Oecologia Montana 2015, **24,** 1-8

Socioeconomics and environmental ramifications of sustainable development in the Poľana region – GIS analysis

Review of the study was presented at the Workshop on current problems of high mountains protection in Norway and the Slovak Republic, Bø, 27.4.2015 - 1.5.2015

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Abstract. In this study we examined the relationship between economical factors, geopolitical data, regional demography and nature protection structure. The main part of the thesis consists of regional analysis using a geographic information system (GIS) and the creation of a complex matrix and consequential matrix analysis using principal component analysis. By carefully combining and evaluating the connection between these variables, we are able to identify tendencies that give us a hint of he overall development in the region. Population migration as the most visible aspect concerning this could have a serious effect on the sustainable development of the region.

Key words: PLA Poľana, Sustainable development, GIS analysis

Introduction

The spectacular landscape surrounding the most famous volcano in Slovakia is home to an enormous variety of fauna and flora flourishing in many places and forms. Even though the Poľana volcano is long since inactive, it still provides unique ecosystems that are unparalleled in Slovakia. The region's potential regarding resources and leisure has been evident ever since the first settlement of the area, but due to the escalation of mankind's effect on the planet throughout the last century we need to understand the tendencies of nature development to be able to make it sustainable. Humans as a part of nature play a major role as an ever changing element so understanding human activity results in a better understanding of nature's development. There are many driving forces that make people act the way they do, but one common (and easy to compare) factor is economy.

The demographic changes greatly affect mountain regions, given that they are predominately rural; therefore, to promote sustainable development in mountain ecosystems, it is essential that the causes and consequences of migration are well understood (Grau and Aide 2007). The process of modernisation in the life of rural society during four decades of changes in agriculture (and also industry) in Slovakia have had their socio-cultural and economic consequences. The creation of new urban centres, jobs and housing attracted the rural population and caused migration from the traditional rural settlements (Ira and Huba 1999). During the socialist era development was concentrated on economic centres while peripheral areas and especially border regions were left almost untouched. As a result, many areas could conserve their high biodiversity, for example bear; wolf and beaver are still found in Central and Eastern Europe whereas in Western Europe these species are bordering on extinction (Nolte 2007).

The Poľana Protected Landscape Area (PLA) was declared in 1981. However, a number of its most valuable elements were protected by law long before (Hrúz 2009). There are seven national nature reservations, 11 protected nature monuments and one protected discovery site within the Poľana protected landscape area. Due to the fact that the Poľana region contains many extremely valuable sites, in 1990 it was declared a part of The UNESCO World Network of Biosphere Reserves (Slávik 1999). This implies that the management and development of this region has to correspond to international regulation, Slovak legislation and sustainable development (Slávikoá 1995). Sustainable development from a global point of view is a hot topic considering on-going changes in biodiversity and climate all around the world. In 1993 the Slovakian State Council and Government adopted decrees on strategies, fundamental issues and the priorities of national environmental politics (Ira *et al.* 2005). These consist of basic rules which are supposed to be implemented at global and regional level and require fundamental change in all aspects of habitual everyday life. The most serious impacts on the environment are caused by unsustainable exploitation, pollution and land-use changes. Therefore, protected areas need new strategies how to manage conflicting interests in order to support sustainable development.

In this paper we try to add new knowledge regarding the ongoing socio-economic relationships with the natural environment and nature protection.

Material and Methods

The aim of our study was to create a data matrix of vital information in the Poľana region and subsequently analyse correlations to highlight possible adversity. As a base unit of this data matrix we chose the smallest municipal unit in the Slovak Republic - the cadastral unit. We used 14 cadastral units that intersect PLA Poľana (Fig. 1): Čierny Balog, Detva, Dúbravy, Hriňová, Hrochoť, Hronec, Ľubietová, Očová, Osrblie, Poniky, Povrazník, Sihla, Strelníky and Valaská. We obtained the layers of cadastral units by reassessing openly available WMS layers. (www.nipi.sazp.sk 2013).

Geographic information system - GIS

To analyse geospatial relations within the each cadastral unit we used GIS called Quantum GIS or QGIS. This is free software developed under GNU/GPL license by OpenSource community. Due to it is openly available nature and active development it naturally supports more data formats and an easily implement new ones if needed (www.qgis.org 2014). We used QGIS version 2.2.0 (Valmiera), which was the latest available at the time of research. For map exports we used a background layer of Open Street Maps (www.openstreetmap.org 2013) implemented using QGIS using OpenLayers plugin version 1.1.2.

To calculate shares of studied polygons within the cadastral unit we used an intersection tool to create temporary polygon layers with attributes inherited from both cadastral unit layers and any studied layer. We transformed this temporary layer using a dissolve tool with a unique field ID of cadastral unit name as a unique marker. The result was a multipolygon layer with features of the studied original layer split by the borders of cadastral units and merged by each cadastral unit uniquely. The next step was to calculate the area of each multipolygon feature using a data field calculator and compare it with the original area of cadastral unit.

Data collection

The whole data matrix can be divided into four main parts containing four groups of information in any given cadastral unit. (Protected areas, CORINE Land cover, Demography and Economy).

Protected areas

We studied four different protected areas, the first being the Polana Protected Landscape area and its share within the cadastral units it intersects. Next are smaller protection areas including protected Sites, National Nature Monuments, National Nature Reserves, Buffer zones of National Nature Reserves, National Monuments and National Reserves (www.nipi.sazp.sk 2013). A further two areas are Special Protection Areas (SPA) and Sites of Community Importance (SCI) defined by Natura 2000 (www.eea.europa.eu 2013a). Using these areas we calculated the share of coverage within each cadastral unit and the results were calculated in m^2 to approximately 2 decimal places. This resolution is higher than the resolution of the original areas used, but since we used only the ratio between areas, the margin for error is very low.

CORINE Land cover

CORINE (Coordination of Information on the Environment) land cover is a European Union (EU) project to unify map land cover types within the EU. The most recent mapping was carried out in 2006 and these were also used to calculate the proportional share of each land cover type within each cadastral unit.

Demography

Demography is an essential indicator of any regional development. Data used in this study is based on the last census carried out in 2011 (www.portal.statistics.sk 2013) and grouped according to gender, age, education and economic status. Using

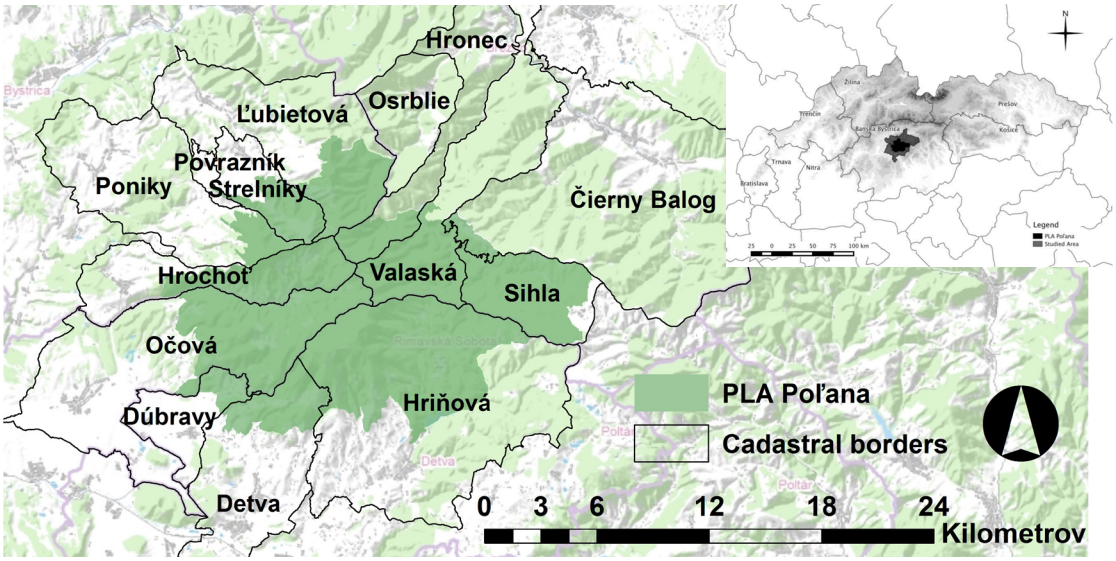

Fig. 1. Study area and PLA Poľana

this data we also calculated the population density in each cadastral unit.

Economy

This part of the data matrix is made up of four columns. The first is the cadastral unit tax income and we used the basic tax income of each cadastral unit. This information is part of the obligatory annual reports available on the webpage of every cadastral unit. If a particular cadastral unit did not have this information on the internet, we made enquiries at local administrations to obtain the necessary information. We used 2011 data as it was the most accurate for each cadastral unit. The second column is forest revenue of the cadastral units and to calculate forest revenues we used data available from LGIS by Zvolen University (www.gis.nlcsk.org 2013). Due to the fact that forestry units administered by timber companies do not adhere to cadastral borders, we had to calculate the income share of each cadastral unit by its share of land within the forestry unit. The incomes of each forestry unit are estimated by the amount of timber felled in 2013 (LGIS) and the average price of timber at that time. For storm damaged timber we used the price of firewood (www.lesy.sk 2013). The third column is hunting revenues and these were calculated using the average price of meat and the number of animals hunted during one season (Hruška 2012). The revenues of each hunting unit were again divided to cadastral units according to the intersection area of the two (www.gis.nlcsk.org 2013). The last column is agricultural revenue and we used the same method as hunting revenues based on the area of land used in agriculture and subsidies by the state (Hruška 2012).

Statistical analysis

To analyse the matrix we created we decided to use principal component analysis (PCA). Using this analysis we were able to see the relationships between individual variables and identify developing factors. To perform this analysis we decided to use a statistical program called R in version 3.0.3 (2014-03-06) codenamed "Warm Puppy". This is an open source program distributed freely under the GNU/GPL license but because R alone is programming based and difficult to operate, we used a RStudio v.0.98.501 extension to simplify things. We wrote a specific script to carry out PCA analysis to evaluate any data provided in coma separated values files (CSV) and the outcome of this R script are three files beginning with the rotation matrix. This matrix gave us idea of the relationship within the original matrix. The second is factorscores.csv which is the matrix score of factor efficacy within each cadastral unit input, and finally a summary.csv providing us with standard deviation, proportion of variance and cumulative proportion of each factor.

Results

Tables 1, 2, 3, 4, 5, 6 and 7 represent the outcome of GIS analysis and calculations used to obtain input data matrix that was used in PCA analysis (Table 8

CU	Area in m² (GIS)	Non-irrigated arable land	Industrial or commercial units and Discontinuous urban fabric	Pastures	Complex cultivation patterns
Čierny Balog	147,597,490.27	2.03%	1.82%	12.55%	0.18%
Detva	68,162,731.27	17.76%	3.99%	9.60%	4.75%
Dúbravy	18,256,707.75	22.37%	1.13%	3.45%	1.16%
Hriňová	12,6438,411.89	0.74%	1.55%	6.17%	0.91%
Hrochoť	34,778,557.89	6.71%	1.74%	16.97%	0.00%
Hronec	35,236,861.58	0.01%	2.57%	5.49%	0.00%
Ľubietová	60,853,547.80	2.25%	0.66%	10.96%	0.00%
Očová	90,205,900.96	28.01%	2.73%	8.39%	0.00%
Osrblie	24,097,608.08	0.00%	1.18%	0.36%	0.00%
Poniky	58,992,243.24	12.74%	2.07%	29.06%	0.00%
Povrazník	3,404,143.41	3.47%	1.51%	11.02%	0.00%
Sihla	26,702,334.42	0.00%	0.00%	10.66%	0.00%
Strelníky	17,661,355.53	4.83%	1.05%	15.20%	0.00%
Valaská	63,077,422.98	5.74%	5.01%	5.69%	0.00%

Table 1. CORINE Landcover 1 [***Non-irrigated arable land*** - Cereals, legumes, fodder crops, root crops and fallow land. Includes flowers and tree (nurseries cultivation) and vegetables, whether open field or under plastic or glass (includes market gardening). Includes aromatic, medicinal and culinary plants. Does not include permanent pasture. ***Industrial or commercial units and Discontinuous urban fabric*** - Artificially surfaced areas (cement, asphalt, tarmacadam or stabilized e.g. beaten earth) without vegetation occupy most of the area, which also contains building and/or vegetation and Areas where most of the land is covered by structures. Buildings, roads and artificially surfaced areas are associated with vegetated areas and bare soils, which occupy discontinuous but significant surfaces. ***Pastures*** - Dense grass cover, of floral composition, dominated by graminaceae, not under a rotation system. Mainly for grazing, but the folder may be harvested mechanically. Includes areas with hedges (bocage). ***Complex cultivation patterns*** - Juxtaposition of small parcels of diverse annual crops, pasture and/or permanent crops (www.eea.europa.eu 2013b).]

CU	Land principally occupied by agriculture, with significant areas of natural vegetation	Broad-leaved forest	Coniferous forest	Mixed forest	Transitional woodland-shrub
Čierny Balog	2.27%	8.63%	35.26%	30.52%	6.75%
Detva	32.85%	13.39%	4.69%	10.51%	2.46%
Dúbravy	6.73%	1.88%	57.63%	3.65%	2.00%
Hriňová	27.03%	17.17%	1.35%	28.66%	15.98%
Hrochoť	5.33%	21.29%	18.81%	25.53%	3.63%
Hronec	1.88%	11.25%	33.20%	29.82%	15.78%
Ľubietová	11.67%	12.85%	13.39%	37.18%	11.05%
Očová	5.59%	15.64%	5.00%	26.24%	7.99%
Osrblie	1.63%	10.44%	46.25%	12.00%	28.13%
Poniky	9.29%	13.00%	1.44%	28.06%	4.34%
Povrazník	0.70%	0.00%	83.16%	0.15%	0.00%
Sihla	3.24%	3.43%	31.91%	15.78%	34.98%
Strelníky	3.00%	0.02%	68.87%	4.59%	2.45%
Valaská	3.64%	8.95%	0.00%	42.01%	28.32%

Table 2. CORINE Landcover 2 [***Land principally occupied by agriculture, with significant areas of natural vegetation*** - Land occupied by agriculture with areas of natural or semi-natural areas (including wetlands and water bodies, outcrops). This heading includes: linear structures of trees organized for truffle producing, hortillonage (vegetable crops and canals) and agriculture and scattered heaps of stones. ***Broad-leaved forest*** - With a crown cover of more than 30 % or a 500 subjects/ha density for plantation structure, broad-leaved trees represent more than 75 % of the planting formation. Three heights under normal climatic conditions are higher than 5 m. ***Coniferous forest*** - Coniferous trees represent more than 75 % of the formation. Three heights under normal climatic conditions are higher than 5 m. ***Mixed forest*** - With a crown cover of more than 30 % or a 500 subjects/ha density for plantation structure. The share of coniferous or broad-leaved species does not exceed 25 % in the canopy closure. Three heights under normal climatic conditions are higher than 5 m. ***Transitional woodland-shrub*** - Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration/recolonization (www.eea.europa.eu 2013b).]

CU	Population	Male %	Female %	0-14 %	15-54 female %	15-59 male %	55f/60m %
Čierny Balog	5,227	49.47%	50.53%	16.55%	29.31%	34.55%	19.59%
Detva	15,046	48.90%	51.10%	13.94%	29.45%	37.95%	32.97%
Dúbravy	935	47.49%	52.51%	11.87%	28.77%	33.26%	26.10%
Hriňová	7,814	48.78%	51.22%	12.82%	29.10%	34.26%	23.82%
Hrochoť	1,499	48.57%	51.43%	16.94%	28.49%	32.82%	21.75%
Hronec	1,220	47.62%	52.38%	15.00%	26.97%	32.13%	25.90%
Ľubietová	1,074	50.09%	49.91%	14.34%	27.84%	35.85%	21.97%
Očová	2,634	48.79%	51.21%	12.91%	27.03%	32.16%	27.75%
Osrblie	386	54.15%	45.85%	11.92%	22.80%	35.23%	30.05%
Poniky	1,590	48.05%	51.95%	14.47%	29.31%	33.40%	22.77%
Povrazník	154	50.65%	49.35%	12.99%	30.52%	33.77%	22.73%
Sihla	203	50.74%	49.26%	16.75%	30.05%	35.96%	17.24%
Strelníky	785	48.66%	51.34%	14.39%	26.37%	34.65%	24.59%
Valaská	3,892	49.31%	50.69%	15.44%	27.18%	31.50%	25.87%

Table 3. Demography

and 9). At the end of 2011 the population of the Poľana region was 42,459, in an area of 786.8 km^2. This region consists of 14 municipalities, of which Detva is the largest with a population of 15,046 (Table 3). The second largest is Hriňová a with population 7,814. Considering the relatively small population distributed in a wide area, the population density (Table 5) is less than half of the overall average in Slovakia (54 p/km^2 in comparison with 110 p/km^2).

Statistical analysis

Factor 1: With a variance proportion of over 26% it shows a common population tendency to live

in bigger cities. Where there is higher population there is also a higher population density and more people in employment because it's much easier to find work in bigger cities such as Detva or Hriňová than in small villages. There is also a link between the type of forest within cadastral unit areas and a higher population as there is more broad-leaved forest in comparison with coniferous forest as well as more agricultural land. The reason for this is that more populated cadastral units are mainly at lower altitudes which are more suitable for broad-leaved forest and with more fertile soil used for agriculture.

CU	Unemployed %	Econ. inactive %	Econ. active pop. %	Higher educ. %
Čierny Balog	11.77%	47.25%	49.44%	5.68%
Detva	8.30%	44.72%	48.36%	10.08%
Dúbravy	9.84%	47.91%	49.09%	6.52%
Hriňová	10.58%	45.75%	49.12%	8.11%
Hrochoť	11.41%	45.36%	51.43%	7.47%
Hronec	9.02%	47.30%	43.28%	13.44%
Ľubietová	5.77%	45.62%	51.96%	9.03%
Očová	6.45%	48.14%	48.06%	13.52%
Osrblie	10.10%	47.15%	48.70%	4.40%
Poniky	6.73%	45.72%	52.08%	12.39%
Povrazník	11.69%	46.10%	48.05%	3.90%
Sihla	11.82%	48.28%	49.26%	9.36%
Strelníky	5.22%	48.54%	49.81%	6.62%
Valaská	10.74%	49.28%	46.51%	10.25%

Table 4. Demography - social structure (***Unemployed*** - The citizens over 16 years old who were not employed and did their best to find the job at the time of census. This condition was not affected by fact that they were or were not subscribed in national workforce registry. ***Economically inactive population*** - The citizens who did not work at the time of census. This includes pre-school population, students, retired population and other classified as not working. ***Economically active population*** - The citizens who did work at the time of census. ***Higher educated population*** - citizens who achieved at least undergraduate degree in their life at the time of census.)

CU	Population density	Population density females	Population density males
Čierny Balog	35.41	17.89	17.52
Detva	220.74	112.79	107.95
Dúbravy	51.21	26.89	24.32
Hriňová	61.80	31.65	30.15
Hrochoť	43.10	22.17	20.93
Hronec	34.62	18.13	16.49
Ľubietová	17.65	8.81	8.84
Očová	29.20	14.95	14.25
Osrblie	16.02	7.35	8.67
Poniky	26.95	14.00	12.95
Povrazník	45.24	22.33	22.91
Sihla	7.60	3.74	3.86
Strelníky	44.45	22.82	21.63
Valaská	61.70	31.28	30.42

Table 5. Population density (Population density is very important geopolitical indicator. We calculated population density of each cadastre unit by dividing overall population of the unit by its area in km^2)

CU	PLA Share	SPA Share	SCI Share	NH Share	NH count
Čierny Balog	2.01%	2.01%	3.34%	3.35%	7
Detva	17.77%	59.33%	4.31%	0.12%	2
Dúbravy	22.13%	72.92%	2.79%	0.00%	5
Hriňová	44.10%	59.76%	6.46%	5.85%	3
Hrochoť	52.77%	57.03%	16.62%	0.67%	0
Hronec	20.26%	20.26%	13.47%	2.34%	2
Ľubietová	25.61%	33.45%	13.54%	3.97%	0
Očová	37.90%	60.87%	3.46%	0.86%	0
Osrblie	0.06%	0.06%	0.00%	0.00%	4
Poniky	9.32%	31.12%	0.25%	0.23%	2
Povrazník	4.93%	39.88%	0.00%	0.00%	4
Sihla	90.33%	90.33%	0.67%	0.74%	2
Strelníky	51.95%	73.80%	0.07%	0.00%	4
Valaská	28.91%	28.91%	6.85%	3.27%	0

Table 6. Protected areas (***PLA Share*** - is proportional share of the Protected Landscape Area Poľana within cadastral unit; ***SPA Share*** - is proportional share of Special Protection Areas cadastral unit; ***SCI Share*** - is proportional share of the Sites of Community Importance combined area within cadastral unit; ***NH Share*** - is proportional share of the National heritage sites within cadastral unit; ***NH Count*** - is the number of heritage sites which is centroid resides within cadastral unit.)

CU	Tax in €	Forest revenues in €	Hunting revenues in €	Agricultural revenues in €
Čierny Balog	2,101,388	153,319	760	0
Detva	4,357,210	404,525	2,036	0
Dúbravy	76,807	240,644	1,233	0
Hriňová	3,290,765	1,973,125	33,945	0
Hrochoť	1,070,510	856,596	5,615	128,216
Hronec	414,426	1,383,730	3,622	0
Ľubietová	705,443	1,535,223	5,100	0
Očová	1,330,052	1,619,941	25,986	62,000
Osrblie	154,464	573,150	0	0
Poniky	418,330	1,508,721	9	0
Povrazník	61,200	0.00	349	0
Sihla	81,233	1,778,503	9,577	0
Strelníky	715,074	379,899	2,085	114,080
Valaská	2,213,343	2,002,271	6,765	0

Table 7. Regional economy

	PC1	PC2	PC3	PC4	PC5	PC6
Standard deviation	2.9663	2.4858	1.9848	1.6912	1.5973	1.4912
Proportion of Variance	0.2666	0.1873	0.1194	0.0867	0.0773	0.0674
Cumulative Proportion	0.2666	0.4539	0.5733	0.6599	0.7372	0.8046
Area in m2	0.1565	0.1696	-0.1338	0.1822	-0.1421	-0.1138
Non irrigated arable land	0.1424	-0.0565	0.2147	-0.2884	0.0128	0.0630
Industrial or commercial...	0.2143	0.0610	-0.1107	-0.2695	-0.1425	-0.1489
Pastures	0.0057	0.0645	0.3286	0.1815	-0.2259	0.1333
Complex cultivation patterns	0.2932	-0.1832	-0.0105	0.0295	0.0954	-0.0087
Land occupied by agriculture	0.3032	-0.0207	-0.0207	0.1452	0.1256	0.1025
Broad leaved forest	0.1683	0.2353	-0.0514	0.0441	-0.1224	0.2820
Coniferous forest	-0.2090	-0.2785	0.0622	-0.0145	-0.0097	-0.1418
Mixed forest	0.0555	0.3563	-0.1285	0.0269	-0.1765	0.0042
Transitional woodland shrub	-0.0987	0.1501	-0.3093	0.0037	0.3213	-0.0276
Population	0.3226	-0.0551	-0.0935	0.0946	0.0298	-0.0670
Male %	-0.1378	-0.1143	-0.3289	0.1168	0.1277	0.2655
Female %	0.1378	0.1143	0.3289	-0.1168	-0.1277	-0.2655
Population 0-14 in %	-0.0225	0.1810	0.1122	0.2302	-0.0550	-0.1736
Female population 15-54 in %	0.0960	0.0031	0.2391	0.2888	0.0007	-0.3141
Male population 15-59 in %	0.1029	-0.1967	-0.0620	0.3132	0.1894	0.2032
Retired population	0.1837	-0.1539	-0.1517	-0.3484	0.0064	0.1865
Unemployed	-0.0558	-0.0246	-0.1735	0.2048	0.0418	-0.3529
Economically inactive	-0.1665	0.0510	-0.0448	-0.2779	0.1965	-0.2743
Economically active	-0.0217	-0.0040	0.2042	0.3193	-0.0497	0.3616
Higher education	0.1291	0.2517	0.0993	-0.2371	0.0281	0.0184
PLA Share	-0.0358	0.1518	0.1985	0.0952	0.4828	-0.0427
SPA Share	0.0486	-0.0183	0.3215	0.0138	0.4593	-0.0577
SCI Share	0.0696	0.2296	0.0230	0.0176	-0.1485	0.0566
NH Share	0.0685	0.2540	-0.2013	0.1852	-0.0455	-0.1516
NH Count	-0.0831	-0.2512	-0.0717	0.1496	-0.1375	-0.2643
Population density	0.3043	-0.1614	-0.0047	-0.0130	0.0396	-0.0496
Population density males	0.3032	-0.1633	-0.0096	-0.0107	0.0399	-0.0469
Population density females	0.3052	-0.1595	-0.0001	-0.0152	0.0394	-0.0521
Tax income	0.3066	0.0265	-0.1128	0.0992	0.0310	-0.0858
Forest revenues	0.0318	0.3495	-0.0632	-0.0443	0.2128	0.0529
Hunting revenues	0.0920	0.2161	-0.0372	0.0021	0.2810	-0.0074
Agricultural revenues	-0.0355	0.0376	0.2898	-0.0715	0.0312	0.1793

Table 8. Rotation matrix of PCA

It is also obvious that there are higher tax incomes in the larger cities.

Factor 2: With a variance proportion of 18.7% this factor represents a higher income in the timber industry of regions with mixed forest, which was unexpected as coniferous forest dominates the whole study area. This can by explained by the fact that more remote regions with higher altitudes are difficult to access and are also part of PLA Poľana so tree felling is more restricted there. As a result, more broad-leaved trees are cut down. Also rather surprisingly, it is evident that the timber industry doesn't have a significant affect on general employment. It is also evident that forest share and hunting revenue increases with a higher proportion of PLA and SCI. This factor affects mostly the Hriňová, Očová and Valaská regions.

Factor 3: With a variance proportion of nearly 14% this shows the relationship between the percentage of agricultural areas such as pasture and land used mainly for agriculture, with the agricultural revenue of the cadastral unit. This consideration affects mostly Hrochoť, Poniky and Strelníky and also highlights the difference between the percentage of male and female population, which is self evident.

Factor 4: With a variance proportion of 8.7%, this illustrates the relationship between the population able to work (females from 15 to 55 and

	PC1	PC2	PC3	PC4	PC5	PC6
Čierny Balog	-0.494	-0.375	-1.677	1.952	-2.712	-2.283
Detva	8.839	-3.299	-0.329	-0.034	0.615	0.608
Dúbravy	-0.701	-2.874	1.87	-1.488	0.082	-1.366
Hriňová	2.704	2.54	-1.665	1.826	1.375	-1.29
Hrochoť	-0.132	1.804	2.382	1.632	-0.623	0.974
Hronec	-0.657	1.97	-0.473	-2.455	-1.288	-0.885
Ľubietová	-0.553	1.962	-0.427	1.912	-0.4	2.034
Očová	0.607	2.42	1.375	-2.44	0.75	1.109
Osrblie	-3.156	-2.724	-4.271	-0.585	0.27	2.749
Poniky	0.034	1.177	2.158	0.793	-1.997	1.293
Povrazník	-2.246	-3.871	0.121	0.328	-0.817	-1.03
Sihla	-2.897	0.604	0.152	1.445	3.909	-1.146
Strelníky	-1.854	-2.252	2.718	-0.395	0.87	0.246
Valaská	0.506	2.92	-1.933	-2.49	-0.033	-1.015

Table 9. PCA Factor scores

males from 15 to 59) and the overall percentage of the population . This more economically active population live in farmstead and agricultural areas in less built up cadastral units like Ľubietová, Čierny Balog or Sihla. The percentage ratio of higher educated people in the population can also be seen, the reason for this being that gaining a higher education takes up time studying instead of working to earn money and contributing to the economy.

Factor 5: With a variance proportion of 7.7% this shows the relationship between protected landscape areas and special protected areas (SPA) within each cadastral unit and hunting revenues of the cadastral unit. It also shows the relationship between transitional woodland shrubs with forest revenues, which is understandable because transitional woodland shrub is an indicator of active forestry work. There also appears to be a higher percentage of unemployed people in regions with active forestry and hunting.

Factor 6: With a proportion of variance 6.7% this shows the relationship between the unemployment rate and the female population able to work. This illustrates the problem of women being able to find work in the region and reinforces the concept of a typical family structure where men work and women stay at home to take care of the domestic chores. The percentage of youngsters in the community is apparent here, mainly connected with a higher active female population and most evident in Osrblie and Ľubietová.

Discussion

Population migration as the most evident factor in this area complies with the general tendency in Europe after World War II. This fact was strengthened during the communist era in Slovakia (Bezák and Mitchley 2013; Izakovičová 2013), and has now probably reached its peak. The population tends to concentrate in bigger cities resulting in higher population density. This brings more opportunities for jobs, entertainment and the social aspects of life (Antrop 2004). In our studied area, Detva and Hriňová are the cities that attract most population, but there are larger cities nearby such as Zvolen, Banská Bystrica or Brezno which also provide better job prospects and improved cultural benefits whilst still being within reasonable distance of Poľana. A low population density without local services restricts viable employment opportunities (Lundmark *et al.* 2010). Thanks to the integrated adaptation of all cadastral units within the Poľana region, the protected landscape area and the Poľana volcano have become unifying agents. None of the cadastral units holds a majority of the land here which has created a sort of equilibrium of actual ownership felt by people living at the base of the volcano. Generally speaking, the depopulation of rural areas might have a serious effect on sustainable development of the region (Grau and Aide 2007). On one hand, when there are less people living in an area, nature tends to flourish more. There is less pollution, noise and less exploitation of resources. On the other hand though, people who have sincere relationships with the land they manage are probably the best to promote development with sustainability in mind.

The Poľana region as a whole follows the same basic tendencies of population development that can be observed throughout Slovakia. (Jurčová 2003, 2004) The population is getting older both relatively and categorically and for the Poľana region as a whole, a small and steady long-term increase in the population illustrates this trend. Due to the overall decrease of natality and the decline in population migration after 1990, a general polarization of population growth between cities and villages is very obvious (Ira *et al.* 2005). Demographic distribution within the region demonstrates how the links between female population and unemployment rates and the classical lifestyle that still exists can affect future development of the region. Whereas a higher female population is causing higher birth-rates, this also brings with it certain

maternal obligations. According Ira *et al.* (2005) only as recently as 1990 did long-lasting depopulation and concentration trends slowly start to change when employment in the larger regional companies started to decline. Some dispersed farms have started to work. The consequence of the general socio-economic development also became manifest in the demographic characteristics of the region both as a whole and within individual sectors.

It is abundantly clear that the timber industry doesn't significantly affect regional employment and it appears that there is more unemployment in regions with active forestry and hunting. In contrast, Kovalčík *et al.* (2012) argue that the current range of economic restrictions in "an inadequately extensive system of protected areas" has a negative impact on the balanced fulfilment of economic, ecological and social forest functions, and also on regional development, quality of life, employment and income of the population especially in rural mountainous areas. Consequently, if nature protection becomes irrelevant to socio-economic relationships within the region, then it may be treated as insignificant by the inhabitants.

Acknowledgements

Activity was supported from the EEA and Norway Grants BFENV14-002..

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