



ИЗВЕСТИЯ НА БЪЛГАРСКОТО ГЕОГРАФСКО ДРУЖЕСТВО JOURNAL OF THE BULGARIAN GEOGRAPHICAL SOCIETY

Journal homepage: www.geography.bg/



Development of the land cover in Mala Planina

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ABSTRACT

Key words:

Mala Planina, CORINE Land Cover, GIS, changes

The current study investigates the development of the land cover in the mountainous territory of Mala Planina, located in the western part of Stara Planina. It focuses on cameral and terrain research in which basis is the CORINE Land Cover (CLC), initiated by the European Union. All existing databases for the country were applied (CLC 1990, 2000, 2006 and 2012). Each updated version of the CLC data shows typical transformation in Mala Planina's land cover. A thorough investigation is made about all parts of the mountain and published within the results. Four GIS derived maps are published. The results show that the most significant dissonance occurs between CLC 1990 and the rest CORINE Land Cover data sets (CLC 2000; 2006; 2012) and the reason for the imparity lies mainly in the extensive timeframe. Almost no distinction is observed, when we compare CLC 2006 and 2012. The most common changes are connected with the transition to land principally occupied by agriculture, with significant areas of natural vegetation, which is explained by the decreasing number of population and abandonment of the agricultural areas.

Introduction

For a long time it was supposed that continuing human impact had little lasting effect on the land, although it was clear enough that the farming practices, for example, were altering the environment. The emergence of different types of environmental issues pushed the Commission of the European Communities and the Portuguese State Secretariat for the Environment made to set up a pilot land cover project in the country. Thus, the European Union initiated the CORINE programme (the CORINE Land Cover (CLC) inventory) in 1985.

The term CORINE is the abbreviation for 'coordination of information on the environment'. Its databases and several of its programmes are taken over by the European Environment Agency (EEA). The CORINE programme has three main aims, which are bound to assembling information on the state of the environment of the EU countries, coordinating it within the Member States and ensuring the consistency of data. Another aim of the programme is to combine the acquired information, dealing with environmental conditions (<http://www.eea.europa.eu/publications/COR0-landcover>).

The CORINE Land Cover consists of 44 classes, which are a part of 5 categories (artificial surfaces, agricultural areas, forest and semi

	CLC 1990	CLC 2000	CLC 2006	CLC 2012
Satellite data	Landsat-5 MSS/TM single date	Landsat-7 ETM single date	SPOT-4/5 and IRS P6 LISS III	IRS P6 LISS III and RapidEye
Time consistency	1986-1998	2000+/- 1 year	2006+/- 1 year	2011-2012
Geometric accuracy, satellite data	≤ 50 m	≤ 25 m	≤ 25 m	≤ 25 m
Min. mapping unit/width	25 ha/ 100m	25 ha/ 100m	25 ha/ 100m	25 ha/ 100m
Thematic accuracy, CLC	≥ 85% (probably not achieved)	≥ 85% (achieved)	≥ 85% (not checked)	≥ 85%
Production time	10 years	4 years	3 years	2 years
Number of countries involved	26 (27 with late implementation)	30 (35 with late implementation)	38	39

Table 1: Evolution of CORINE Land Cover

natural areas, wetlands, water bodies) and the mapping scale, chosen for the project, is 1:100 000. The CORINE Land Cover database must be regularly improved in order to be accurate and up to date so updates were introduced in the years 2000, 2006, and 2012 (table 1). The already mentioned table is published on (<http://land.copernicus.eu/pan-european/corine-land-cover>) and represents an exhaustive summative information about the development of CLC.

CORINE Land Cover has a wide variety of applications in environmental management, agriculture, transport etc. and some influential research, using CORINE Land Cover were conducted in Bulgaria during the recent years (Nedkov, 2010; Nedkov & Burkhard, 2012; Nedkov et al., 2015). But the start of the programme in the country was almost 15 years earlier. In 1995 a decision was made for the implementation of the project in Bulgaria. According to the Bulgarian National project plan (http://eea.government.bg/bg/projects/korine-14/Nationalprojectplan_BG.pdf) CLC Bulgaria is the first complete land cover database that encompasses the whole territory of the country and it is also the first large digital database on national level in GIS ARC/INFO format, compatible to the CLC databases in the other Member States.

Bulgaria is a part of the CORINE Land Cover 1990, 2000, 2006 and 2012 projects. CORINE Land Cover Bulgaria 1990, CORINE Land Cover Bulgaria 2000 as well as CORINE Land Cover Bulgaria 2006 were carried out by the Executive Environment Agency (ExEA) at the Ministry of Environment and Water. The used satellite/sensors are Landsat 5 TM, Landsat 7 ETM+, SPOT 4, SPOT 5, IRS P6. The databases are in GIS ARC/Info format with minimal mapping area of 25 ha, 1: 100 000 scale and minimum width of polygons ≥ 100 m.

Materials and Methods

The object of the current study is Mala Planina – a mountain that is a part of the Western Balkan Range, situated in an immediate proximity to the capital city of Bulgaria, thus the land cover is under huge anthropogenic pressure and changes are not a matter of accident. Mala Planina is a part of the biogeographic region of the Balkans (Assenov, 2006).

Uncovering the typical CORINE Land Cover classes for the mountain today and their transformation in the past are problems of current interest and Popov (2012) presented an important source of information for this research. A main task was set up - the territory's

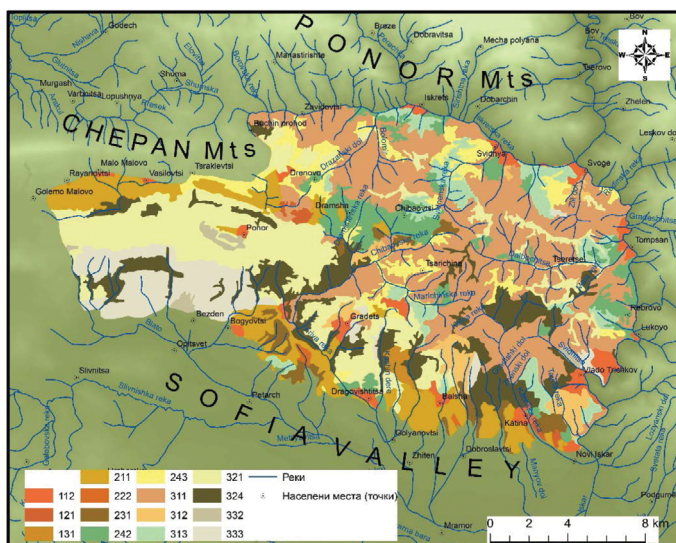


Fig. 1. Map of Mala Planina - CLC 1990

land cover development was compared by the use of the all existing CLC databases for Bulgaria (CLC 1990, 2000, 2006 and 2012). The CORINE Land Cover 2006 and 2012 data sets were downloaded freely from the Executive Environment Agency website (<http://eea.government.bg/bg/projects/korine-14/kzp-danni-clc-data>), but the previous data sets weren't available for download, thus data was insufficient. The thoroughness of the research required the full spectrum of CLC databases in Bulgaria, so in order to acquire these databases, the authors sent an official letter to the Ministry of Environment and Water of Bulgaria, in order to obtain this information and the request was approved. As the authors supposed, each updated version of the CLC data shows typical transformation in Mala Planina's land cover and this is useful information for the management of the environmental impact, due to anthropogenic influence.

Results

The maps, comparing the four CORINE Land Cover databases (CLC 1990; 2000; 2006; 2012), representing the changes and development of the land cover in Mala Planina, are presented in fig. 1, 2, 3 and 4.

When searching for the similarities and differences between these four maps, it becomes clear that the most significant dissonance occurs between CLC 1990 and the rest CORINE Land Cover data sets (CLC 2000; 2006; 2012). The reason for the disparity lies mainly in the extensive timeframe, the changes in the environment that come from it and the different types of human actions. Mala Planina is an easily accessible mountain and is located near Sofia and these are basic impact factors for the significant human stress. If we compare CLC 2000 with CLC 2006 we find out that there appear differences as well, but not as much, as in the CLC 1990 - CLC 2000; 2006; 2012 interrelationship. At the same time CLC 2006 and CLC 2012 are almost the identical with the exception of a small area, representing a transition from mixed forest to transitional woodland-shrub.

The comparison between the four databases is made from west to east with emphasis on the most significant differences.

Firstly, the focus is on the north-westernmost corner of the mountain, to the east of the village of Golemo Malovo, where there is a lack of „W“ - shaped band in CLC 1990 and it appears in the following CLC 2000; 2006; 2012. This area represents land principally occupied by agriculture, with significant areas of natural vegetation

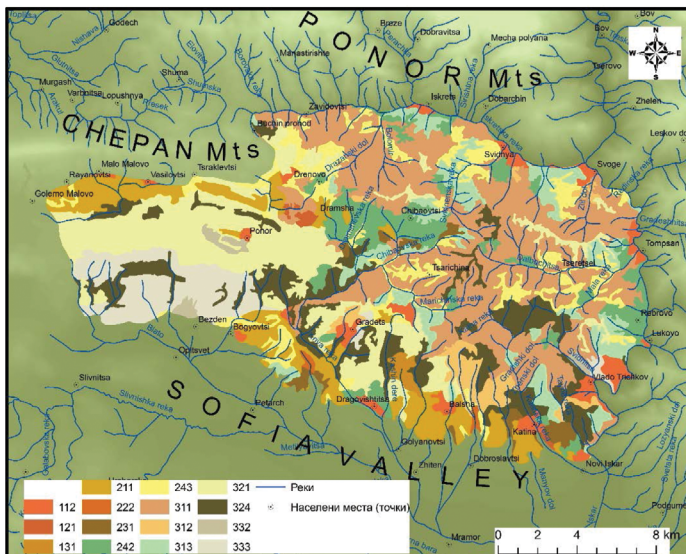


Fig. 2. Map of Mala Planina - CLC 2000

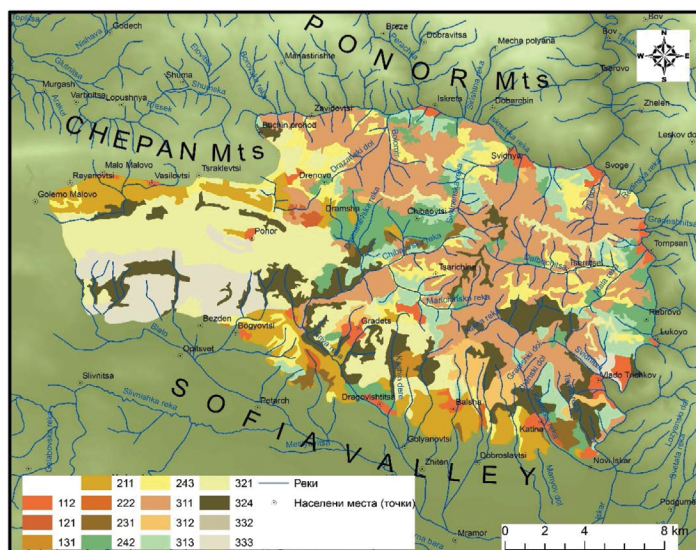


Fig. 3. Map of Mala Planina - CLC 2006

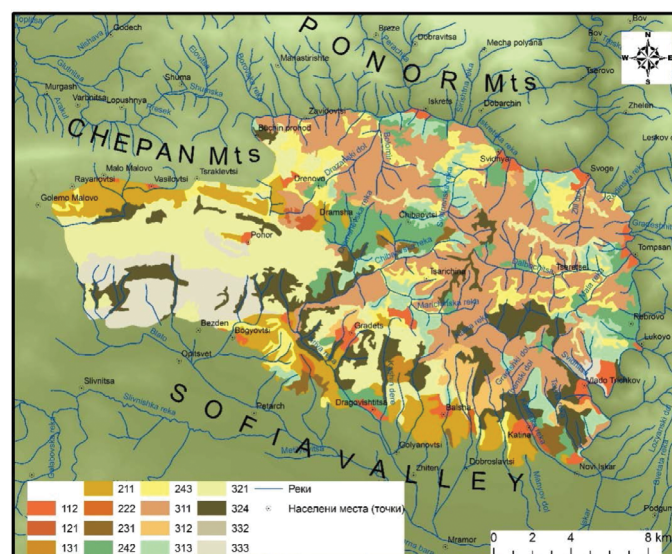


Fig. 4. Maps of Mala Planina - CLC 2012

and the main reason for this change in the land cover is the abandoning of arable land due to the decreasing numbers in the overall population after 1990. Another important process, which undoubtedly had an impact is the change of the land ownership (the restitution of land to the people) after the fall of the previous political regime. Also in the western part, there is a small band of bare rocks in CLC 1990 that in the following CLC 2000; 2006; 2012 are taken by natural grasslands.

When we compared the CLC 1990; 2000 with CLC 2006; 2012 in the southwestern part of Mala Planina, to the north of Bezden village, we find out that there is an almost round shaped area, which has changed from bare rocks to natural grasslands. Just next to it to the west is a band of land, which in CLC 1990 is classified as a sparsely vegetated area, then in CLC 2000 it has become natural grassland and finally in CLC 2006 and 2012 it transformed into transitional woodland-shrub. This change can be used as an example of an ecological succession.

Another change occurred near the village of Ponor, where we found a transition of an area, classified as bare rocks in both CLC 1990 and 2000, into sparsely vegetated area in the following two CLCs (2006 and 2012). Activities, including clearance of shrubs following the implementation of “Recovering and maintenance of grassland areas with high nature value” thematic area (measure 10 “Agroecology and Climate” of the Rural Development Program 2014–2020) were observed during terrain research in the autumn of 2014 and the results of the same actions were observed in the spring of 2016 near the village of Tsraklevtsi.

Very interesting from conservational point of view is the territory, situated at both sides of the river, to the north of Ponor village and to the west of Drenovo village, named the Ranislavtsi Field. This territory is the only home in Bulgaria of three critically endangered plant species (*Lathyrus palustris*, *Plantago maxima*, *Salix rosmarinifolia*), included in the following fragmented protected areas: “Nahodishte na Blatno Sekirtche [Locality of *Lathyrus palustris*] – Buchin Prohod Village Protected Site”, “Nahodishte na Gigantski Zhivovlyak [Locality of *Plantago maxima*] – Buchin Prohod Village Protected Site”, “Rozmarinolistna vurba [Locality of *Salix rosmarinifolia*]. The problem with the land cover of that particular territory is the conflict between the state and private property in the Ranislavtsi Field, which leads to a big paradox – some of the proved localities of critically endangered species cannot be included into the protected area, because

of the specifics of the ownership of the land (Grigorov et al., 2016).

There is another transition of the land cover near Buchin prohod village, which in 1990 is classified as a broad-leaved forest and then it became mixed forest in the newer databases, because of the growing of pine tree species.

To the east of Tsraklevtsi village the land was principally occupied by agriculture, with significant areas of natural vegetation, shown distinctively in CLC 1990, but then this area was defined as natural grasslands in CLC 2000 and finally some parts of the land became non-irrigated arable land in both CLC 2006 and CLC 2012 databases.

There is another change in the land cover in the territory between the villages of Bogoyovtsi and Bezden, which are situated to the south. This area is classified as sparsely vegetated area in CLC 1990, but then it transformed to land principally occupied by agriculture, with significant areas of natural vegetation, which is shown in the other three databases. In addition to this an interesting transition occurred in the area locked between the village of Bogoyovtsi and Kriva River, which CLC 1990 determines as pastures, but it changed to land principally occupied by agriculture, with significant areas of natural vegetation in the other three data sets. Undoubtedly, human impact was the reason for the transformation of this land and the use of agricultural techniques was a key moment.

A change also occurred in the center of the triangle of the villages of Ponor, Dramsha and Gradets, where CLC 1990 classifies the area as natural grasslands. Later human actions transformed this land to complex cultivation patterns, which can be observed in the other three databases and the reason for this change may be based on the fact that in the last decades the number of villas in the area increased.

Another transition is localized in the valley of Chibaovska River – situated at the central part of the mountain, where a coniferous forest and transitional woodland-shrub area transformed into a mixed forest, due to the reintroduction of broad-leaved species, typical for Mala Planina.

A small territory between the villages of Zavidovtsi and Iskrets was also transformed and from complex cultivation patterns, which are presented in CLC 1990, it changed to land principally occupied by agriculture, with significant areas of natural vegetation, which are represented in CLC 2000; 2006 and 2012 databases. This circumstance may be explained by the fact that the reduction in the number of population has led to the abandonment of some of the villas and

thus the agricultural areas near them were neglected.

Another change is observed in the area, situated between the rivers of Chibaovska and Marichinska, where the land cover transformed from broad-leaved forest to mixed forest, shown in CLC 2006 and 2012.

A part of the area to the east of Kashin dere River is classified as a mineral extraction site in CLC 1990 and 2000 – this is the quarry, situated on the slopes, northern of Dragovishtitsa and Balsha villages, but in the two newer databases it underwent a transition into natural grassland area and the reason for this is the reduction of the scale of the extraction of minerals.

A band of land to the north of Balsha village also changed during time and it became natural grasslands from transitional woodland-shrub, which can be explained by the human activities that led to the clearance of shrubs and the grassland dominance that followed.

There is an area classified as natural grasslands in CLC 1990 to the east of Svidnenska River, which changed into transitional woodland-shrub and this can be used as another example of an ecological succession in Mala Planina.

At the river-head of the left easternmost tributary of Chibaovska River the transition from broad-leaved forest to mixed forest can be observed, due to the growing of coniferous species in the area.

Another transition is observed in the territory between the villages of Balsha and Kutina, to the west of Kutinska River and Zhenski dol River. The land cover is classified as transitional woodland-shrub in CLC 1990, but then was transformed into coniferous forest, which is presented in the other three data sets.

The area along the river valley, located to the west of Katinska River, transformed from pastures, represented in both CLC 1990 and CLC 2000, into land principally occupied by agriculture, with significant areas of natural vegetation, shown in CLC 2006 and 2012, which can be explained by the human impact that led to land processing.

The area to the west of Zlil dol River is classified as mixed forest and sparsely vegetated area in CLC 1990 and, as it can be confirmed, by the other three databases, it changed into land principally occupied by agriculture, with significant areas of natural vegetation and broad-leaved forest. At the same time, a similar transition is observed along the valley of Dalbochitsa River to the west of Tseretsel village, where broad-leaved forest transformed into land principally occupied by agriculture, with significant areas of natural vegetation. Another similar transition is observed along Dalbochitsa River valley to the east of Tseretsel village, where land with complex cultivation patterns changed into land principally occupied by agriculture, with significant areas of natural vegetation, due to the abandonment of agricultural territories.

The territory near Mala River in the eastern part of Mala Planina is classified as a transitional woodland-shrub in CLC 1990, which transformed into land principally occupied by agriculture, with significant areas of natural vegetation in the three newer databases and the reasons for this again are human actions that led to the conversion of the land cover.

The area between the villages of Vlado Trichkov, Rebrovo and Lukovo also transformed in time from broad-leaved forest into mixed forest stands and last, but not least, a transition occurred in the valley of Tayna River, where a large area with coniferous forest, according to the CLC 1990 database, converted to transitional woodland-shrub area in the following three CLC data sets.

Conclusions

Based on the conducted research in the territory of Mala Planina concerning the development of the land cover, by using the comparative analysis method for the four CORINE Land Cover databases (1990; 2000; 2006; 2012), a few conclusions can be stated:

- the most extensive differences occur between CLC 1990 and the other three data sets – CLC 2000; 2006 and 2012, which can be explained by the large timeframe;
- the dissonance between CLC 2000 and CLC 2006 is also present, but not at that high rate;
- almost no distinction is observed, when we compare CLC 2006 and 2012 with the exception of the transition from mixed forest to transitional woodland-shrub of a small area at the center of the mountain;
- the most common changes are connected with the transition to land principally occupied by agriculture, with significant areas of natural vegetation, which is explained by the decreasing number of population and abandonment of the agricultural areas;
- another frequent change is the transformation of broad-leaved forests into mixed forests, which is explained by growing of pine trees;
- some of the major differences come from the decreasing number of people, the change of the ownership of the land after the start of the new political system and the establishment of new villas in the last decades;

The fulfilled study represent a base for an expansion of the investigation about the land cover in other areas of the Western Balkan Range. The promising results can be used as a starting point for similar types of research.

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