

## PLANNING AS TRIGGER FOR LAND USE CHANGES

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**Abstract.** In Poland significant changes in landscape intensified after the political transformation in late 1980's. One of the signs of the changes are more transformations of agricultural land into developed land (industry, housing, services). At the same time, abandoned land started overgrowing with trees and brushwood. These are a result of changes in living and housing conditions, technical progress and changes in legislation. Local spatial plan is a planning act that defines the designation of the land in Poland. This act is optional at the level of communes (the lowest level of administrative division). If there is no local spatial plan, the designation for non-agricultural and non-forest purposes is determined by an administrative planning decision usually on the basis of the designations of the adjacent plots. The study shows that the direction of changes in land use is affected mainly by local planning policy, including local spatial plans that are perceived to be an instrument of managing suburbanisation in rural areas. Local spatial plans are legal acts, therefore they are binding for the inhabitants and allow for "controlled" spatial development of the communes. But they may be a threat for agricultural areas as they encourage the expansion of developed areas.

**Keywords:** land use cover changes, spatial planning.

### Introduction

Land use changes are a subject of many research studies in the world [1]. Land use changes are a result of changing natural, social and cultural conditions. Land use in Poland is rapidly changing, too. An important question is: should we preserve the historical land use and landscapes [2; 3]? Particularly rural areas in Poland have been undergoing significant changes in recent decades [4]. The changes are caused by many factors [5; 6]. The first factor was the political transformation in 1989 [7]. The main cause of the changes in that year was legislation change that introduced the right to private property [8]. Even more changes were caused by the EU accession in 2004 which opened the labour markets of Western Europe for cheap, educated workforce from Poland [9]. In the new reality young people are less keen to work in agriculture than previously, which in turn causes an increase in land abandonment [10].

For areas of close proximity to large urban centres, there are direct noticeable consequences to the demographic, economic and social structures [11]. For example, rural populations imitate high living standards that were specific for the population of the cities previously. Currently the definition of rural population encompasses people working outside agriculture. Another important phenomenon adding to the changes in rural areas is the suburbanisation, i.e.: the centres of villages become more and more similar to the cities [10]. The phenomenon is particularly visible in the close proximity to the big cities and is strengthened by the spatial policy of rural communities reflected in local spatial plans and planning documents [12]. The local spatial plans encourage further development of previously agricultural land. Also, local plans as a law for inhabitants allow developing space in predictable ways. Therefore, they are the main element of sustainable development [13].

Land use changes and suburbanisation are particularly dynamic in southern Poland [14], especially in Małopolska (Lesser Poland) [15]. The region of Małopolska presents the most diverse physiography in Poland [16]. Małopolska is characterised by undulating landforms which determine the pattern of land use and the size of farms [17]. Małopolska has an area of 1.47 mln ha and the population of about 8.5 mln. The population density is around 140 people per square kilometre [18]. Agricultural areas prevail in the land use of Małopolska. Drzewiecki [16] states that agricultural areas covered 749,000 ha (49.3 % of the region's overall surface) in 2013. This land use class includes arable land (65 %), orchards (1.8 %), and pastures (33.3 %) [16].

Polish history of inheritance law in Małopolska encourages land mosaic in farming. Baran-Zgłobicka [19] claims that the reasons for such situation are historical and legal factors and states that: "the lack of ownership changes during the twentieth century has led to the preservation of family-based, extensive agriculture, characterised by very high land fragmentation with mosaic crops". Herzog [20] defines such a historically determined land use pattern as "a traditional agroforestry system". Now, due to planning policies, the number of land mosaic is decreasing. Predicted extent of

the change in land use of agricultural land and green areas in Małopolska is described as “increasing, local and strong” [21]. The question is if we are able to predict the direction of the changes [22].

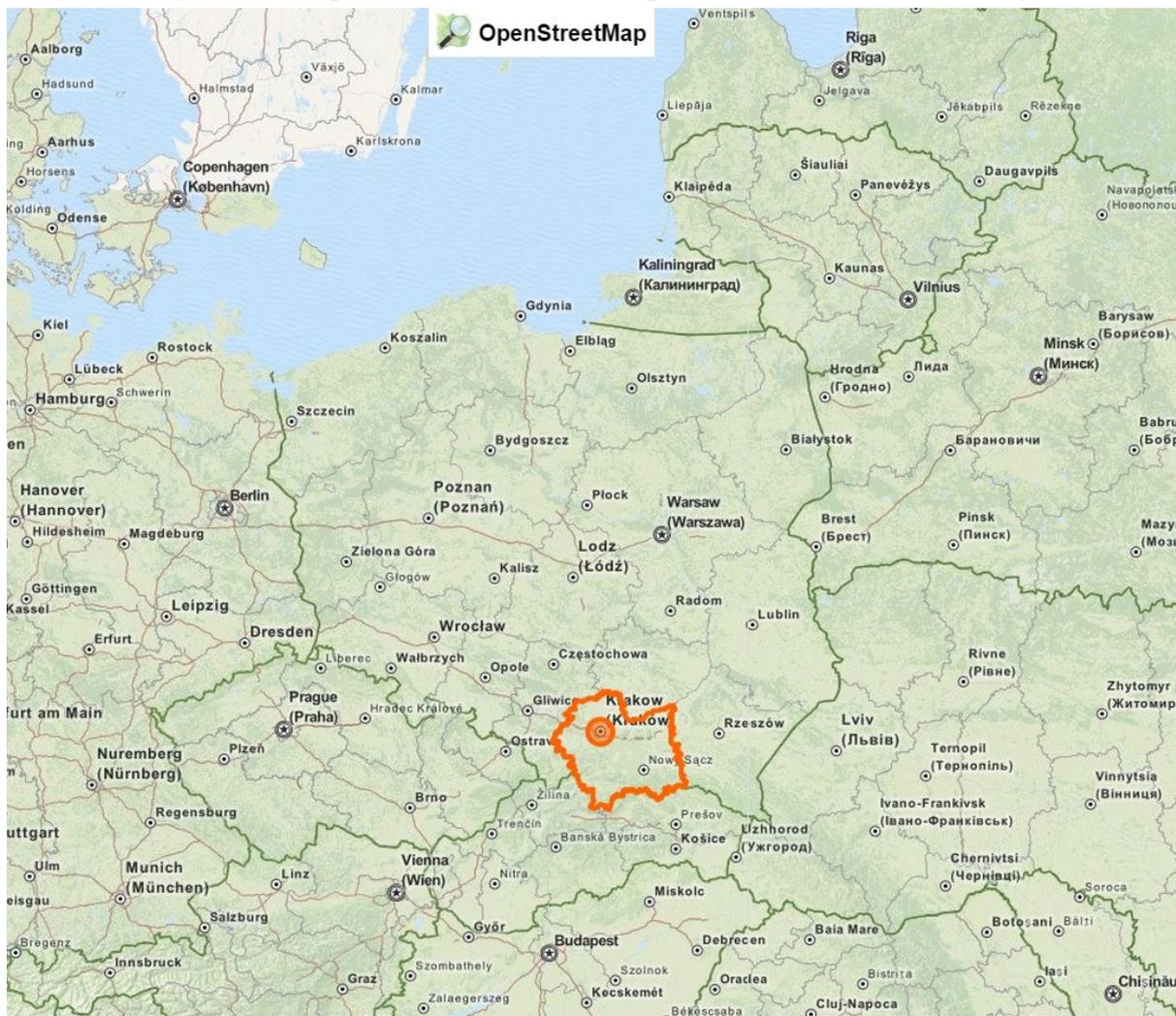


Fig. 1. Location of Małopolska – the study area (source: [www.openstreetmap.org](http://www.openstreetmap.org))

The same question is present in spatial planning. The Act on Spatial Planning from 1994 introduced optional spatial planning acts at the commune level, i.e.: local spatial plans. The act also introduced the concept of private property which was absent in the past reality of state property and state agricultural farms. The provisions of the act determined that everybody has a right to use the land that they possess according to the instructions provided by a local spatial plan. Last decade of the 20th century was also a time of significant changes in market economy: growing market and growing agricultural land market. Free market and international trade caused decreasing cost-effectiveness of agricultural production and decreased the demand for agricultural production. Cheap imported food replaced home production and based on individual farms agriculture did not revive as it was predicted [23]. Between 2000 and 2006 many new measures were introduced. In 2003 the Polish parliament passed the new act on spatial planning and development. Spatial plans enacted before 1995 expired. Polish government put much effort to prepare for the EU accession, which induced new changes in agriculture such as the tendency to enlarge farms. The next period between 2006 and 2013 brought open European markets for cheap work force from Poland. Outflow of population was particularly noticeable in less developed rural areas. Therefore, the landscape of Polish rural areas changed. Rural areas constitute 90 % of Poland and are currently inhabited by 15 mln people. Rural areas are under strong urban pressure [24], even though they are considered to be underdeveloped and underinvested [25]. During the last research period (2006-2013) the number of local spatial plans increased. In 2013 local spatial plans in Małopolska covered over 65.5 % of the province, which is the highest proportion

among all other provinces (Polish Central Statistic Office). The changes in land use in Małopolska are significant.

### Materials and methods

This study is an attempt to capture the correlation between the administrative planning decisions and changes in land use patterns. The paper is based on the data collected after the transformation in 1989, i.e.: Corine Land Cover data (CLC) from 1990, 2000 and 2006, cadastre data (as for 2013) and local spatial plans (as for 2013). The division into the periods that were analysed is not random. It resulted mainly from the data obtained from the Corine Land Cover but historical, economic and social situation which also shaped the changes justifies the division.

Analysis was made in 226 communes in Małopolska. Changes in land use visible in the Corine Land Cover data and land register data were analysed. Analyses were made in three research periods: 1990-2000, 2000-2006 and 2006-2013. The data on land cover from the Corine Land Cover from 1990, 2000, 2006, land register data as for December 2013 and the data on the percentage of local spatial plan coverage in Polish communes were the input data. The data on the local spatial plans coverage is based on the survey research and shows the status as for the end of 2013.

Analyses were conducted in two steps. The goal of the first step was to check in which of the periods the land use changes were the most significant. This step was based on the Corine Land Cover data collected by the European Environment Agency (EEA). Land cover classes in the data are divided into three levels. The first level includes five main types of land use occurring in Europe: artificial surfaces, agricultural areas, forests and semi-natural areas, wetlands, marine waters. There are 15 land use classes at the second level that may be represented in map scales from 1:500 000 to 1: 1 000 000. The third level consists of 44 categories observed in all European countries. 31 of these categories are present in Poland. The minimum mapping unit used in the Corine Land Cover is 25 ha, the minimum width of linear phenomena is 100 m. Land use Corine Land Cover data were produced with visual interpretation of satellite images (Landsat, SPOT and IRS satellites) [21].

Detailed analyses of the data from the period with the most significant changes (2006-2013) were the subject of the second step. Following analyses were made at this stage of the research: analysis of the association between surface changes of land use classes in the Corine Land Cover data and the percentage of coverage with local spatial plans in the communes. The Pearson product-moment correlation coefficient at the significance level of 0.05 ( $\alpha$ ) was used to determine the magnitude and direction of the correlation between nineteen variables. The following variables were analysed:  $x_1$  – total area of a commune,  $x_2$  – percent of the local spatial plan coverage in a commune,  $x_3$  – area of developed land,  $x_4$  – area of industrial land,  $x_5$  – roads,  $x_6$  – open spaces with little or no vegetation,  $x_7$  – dumps,  $x_8$  – construction sites,  $x_9$  – areas with sport facilities,  $x_{10}$  – arable land,  $x_{11}$  – orchards,  $x_{12}$  – meadows,  $x_{13}$  – forests,  $x_{14}$  – pastures,  $x_{15}$  – areas covered with brushwood,  $x_{16}$  – wasteland,  $x_{17}$  – watercourses,  $x_{18}$  – standing waters,  $x_{19}$  – area covered with local spatial plan.

An analysis of the association between land use in the land register and local spatial plan coverage as for 2013 was conducted. Research was made on the basis of the data from the national register of boarders available as a Web Map Service (WMS) and Feature Map Service (WFS).

We conducted also an analysis of aggregated land use changes in each commune in comparison to the total surface area of the communes. Both increases and decreases in land use classes were analysed. The percentage of changes in the surface area in each commune between 2006 and 2013 (Fig. 3) was obtained. The domain of the values was divided into 5 classes using the “natural breaks” function.

The data on the percentage of local spatial plan cover were used to allocate to each commune a centroid with an attribute of the percentage of local spatial plan coverage. The area was divided into regions. Isolines are dividing the communes with local spatial plan (factor > 60 %) and not covered with local spatial plan (factor < 60 %).

Krakow was excluded from the analyses as many other factors have an impact on land use changes in Kraków [26]. Krakow is a quickly developing regional centre and is not affected by spatial policy of the communes [27].

## Results and discussion

The first stage of the research showed that among three periods: 1990-2000, 2000-2006 and 2006-2013, the most significant changes in land use occurred between 2006 and 2013, as shown in Figure 2. Least significant but still noticeable changes occurred between 1990 and 2000. The most visible changes between 1990 and 2000 were related to the increase of the surface of standing waters (increase of about 1,500 ha) and in the areas covered with brushwood (increase of about 1,400 ha). Simultaneously the area of forests and meadows decreased. Changes in land use started to be more noticeable between 2000 and 2006 (Fig. 2). The area of forests and developed areas increased and the area of arable land decreased during this period. The changes are in the range of -27,000 ha to +13,300 ha.

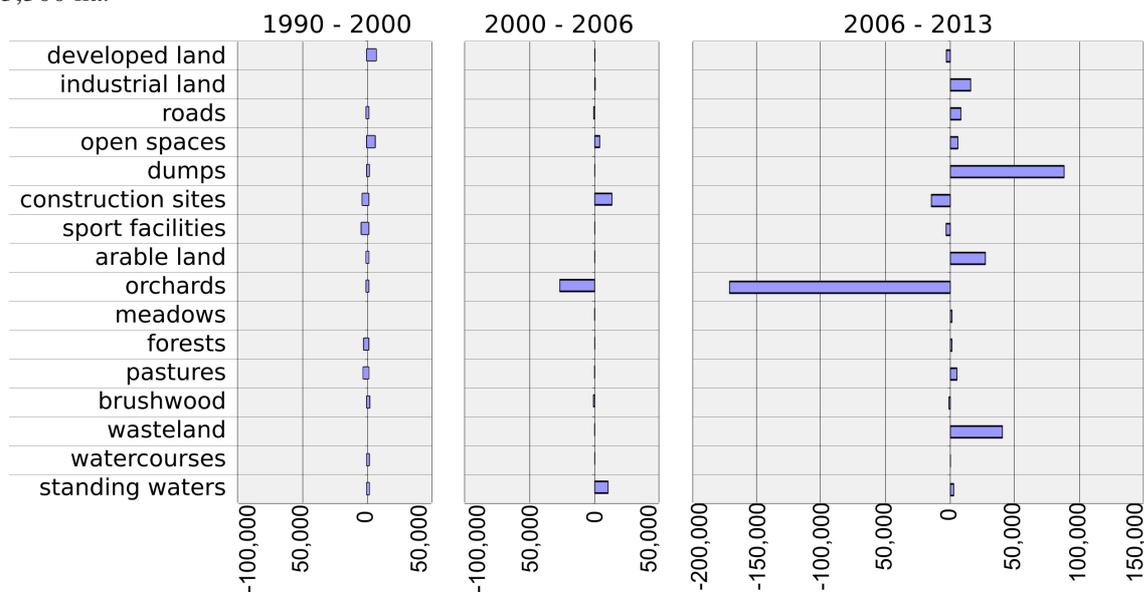


Fig. 2. Changes in land use (ha) between 1990 and 2013 in the communes of Małopolska province, divided into three research periods: 1990-2000, 2000-2006 and 2006-2013

The area of roads, orchards, pastures, wastelands and areas covered with brushwood significantly increased between 2006 and 2013. Growth of developed areas was also observed. The area of arable land significantly decreased (decrease of 171,200 ha).

The research shows strong correlation between the coverage of local spatial plan ( $x_{19}$ ) and roads ( $x_5$ ) – 0.611, forests (0.570), pastures (0.553) and arable land (0.471) in 2013. Local spatial plan coverage in 2013 is correlated also to the size of developed areas (0.335), meadows (0.359), watercourses (0.306) and orchards (0.238).

On the basis of the differences in land use between 2006 and 2013 in each land use class to local spatial plan coverage in 2013, we noticed that introduction of local spatial plans resulted in increased number of roads. The correlation coefficient is positive and high: 0.599. Moreover, simultaneously with higher coverage of local spatial plan the area of pastures (0.548), watercourses grew (0.382) and the area of arable land (-0.289) decreased.

The analysis of land use changes (aggregated for all land use classes) related to the area of the communes, as shown in Fig. 3., revealed that among 226 communes, in as many as 102 of them, between 2006 and 2013 the changes were at the level between 14 % and 23 % of their total area. In 62 communes the changes were at the level of 23-31 %. In 15 communes the changes were observed on 31-40 % of its areas. Exceptionally significant land use changes (40-49 %) were detected in 3 communes. The lowest percentage (5-14 %) was determined in 44 communes. The results show a correlation. As it can be seen in Fig. 3., northeastern and southern parts of Małopolska, including some communes in the western part of the province, do not have a local spatial plan. In these areas the changes are less significant than in central Małopolska which is covered to some extent with local spatial plans. Detailed analyses show a decrease in arable land and an increase in the area of meadows and pastures, including some fallow lands and set-asides in central Małopolska. The growth of developed and urbanised areas (including roads) is also visible in central Małopolska.

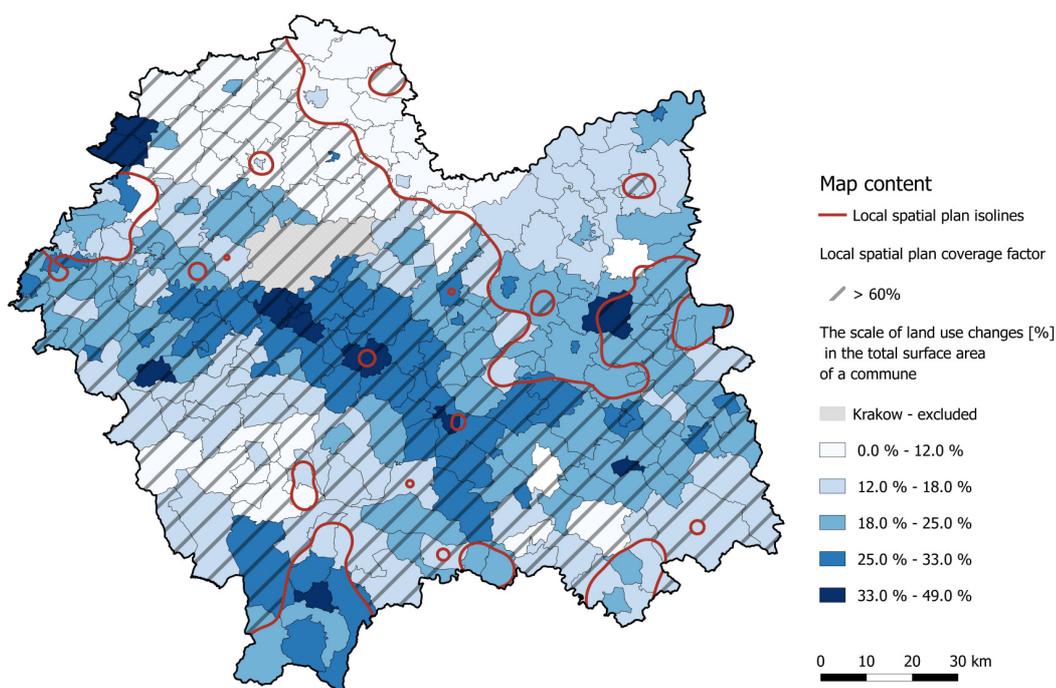


Fig. 3. Aggregated land use changes (%) in communes of Małopolska province between 2006 and 2013 and the data on local spatial plan coverage (isolines)

### Conclusions

The research on the land use changes in Małopolska between 1990 and 2013 shows that in each period after political transformation there were more land use changes. The least noticeable changes occurred in the period from 1990 to 2000, and the most visible changes between 2006 and 2013. The changes in the second period progressed quicker and were more widespread. The analysis shows that there is a correlation between the land use changes and local spatial plan coverage. An increase in local spatial plan coverage resulted in increasing investments in areas that are transformed from agricultural areas. In the research period of twenty four years (1990-2013) the biggest changes were observed in a decrease in the area of arable land. Simultaneously, there was an increase in the surface areas of roads. The changes are particularly obvious in central Małopolska in northwestern and southeastern part of the province.

It may be also noticed that, despite few exceptions, the communes in northern, eastern and southern part of Małopolska are not covered with local spatial plans and the changes are therefore less evident. Thus, we can draw a general conclusion that an increase in the local spatial plan coverage leads to an increase in the number of land use changes. Local spatial plans are an incentive for investments which need to take place in agricultural areas. Hence, land use changes are particularly evident in agricultural areas. We can even risk a statement that agricultural areas in Małopolska are irreversibly changing and that the rate of land use changes will remain constant in nearest future.

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