

THE ASSESMENT OF LAND COVER IN THE NOWY TARG COMMUNE WITH PARTICULAR FOCUS ON THE AREA OF NATURA 2000

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Summary

The rural landscape in Poland has been changing for the past several dozen years. The changes are visible in the land use and land cover. Technological progress, changes in people's outlook and a low profitability of agriculture resulted in transformations of rural landscapes, especially in the areas of high level of land fragmentation, as it is the case in the south part of Poland. These changes are accompanied by growing awareness of environmental or cultural landscape protection related issues. Recent years have also brought new forms of environmental protection, for example the programme Natura 2000, being the result of agreements with European Union. The network of Natura 2000 cover the areas of special protection of birds, habitats, and according to the Act on Nature Conservation – areas of special interest for the Community. The goal of this form of protection is a preservation of valuable or engendered elements of biodiversity. The question arises then whether in the era of landscape transformations and changes of land cover qualifying a particular area as part of Natura 2000 network has any influence on the way of land use. The aim of the article is an analysis and evaluation of land cover changes, also in the areas covered by Natura 2000 programme, within the piedmont commune of Nowy Targ in Małopolskie Voivodeship. Moreover, a thesis is proposed that submontane lands, specifically used, due to large terrain height differences, are faced with less intense urbanization pressures and land transformations. Is it also the case of the Nowy Targ commune, covered in more than 22% by the Natura 2000 areas?

Keywords

Natura 2000 areas • land cover changes • landscape transformations

1. Introduction

The rural areas take up more than 90% of Poland's territory [Staniak 2009]. It means that they have a considerable influence on the country's natural environment. For centuries mosaic of cultivated lands, permanent grasslands, forests and rural settlements have been creating typically Polish, traditional rural landscape [Staniak 2009, Baran-Zgłobicka and Zgłobicki 2012]. The environmental and cultural value of rural

areas in Poland is highly valued in Europe, because most of the unique habitats and plant communities is related to rural areas, and is used as meadows and pastures [Andrzejewski and Weigle 2003].

Historically, agriculture was a direct cause of creation of rural landscapes characterized by rich biodiversity. The changes in agriculture of the last fifty years, including specialization, intensive farming economy, technological development, led to better crop efficiency and increased the competitiveness of agriculture. All this resulted in land use changes, in introduction of new kinds of crops, acreage increase of agricultural plots. The characteristic mosaic of lands [Baran-Zgłobicka and Zgłobicki 2012] and transformations have an adverse impact on water environment, soils, air quality, biodiversity and rural landscape [Kozłowski 2004, Burchard-Dziubińska 2010].

The forms of land use influence the picture of land cover, which can both be a result of natural and anthropogenic factors. It is proved that land cover influences many elements, for example local climate, development of physiographic conditions, including soil conditions, but also visible forms of natural and cultural landscape [Richling 1996]. Land cover includes [Ciołkosz and Bielecka 2005]:

- 1) vegetation, including forests, grasslands, agricultural lands),
- 2) open areas (sands, solid rocks),
- 3) waters.

There is a strong correlation between “land use” and “land cover”. Zwoliński [1998] says that land use is a result of combining land cover with its use. In this view the notion of land use is prior to the notion of land cover.

Land cover and land use as well as their changes for a long time have been the subject of interest for specialists of many domains. And it applies to changes on a local and global level. In 1985 the Council of Europe decided to implement programme CORINE Land Cover (Coordination of Information on the Environment), supervised by the European Environmental Agency (EEA). The first stage of the programme was the study of changes in land cover in 1990 on the basis of aerial photographs taken by a satellite Landsat by means of a TM scanner. Ten years later the land cover changes were significant enough to update the databases already in 2000. The changes were so fast that decision was made to update the databases more often, that is not every ten but every five years. The land cover changes were noted in three levels. The first one includes five basic types of land cover [Ciołkosz and Bielecka 2005]:

- 1) anthropogenic (artificial) surfaces,
- 2) agricultural areas,
- 3) forests and semi-natural areas,
- 4) wetlands,
- 5) water bodies.

In the second level 15 forms of land cover are distinguished, and the third one is the most precise with 44 classes. In Poland 31 out of 44 defined classes of land cover were

noted, and in Małopolskie Voivodeship itself 28 classes were observed. In the CORINE databases raster data are stored, with a minimal size of a classified area of 25 ha and width of at least 100 m, but an annotation is made when a visible change of 5 ha division range occurs or 25 ha change in case of new forms of cover.

CORINE Land Cover enables spatial analyses for environmental protection purposes and creation of thematic maps. The programme offers the first complete and uniform digital picture of land cover in Poland.

Poland has more than 32% of the country covered with protected areas, 11% of which are national parks, landscape parks and natural reserves, characterized by strict environmental protection rules [Radziejowski 2004]. Implementing another type of protection means an expansion of areas of great natural interest with spaces that were not under other forms of protection before. The principal goal of the Natura 2000 programme, created by the EU member countries, was preservation of biodiversity in Europe. These areas include especially places where flora and fauna populations are declining and natural habitats at risk of deterioration or shrinking [Tarchalska 2008]. According to the Act on Nature Conservation of 2004, the network of Natura 2000 areas (established by the same act) covers the areas of special protection of birds, habitats, and areas of special interest for the Community. By definition the established network Natura 2000 can cover a part or the whole of areas under other forms of environmental protection. The environmental protection related activity consists in preserving, sustainable use and restoration of resources, formations and elements of nature. Landscape is also included in this definition. Therefore it can be concluded that areas under environmental protection of any form, when taken into account in ecological policies, in programmes of environmental protection, in development plans for the whole country, in development strategies of voivodeships and communes, in voivodeships, communes and local spatial development plans, in communes studies of land use conditions and directions, would undergo less intense transformations than the non-protected areas. The conclusion is confirmed by the principal assumption of Natura 2000 programme, which is to preserve the protected area in a state found when the necessity of protection appeared. Covering some part of a commune area by the Natura 2000 protection may slow down the area's economic development and impede administrative processes in undertakings carried out within this area or in its immediate vicinity [Tarchalska 2008]. The task to reconcile the needs for development of rural areas and agriculture with environmental and landscape protection is very difficult to accomplish [Staniak 2009].

The presented work aims at presenting land cover changes observed in the CORINE Land Cover databases with regard to the piedmont commune of Nowy Targ, situated in Małopolskie Voivodeship. The additional goal of the article is an analysis and estimation of changes in agricultural lands, with particular focus on changes within the Natura 2000 area located in the studied commune.

Table 1. Land cover classes in the CORINE Land Cover databases

Level 1	Level 2	Level 3		ID
1. Anthropogenic surfaces	1.1. Urban fabric	1.1.1	Continuous urban fabric	1
		1.1.2	Discontinuous urban fabric	2
	1.2. Industrial, commercial areas and transport units	1.2.1	Industrial or commercial units	3
		1.2.2	Road and rail networks and associated land	4
		1.2.3	Port areas	5
		1.2.4	Airports	6
	1.3. Mine, dump and construction sites	1.3.1	Mineral extraction sites	7
		1.3.2	Dumps sites	8
		1.3.3	Construction sites	9
	1.4. Urban green and leisure areas	1.4.1	Green areas	10
		1.4.2	Sport and leisure areas	11
2. Agricultural areas	2.1. Arable land	2.1.1	Non-irrigated arable land	12
		2.1.2	Permanently irrigated arable land	13
		2.1.3	Rice fields	14
	2.2. Permanent crops	2.2.1	Vineyards	15
		2.2.2	Orchards and plantations	16
		2.2.3	Olive groves	17
	2.3. Meadows and pastures	2.3.1	Meadows, pastures	18
	2.4. Heterogeneous agricultural areas	2.4.1	Annual crops associated with permanent crops	19
		2.4.2	Complex cultivation patterns	20
		2.4.3	Land principally occupied by agriculture, with significant areas of natural vegetation	21
		2.4.4	Agro-forest areas	22
3. Forest and semi-natural areas	3.1. Forests	3.1.1	Broad-leaved forests	23
		3.1.2	Coniferous forests	24
		3.1.3	Mixed forests	25
	3.2. Shrub and herbaceous vegetation	3.2.1	Natural grassland	26
		3.2.2	Heathlands and shrubs	27
		3.2.3	Sclerophyllous vegetation (Mediterranean)	28
		3.2.4	Transitional woodland / shrub	29
	3.3. Open spaces, with little or no vegetation	3.3.1	Beaches, dunes, sands	30
		3.3.2	Exposed rocks	31
		3.3.3	Sparsely vegetated areas	32
		3.3.4	Burnt areas	33
3.3.5		Glaciers and permanent snowfields	34	

4. Wetland	4.1. Inland wetland	4.1.1	Inland marshes	35
		4.1.2	Peat bogs	36
	4.2. Coastal wetland	4.2.1	Salt marshes	37
		4.2.2	Salines	38
		4.2.3	Intertidal flats	39
5. Water bodies	5.1. Continental waters	5.1.1	Water courses	40
		5.1.2	Water bodies	41
	5.2. Marine waters	5.2.1	Coastal lagoons	42
		5.2.2	Estuaries	43
		5.2.3	Seas and oceans	44

Source: authors' study (based on Ciołkosz and Bielecka [2005])

2. Material and methods

The analysis of land cover changes in the studied area has been carried out based on a raster terrain model CORINE Land Cover of 1990, 2000 and 2006 with a resolution of 100 m per pixel. The models were acquired free of charge from the site of the European Environmental Agency (www.eea.europa.eu/data-and-maps/explore-interactive-maps/corine-landcover). The CORINE data were calibrated to the reference coordinate system WGS 84. The analysis of features of the land were carried out based on a digital terrain model (DTM or MNT) from ASTER GDEM (Global Digital Elevation Map) with a resolution of 30 m. Based on the DTM and assumed range classes the study of slopes was conducted. Thanks to this conversion an analysis of landform features in confrontation with land use was possible. In the same reference coordinate the DTM area range was adjusted and it required additional processing with regard for longitude and latitude, for which it can be acquired. On the basis of gathered information maps were worked out as a spatial intersect of layers. The results of modelling were created by means of software using GIS analyses: Idrisi Andes and Golden Software Surfer 8. To analyse the land use for areas of Natura 2000 and inside the limits of Nowy Targ commune, reclassification of raster and layers intersect of particular thematic maps. Multicriteria spatial analyses allowed the presentation of studied problems in the form of output layers and additionally their composition by means of simple statistical analyses.

3. The scope of the study

The commune of Nowy Targ belongs to Nowy Targ district and is situated in Małopolskie Voivodeship. It is the biggest commune in the district, covering 21 villages: Dębno, Długopole, Dursztyn, Gronków, Harkłowa, Klikuszowa, Knurów, Krauszów, Krempachy, Lasek, Ludźmierz, Łopuszna, Morawczyna, Nowa Biała, Obidowa, Ostrowska, Pyzówka, Rogoźnik, Szlembark, Trute and Waksmund.



Source: authors' study

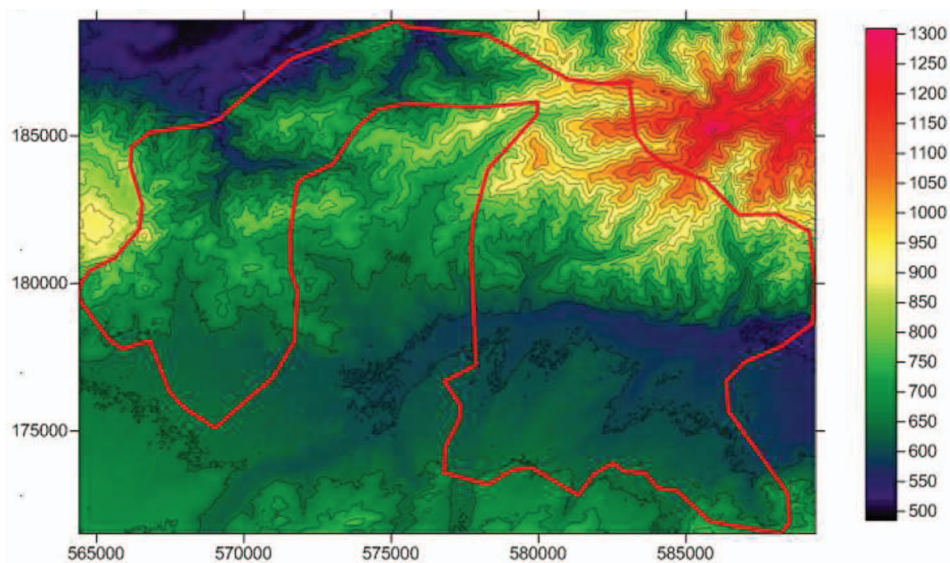
Fig. 1. Location of the Nowy Targ commune in Małopolskie Voivodeship

Geographical location of the Nowy Targ commune is very diverse. In the northern part it lies in the mountain range Gorce in Western Beskids. The southern part of the commune is located in the plain of the Orava-Nowy Targ Basin. It is also the lowest part of the Orava-Podhale Depression (Podhale-Magura Area), between Beskids in the north and the Spisko-Gubałowskie Foothills in the south. The southern and northern borders of the commune reach as far as Pieniny Klippen Belt. Location and landform features of the Nowy Targ commune influences the structure of land use (Table 2). Out of total area of about 207.6 km² a little above 56% are covered with agricultural lands, 37% of which are arable lands, and less than 20% is used as permanent grasslands. About 37% of the commune area are covered with forests, and less than 2.5% of lands was classified as under water. Therefore the land use structure shows the agricultural and forest character of the studied commune. Its piedmont location is also the reason of large height differences and slopes.

Table 2. The size and percentage of agricultural lands in the Nowy Targ commune

Group of agricultural lands		Area [ha]	Share in the total area [%]
Użytki rolne	Arable land (AL)	7 566.88	36.44
	Orchards (O)	21.34	0.10
	Meadows (M)	2 999.96	14.45
	Pastwiska (Ps)	1 098.35	5.29
	Pond bottoms (Wsr)	3.27	0.02
	Ditches (W)	7.35	0.04
	Total agricultural areas	11 697.15	56.33
Woodlands, tree-covered areas and shrublands		7 610.21	36.65
Built-up and urbanized areas		741.58	3.57
Wastelands		207.10	1.00
Areas under water		500.02	2.41
Mixed areas		9.14	0.04
Total		20 765	100%

Source: authors' study based on data from the Communal Office of Nowy Targ, status as at December 2013



Source: GIS of Nowy Targ commune [<http://nowytarg.e-mpzp.pl>]

Fig. 2. Aster GDEM of the Nowy Targ commune

The digital terrain model analysis showed that 30% of the area of the Nowy Targ commune (6065 ha) is situated on slopes of 0–3°, which means the areas are almost flat. Around 18% of the commune area is situated on slopes of 3–6°, and 21% (4224 ha) – on slopes of 6–10°.

Within the slope range of 10–15° there is 21% of the commune area, and above 15° of slope there is about 12% of the area, and around 529 ha is situated on slopes above 20°. It means that the commune has a high percentage of lands located on steep slopes. These conditions affect largely the way of land use, and consequently the land cover.

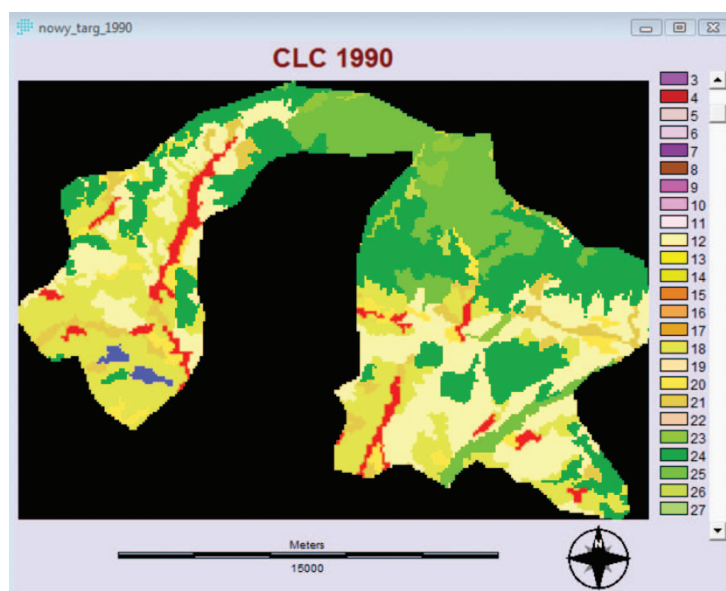
High natural and landscape values resulting from the commune's location and landform features contributed to the fact that its large part (around 22.36%, which is equivalent to 4553 ha) found itself under the environmental protection of Natura 2000. In the Nowy Targ commune Natura 2000 areas are covered in 82% by forests, in 16% by agricultural lands and in 2% by wetlands and anthropogenic surfaces that existed there before Natura 2000 was Hestablished.

4. Results and discussion

Data spatial analysis of CORINE Land Cover of 1990, 2000 and 2006 for the Nowy Targ commune (Figures 3a, b, c) showed visible land use changes of lands marked according to land cover classes (Table 1) as: 2 – discontinuous urban fabric, 12 – non-irrigated arable land, 18 – meadows and pastures, 20 – complex cultivation patterns, 21 – areas principally occupied by agriculture, with significant areas natural vegetation, 23 – broad-leaved forest, 24 – coniferous forest, 25 – mixed forest, 26 – natural grasslands, 29 – transitional woodland/shrub, 36 – peat bogs, and 41 – water bodies (distinguished only for CLC 2006).

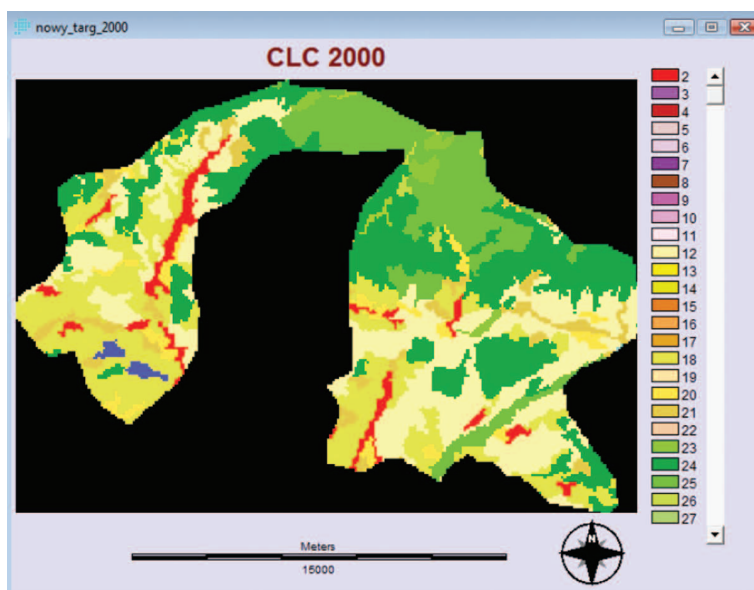
When comparing land cover in 1990, 2000 and to 2006 one can see that in sixteen years there have been some changes in land cover. Changes between 1990 and 2000 were notably smaller than these between 2000 and 2006. In the whole studied period decrease of anthropogenic areas by 11 ha, arable lands by 6 ha, cultivation patterns by 2 ha was observed. However there was an increase of 246 ha of meadows and pastures. In general comparison the size of agricultural lands decreased by 361 ha (3.08%). The changes have also been observed in woodlands. The size of broad-leaved forests increased by 381 ha and coniferous forest grew by 35 ha. At the same time the size of mixed forests decrease by 322 ha. And water bodies were larger by 4 ha.

When comparing the results of the land cover in the Nowy Targ commune with changes noted in the Małopolskie Voivodeship [Piskulak 2012] one can see that, in Małopolskie Voivodeship and in the Nowy Targ commune alike, the differences were related to land cover in the following classes: 1 – complex cultivation patterns (which is a mosaic of small adjacent plots under various kinds of cultivation, and small meadows and pastures), 2 – agricultural lands with significant areas of natural vegetation, and 3 – discontinuous urban fabric. An increase was noted in discontinuous urban fabric together with a decrease of size of continuous urban fabric.



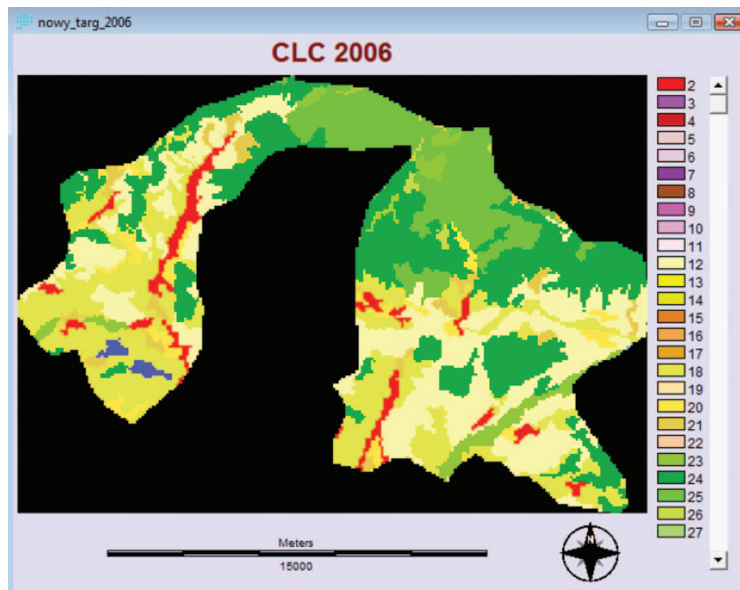
Source: authors' study

Fig. 3a. Spatial analysis of land cover in the Nowy Targ commune in 1990



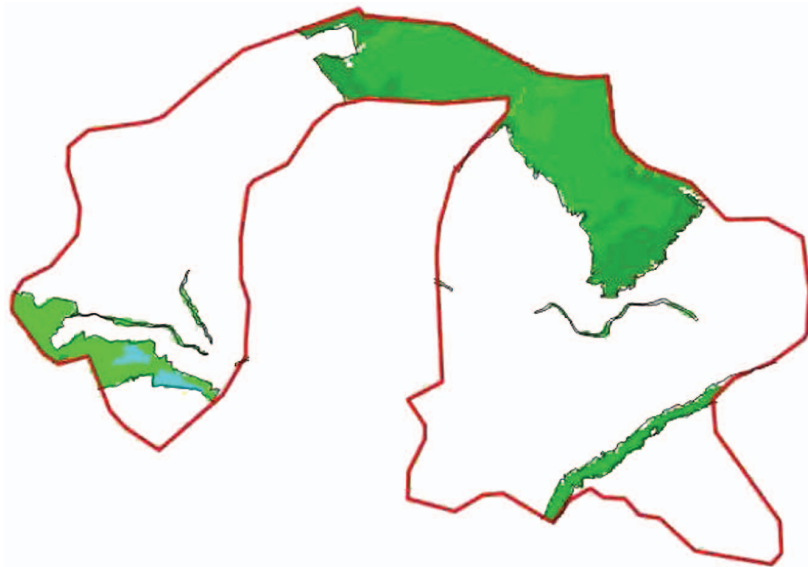
Source: authors' study

Fig. 3b. Spatial analysis of land cover in the Nowy Targ commune in 2000



Source: authors' study

Fig. 3c. Spatial analysis of land cover in the Nowy Targ commune in 2006



Source: authors' study

Fig. 4. The area of the Nowy Targ commune with an information CLC 1990 showing land cover within Natura 2000 areas

After limiting the scope of analysis to the Natura 2000 areas the following regularities were observed (Figure 4). The analysis showed that within Natura 2000 areas in the Nowy Targ commune eleven land cover classes can be singled out, such as: 2 – discontinuous urban fabric, 12 – non-irrigated arable lands, 18 – meadows and pastures, 20 – complex cultivation patterns, 21 – areas principally occupied by agriculture, with significant areas natural vegetation, 23 – broad-leaved forest, 24 – coniferous forest, 25 – mixed forest, 26 – natural grasslands, 29 – transitional woodland/shrub, 36 – peat bogs. For comparison, project CLC 2006 showed most significant land cover changes with regard to size of forests and agricultural lands. During the sixteen years the size of agricultural lands within Natura 2000 area have decreased. However the size of forests in the area increased in the studied period by 43 ha.

5. Conclusions

Apart from a suburbanization phenomenon observed in recent years, a visible process of transformations of rural landscapes can be seen. It is noticeable in changing ways of land use. The global changes can be viewed with the help of satellite pictures. Thanks to the programme CORINE, launched in the mid 1980s, observation of land cover changes in the territory of Europe was possible. Poland's territory was also included in the programme. Satellite pictures processed into raster images taken in 1990, 2000, 2006 show considerable land cover changes. It has been observed that changes are more and more faster. When comparing two studied periods: 1990–2000 and 2000–2006, the authors found that more considerable changes took place in the second period. In the studied sixteen years period land cover changes in the Nowy Targ commune are also visible, especially in the size of agricultural lands and forests. In that period the size of meadows, pastures and forests increased, but the share of arable lands and anthropogenic areas in the land use structure decreased.

The communal areas of Natura 2000 have also undergone changes in land cover. The changes led to a decrease of size of agricultural lands in favour of forests surfaces. It proves that in the studied commune the Natura 2000 programme, being a form of protection aimed at preserving the terrain in its original state, resulted in an increase of forest area at the expense of the size of agricultural lands. In the CORINE databases there were no suburbanization changes visible in these areas. One can assume that protection of Natura 2000 contributed to the lack of anthropogenic changes in the studied area. Today, however, within the Nowy Targ commune there is an increase of discontinuity of urban fabric, which moves to areas of unfavourable topographic conditions (steep slopes). The areas of high natural and landscape values are also endangered by the expansion of building development. The phenomenon occurs mostly on southern slopes of Gorce, hilltop range of Pieniny Klippen Belt and valleys of streams and in agro-forest boundary areas. The changes are not visible in the CORINE databases because of high degree of generalization of the picture.

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