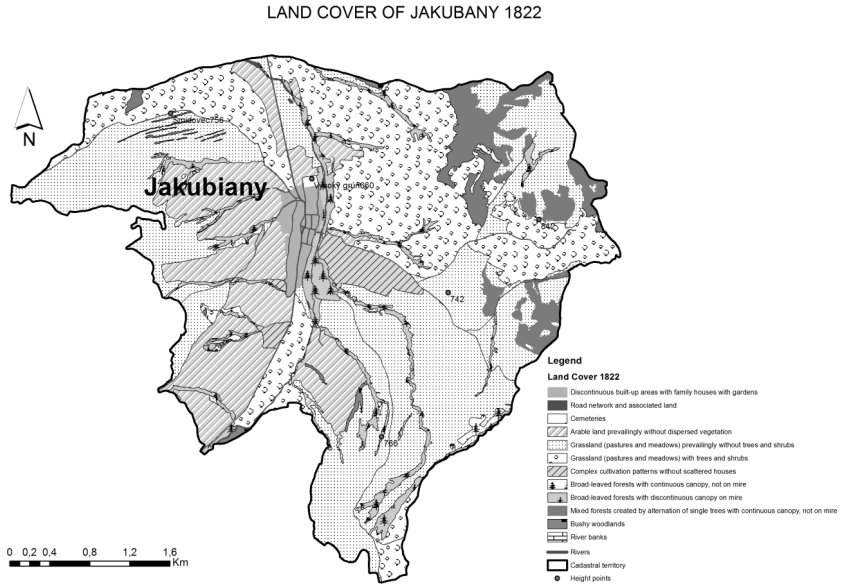

Fig.3 *Land Cover of Jakubany 1822*

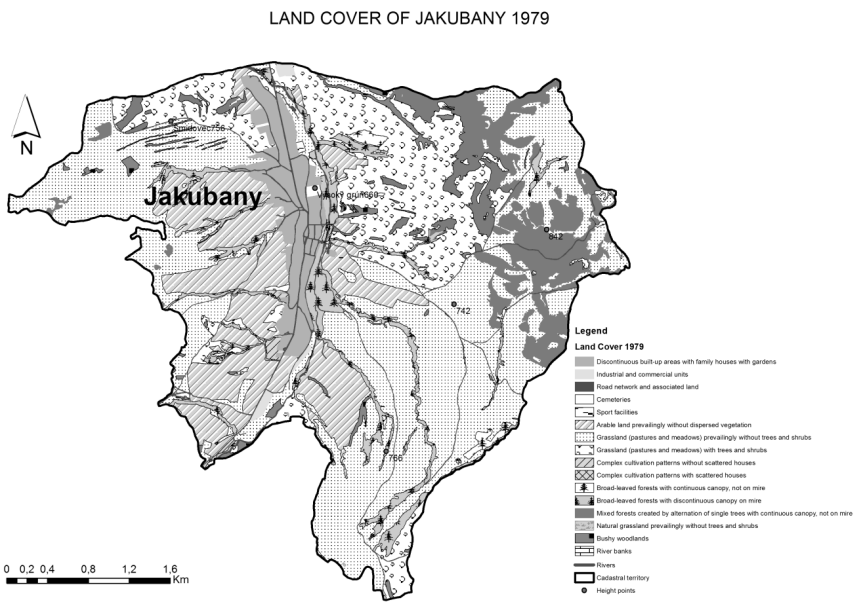

Fig.4 *Land Cover of Jakubany 1979*

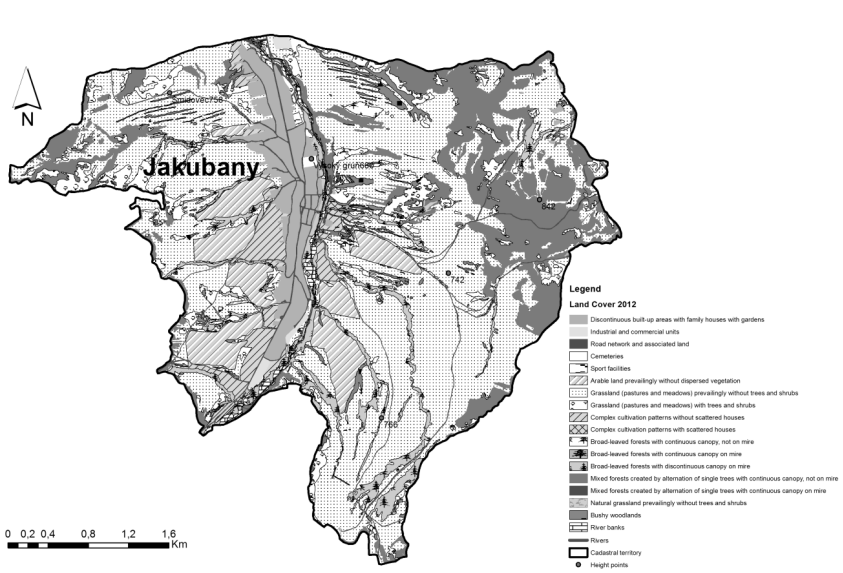

Fig.5 *Land Cover of Jakubany 2012*

Maps from the three time horizons (1822 - 1979 - 2012) were the basis for determination the changes of the land cover in investigated period. Result from a comparison of the individual maps of land cover is Fig. 6, which shows the surfaces without change and changed surfaces within the period under review. The total area of territory without change represents 763 ha. Most stable area from the aspect of land cover is located in the south-eastern part of the cadastral territory of Jakubany, here in after the older part of the built-up area of the village from the year 1822 and north-western and north-eastern slopes covered with forests. On the other side the changes of land cover are most commonly along the line elements (watercourses, roads) and around built-up area of the village. For clarity, changes in the different types of land cover to another type of land cover, we have created a transformation matrix changes between two time horizons, namely the horizon in 1822 and 2012 (Table 3). In this table it is possible to clearly identify any change in the context of land cover types. The amount of the data we choose the most relevant changes:built-up area of the village is expanding more than threefold, mainly at the expense of Arable land prevailingly without dispersed and Grassland vegetation (pastures and meadows) with trees and shrubs.

Table 2 *Spatial rate of the category of Land Cover*

Land Cover of Jakubany in ha	1822	1979	2012
1.1.2.2	28,02	87,24	99
1.2.1.1	0	6,11	6,22
1.2.2.1	12,89	17,17	20,33
1.4.1.2	1,52	1,51	1,51
1.4.2.1	0	0,75	0,75
2.1.1.1	279,81	268,31	122,44
2.3.1.1	648,74	685,4	822,53
2.3.1.2	444,01	290,37	114,58
2.4.2.1	40,3	4,61	56,1
2.4.2.2	0	0	1,5
3.1.1.1	4,82	9,7	9,24
3.1.1.2	0	0	0,81
3.1.1.4	98,61	97,78	94,69
3.1.3.1	104,75	178,22	272,72
3.1.3.2	0	0	0,05
3.2.1.1	0	0,03	0,03
3.2.4.3	8,73	24,65	37,31
3.3.1.3	0,42	0,86	13,15
5.1.1.1	4,3	4,21	3,96
∑	**1676,92**	**1676,92**	**1676,92**

Explanatory notes: 1.1.2.2 Discontinuous built-up areas with family houses with garden; 1.2.1.1. Industrial and commercial units; 1.2.2.1 Road network and associated land; 1.4.1.2 Cemeteries; 1.4.2.1 Sport facilities; 2.1.1.1 Arableland prevailingly without dispersed vegetation; 2.3.1.1 Grassland (pastures and meadows) prevailingly without trees and shrubs; 2.3.1.2 Grassland (pastures and meadows) with trees and shrubs; 2.4.2.1 Complex cultivation patterns without scattered houses; 2.4.2.2 Complex cultivation patterns with scattered houses; 3.1.1.1 Broad-leaved forests with continuous canopy, not on mire; 3.1.1.2 Broad-leaved forests with continuous canopy on mire; 3.1.1.4 Broad-leaved forests with discontinuous canopy on mire; 3.1.3.1 Mixed forest screated by alternation of single trees with continuous canopy, not on mire; 3.1.3.2 Mixed forest screated by alternation of single trees with continuous canopy on mire; 3.2.1.1 Natural grass land prevailingly without trees and shrubs; 3.2.4.3 Bushy woodlands; 3.3.1.3 River banks; 5.1.1.1 Rivers

Most stable type the classes of land cover are the Rivers, Cemeteries and according the acreage areas is largest type especially Arable land prevailingly without dispersed vegetation rowing share of Mixed forests created by the alternation of single trees with continuous canopy, not on mire we file prevailingly on the Grassland (meadows and pastures) without trees and shrubs and on the Grassland (meadows and pastures) with trees and shrubs. According expanse the largest form of conversion one type of land cover to another type is between categories Grasslands (meadows and pastures) prevailingly without trees and shrubs and Grasslands (meadows and pastures) with trees and shrubs (218.33 hectares).

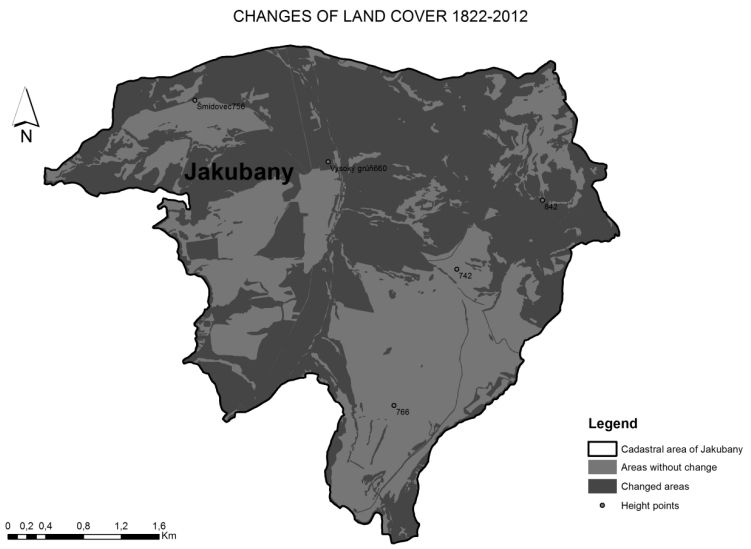

Fig.6 *Changes of Land Cover 1822-2012*

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in ha		Land Cover 1822													
		1.1.2.2	**1.2.2.1**	**1.4.1.2**	**2.1.1.1**	**2.3.1.1**	**2.3.1.2**	**2.4.2.1**	**3.1.1.1**	**3.1.1.4**	**3.1.3.1**	**3.2.4.3**	**3.3.1.3**	**5.1.1.1**	∑
Land Cover 2012	**1.1.2.2**	27,9	0,08	0	29,68	12,18	26,37	2,42	0	0,3	0,07	0	0	0	99
	1.2.1.1	0	0	0	0	0	6,22	0	0	0	0	0	0	0	6,22
	1.2.2.1	0,1	12	0	1,08	3,78	2	0,28	0	0,86	0,22	0	0	0,01	20,34
	1.4.1.2	0	0	1,51	0	0	0	0	0	0	0	0	0	0	1,51
	1.4.2.1	0	0	0	0	0,75	0	0	0	0	0	0	0	0	0,75
	2.1.1.1	0	0	0	94,62	12,98	0	14,76	0	0,08	0	0	0	0	122,44
	2.3.1.1	0,01	0,41	0,02	93,29	495,12	218,33	9,85	0,06	1,88	3,54	0,04	0	0	822,53
	2.3.1.2	0	0	0	8,03	46,26	54,51	1,87	0,03	0,67	2,3	0,92	0	0	114,58
	2.4.2.1	0	0,09	0	36,25	1,24	5,61	7,6	0	5,32	0	0	0	0	56,1
	2.4.2.2	0	0	0	0	0	1,5	0	0	0	0	0	0	0	1,5
	3.1.1.1	0	0	0	0,22	2,41	4,84	0,83	0,19	0,74	0	0	0	0	9,24
	3.1.1.2	0	0	0	0,81	0	0	0	0	0	0	0	0	0	0,81
	3.1.1.4	0,01	0,01	0	10,06	9,6	6,43	0,68	0	67,39	0	0,31	0	0,19	94,69
	3.1.3.1	0	0,27	0	3,01	55,39	99,71	1,03	4,54	9,86	98,62	0,23	0	0,08	272,72
	3.1,3.2	0	0	0	0	0	0,05	0	0	0	0	0	0	0	0,05
	3.2.1.1	0	0	0	0	0	0,03	0	0	0	0	0	0	0	0,03
	3.2.4.3	0	0	0	2,35	7,22	15,35	0,89	0	5,43	0	6,05	0	0,01	37,31
	3.3.1.3	0	0,04	0	0,42	1,74	2,95	0,08	0	6,06	0	1,02	0,42	0,42	13,15
	5.1.1.1	0	0	0	0	0,08	0,1	0	0	0,02	0	0,16	0	3,61	3,96
	∑	**28,02**	**12,89**	**1,52**	**279,81**	**648,74**	**444,01**	**40,3**	**4,82**	**98,61**	**104,75**	**8,73**	**0,42**	**4,31**	**1676,92**

Explanatory notes: 1.1.2.2 Discontinuous built-up areas with family houses with garden; 1.2.1.1. Industrial and commercial units; 1.2.2.1 Road network and associated land; 1.4.1.2 Cemeteries; 1.4.2.1 Sport facilities; 2.1.1.1 Arable land prevailingly without dispersed vegetation; 2.3.1.1 Grassland (pastures and meadows) prevailingly without trees and shrubs; 2.3.1.2 Grassland (pastures and meadows) with trees and shrubs; 2.4.2.1 Complex cultivation patterns without scattered houses; 2.4.2.2 Complex cultivation patterns with scattered houses; 3.1.1.1 Broad-leaved forests with continuous canopy, not on mire; 3.1.1.2 Broad-leaved forests with continuous canopy on mire; 3.1.1.4 Broad-leaved forests with discontinuous canopy on mire; 3.1.3.1 Mixed forests created by alternation of single trees with continuous canopy, not on mire; 3.1.3.2 Mixed forests created by alternation of single trees with continuous canopy on mire; 3.2.1.1 Natural grassland prevailingly without trees and shrubs; 3.2.4.3 Bushy woodlands; 3.3.1.3 River banks; 5.1.1.1 Rivers

Table 3 Transformation matrix of changes

CONCLUSION

From the aspect classes of land cover, we are analysed cadastral area of the municipality Jakubany on the fourth hierarchical level, which corresponds to mapping in the maps of big scale (1:10 000) with using relevant maps documentation. In the studied area we have three time horizons (1822, 1979 and 2012) identified a total of 19 land cover classes. The most widespread types of land cover were throughout the investigation period Grassland (meadows and pastures) prevailingly without trees and shrubs and Grassland (meadows and pastures) with trees and shrubs.The most important changes in the classes of land cover occurred after 1979 which was caused particular processes that had affect management and land use (creation of a unified agricultural cooperative in 1978) as well as a change of ownership after 1989.The built-up area of the village however obtained their character primarily to the year 1979 what related with to population growth and its activities in this area.In the period under were the most stable types of land cover - Cemeteries and Rivers on the other hand were the least stable Grassland (meadows and pastures) prevailingly without trees and shrubs. Areas where changes have occurred have been expressed another type classes of land cover and have been registered mainly along the linear areas and around of built-up area. Areal on which no change has been during the whole investigated period time horizon (1822 - 2012) are located in the south-eastern part of the cadastral territory and also in peripheral mostly wooded areas. The specific features from the aspect of land ownership has acquired land cover in year 2012, when around the built-up area of village has created the Complex of cultivation patterns.

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