

CHANGES IN THE RANGE OF FORESTS AND THE USE OF LANDS IN THE CATCHMENTS OF SMALL LOWER WIEPRZA TRIBUTARIES IN HISTORICAL TIMES

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Abstract

The subject of the study were changes in land use over the last 400 years, including forest areas. The research covered the area, the range of which is determined by the basins of three small left-bank tributaries of the Wieprza River and its direct catchments (Northern Poland). The analysis included selected historical sources and, above all, maps issued in the years 1618-2008. It was found that in the studied area the border between forest and non-forest areas was established in the Middle Ages and subsequent changes in its course were of evolutionary nature. Until the mid-nineteenth century there was significant decline in forest area, which was related to the acquisition of areas mainly for arable fields as well as meadows and pastures. Subsequent changes of forest areas, studied for periods 1836-1934 and 1934-2008 were relatively small, but they were accompanied by significant modifications of the forest species composition. Relatively the biggest changes in the last distinguished period included built-up areas with orchards, where a decrease in occupied areas of almost 25% was noted.

Key words: changes in land use, archival maps, the Sławieńska Plain

INTRODUCTION

Recognition of changes occurring in the natural environment in the past is the basis for determining its current state and creates the opportunity of forecasting further development of the landscape depending on the intensification or attenuation of anthropogenic pressure. One of the least stable elements of the natural environment, subject to the fastest changes, is the use of land. Knowledge of land use changes provides an opportunity to determine the dynamics and directions of transformations

taking place in the natural environment under the influence of human activity (Flis 2000). The thing of particular indicative significance is the assessment of changes in the range of forests, the range and structure of which would undergo significant changes dictated by social demand for wood or agricultural products in historical times. Maps, especially large-scale ones published in the recent 200 years, may be a good source of information on this subject. The newer ones, apart from information on the division of tree stands into deciduous, coniferous and mixed ones, have brought knowledge about the range of coppices or forest nurseries (Kunz 2012).

The inspiration to undertake studies on defining the scope of changes in the forest-non-forest areas' border in the three catchments of small right-bank tributaries of the Wieprza River draining the northern part of the Sławieńska Plain were research works aimed at determining the features of soils occurring in this area and their evolution (Jonczak 2015) as well as the role of fluvial transport in the functioning of the mentioned catchments' geosystem (Florek et al. 2008). Among the assumptions of these research projects, it was presupposed that changes in land use, including afforestation and forest structure, affect both the evolution of soils, as well as the size and nature of surface and ground runoff as well as the transport of suspended and dissolved substances; as a result, it was considered that the examination of changes in land use in the catchment areas would bring a lot of relevant information.

RESEARCH AREA, RESEARCH MATERIALS AND THE SCOPE OF RESEARCH

In the system of physico-geographical regionalisation of Poland according to Kondracki (1994), the research area is located in the northern part of the Sławieńska Plain mesoregion (313.43), which is a part of the Koszalin Coastland macroregion (313.4) (Fig. 1). The terrain surface is not very varied, in places completely flat and rises from 40 to 60 metres above sea level (Kondracki 1994). Sparsely, small patches of moraine uplands, little kames and ozes emerge here (W. Florek 2009).

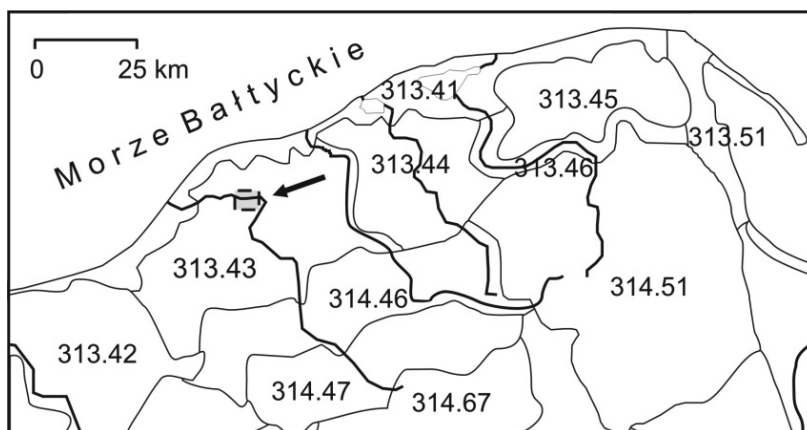


Fig. 1. Location of the research area against the background of the physico-geographical division of Poland (according to Kondracki 1994)

The northern stretch of this area, constituting the basic part of the research area, is diversified with numerous small, damp basins partially occupied by peat bogs. It is overgrown with beech, oak-beech, or mixed beech and pine forests. The parallel part of the Wieprza River valley has in turn very attractive landscape, deeply indented in the plateau with the slopes cut by numerous and relatively long erosional – denudational valleys, ravines and young erosional cuts (valleys of Jasienica, Struga Leśna, Potok Starokrakowski, Jarosławianka and other streams) overgrown with old-growth beech forests. There are also pine forests with an admixture of spruce and mixed forests here (E. Florek 2009), covering mainly river terraces, with the exception of the flood plain occupied by alder carrs and meadows (W. Florek 2009).

The research subject of the authors comprised the catchments of three small left-bank tributaries of the lower Wieprza River: Struga Leśna, Potok Starokrakowski and Jarosławianka streams and the neighbouring left-bank direct catchments of the Wieprza River. There are two villages located in the studied area – Stary Kraków and Mazów. The investigated area comprises 2,761.6 ha, including the catchments of the left-bank tributaries of the Wieprza River, covering respectively: Struga Leśna – 917.8 ha, Potok Starokrakowski – 813.2 ha, Jarosławianka – 570.7 ha, while the direct catchment area covers 455.9 ha. The area was counterpointed by covering with research also the area of the direct catchment located on the right bank of the Wieprza River, including the flood plain and the meadow terrace. In the work, the research area was analysed on the basis of cartographic material created from the seventeenth to the twenty-first century (in the years 1618-2008); selected special maps were used in a supplementary way. The subject of the analyses comprised changes in land use, including changes in the range of forests and their area. The following maps were used:

- *Nova illustrissimi principatus Pomeraniae descriptio...*, by Eilhardt Lubben (Lubinus), from 1618, a scale of approximately 1:227 000,
- *Kabinettskarte Preußischen Provinze*, by Friedrich Wilhelm Carl Schmettau, created in 1767-1787, a scale of 1:50 000; Rügenwalde sheet was used,
- *Preußische Urmeßtischblätter*, created in the years 1832-1838, according to the instructions of general Müffling, a scale of 1:25 000; Grupenhagen sheet was used (318),
- *Meßtischblätter*, first made in 1880, later updated several times, a scale of 1:25 000; Grupenhagen sheet was used (1565), (Krupy) with the situation from 1934,
- *Military Topographic Maps of the General Staff of the Polish Armed Forces*, a scale of 1:25 000; sheets: Krupy (1987), Postomino (1976), Sławno (1976), Stary Jarosław (1987).

In addition, maps of the Cadastral Office in Sławno (Gemarkung Alt Krakow, Gemarkung Meitzow) from 1937, made at a scale of 1:3000, land registry maps from 2008, a scale of 1:5000 and a general map of the Sławno Forest Division, forest circle Stary Kraków, from 2007, a scale of 1:25 000, were used.

The content of these maps has been reduced with cartographic methods, using digital techniques as well as graphic software to the common basis – Gauss-Krüger mapping.

RESULTS

Land use in 1618

Due to the variability of the scale, significant longitude displacement and errors in the location of field facilities, the map by Lubinus cannot be treated as an uncritically reliable source of information about the state of land use, although Plit (2009) made such an attempt. The map was also used by Kunz (2012) and based on it the greatness of the forestation of Western Pomerania was specified. However, this image brings some important information. It can be seen that the area surrounding Stary Kraków was deforested already at the beginning of the 17th century (Fig. 2), which is confirmed by written sources (Witek and Witek 2009). The deforested area, including the area occupied by villages, according to the authors' estimate, amounted to approx. 315 ha. The Wieprza River was accompanied on the left bank by a strip of deforested land which probably covered the bottom of the valley and river terraces. Forests growing on right-bank river terraces and upland were classified as coniferous forests, and the forest complexes covering left-bank dammed areas as deciduous forests. The area of deciduous forests covering the plains to the south of Stary Kraków was estimated to be 2,374 ha and the area of coniferous forests 72 ha (Table 1).



Fig. 2. The surroundings of Mazów (Metzow) and Stary Kraków (Cracow) on the map by Eilhard Lubben (Lubinus) from 1618 (the scale of the original approx. 1:227 000)

Land use in 1780

The content of the map shows that the forest acreage in the studied area was about 2,282 ha, which constituted about 82.5% of the analysed area. It was a mixed forest with predominance of deciduous trees (beech, oak). The forest in this area was not quite impressive because large, robust trees were cut by local people to heat their houses and for construction purposes. Despite the estimated data for the beginning of the 17th century, the size of the decline in forest areas in the period 1618-1780 can be determined, which amounted to 164 ha (from 2,446 ha to 2,282 ha), i.e. by almost 7%. It is also worth noting that the field-forests boundary ran irregularly, which may indicate that the area used to be cleared for farmlands. It is visible to the south-west

of Stary Kraków (Fig. 3A). According to Schmettau's map – it documented not only the state of land use, but also ownership relations, the forests around Stary Kraków (Krakow) and Mazów (Meizow) were ducal forests.

Farmland occupied compact areas adjacent to the village and included only the left bank catchment of the Wieprza River (Fig. 3A). Meadows and pastures with an area of about 86 ha were located along the Wieprza River valley. In their area, drainage was carried out in the form of ditches and canals which was supposed to drain the permanent grasslands. From the south, meadows and pastures directly bordered with arable land occupying 372.1 ha.

Land use in 1836

In the 19th century, the agricultural system was rebuilt. After the Napoleonic wars, the political situation in Pomerania got stabilized. The population would grow, the cities and villages were expanded, which caused a great demand for firewood and wood as a construction material. The peasants were enfranchised and abolition of serfdom took place, while improvement of farming methods (cultivation changed from a three-field to crop rotation) and increasing demand for agricultural products prompted the conversion of forests into arable land (Ślaski 1951). Such a trend in the development of agricultural and forestry economy lasted until the First World War.

The abovementioned changes and tendencies in the economy were reflected in the structure of land use in 1836. The forests covered the area of 2,010.1 ha, which is 272 ha less compared with the situation in 1780, which means that their area decreased by 12% at that time. It can be concluded that the average annual rate of decline of occupied areas in the period 1780-1836 compared to the years 1618-1780 increased, according to estimates, four times. Forest areas were mainly changed into arable fields, meadows and pastures. These changes also included the right-bank part of the Wieprza River valley (Fig. 3B) In just 54 years (1780-1834), the arable land acreage increased by about 38%, and pastures and meadows by over 130% (see Table 1). At the same time, the area occupied by villages increased by over 55%. Based on these changes, it can be stated that it was the heyday of the villages of Stary Kraków and Mazów.

Land use in 1934

Until the Second World War, there was a period of prosperity associated with the development of agricultural economy related to improving cultivation methods, melioration of wetlands and the introduction of new crop species. All this took place at the expense of the forest area – felling and changes in species composition. In relation to 1836, there was a slight increase in forest areas – by about 25 ha, i.e. to 2,036.8 hectares (Table 1). Intensive forest management, however, resulted in the depletion of the old-growth tree stands. In their place, in more humid locations, originally predominated by beech forests, trees dominated by beech and spruce were planted while in upland areas these were mainly beech and pine with a small share of other deciduous trees (Plit 2009). It still has its negative effects as coniferous trees are less resistant to pests and air pollution. Currently, these trees are dying. The Meßtischblätter map shows very well the type of tree stand (mixed forest) overgrowing the studied area.

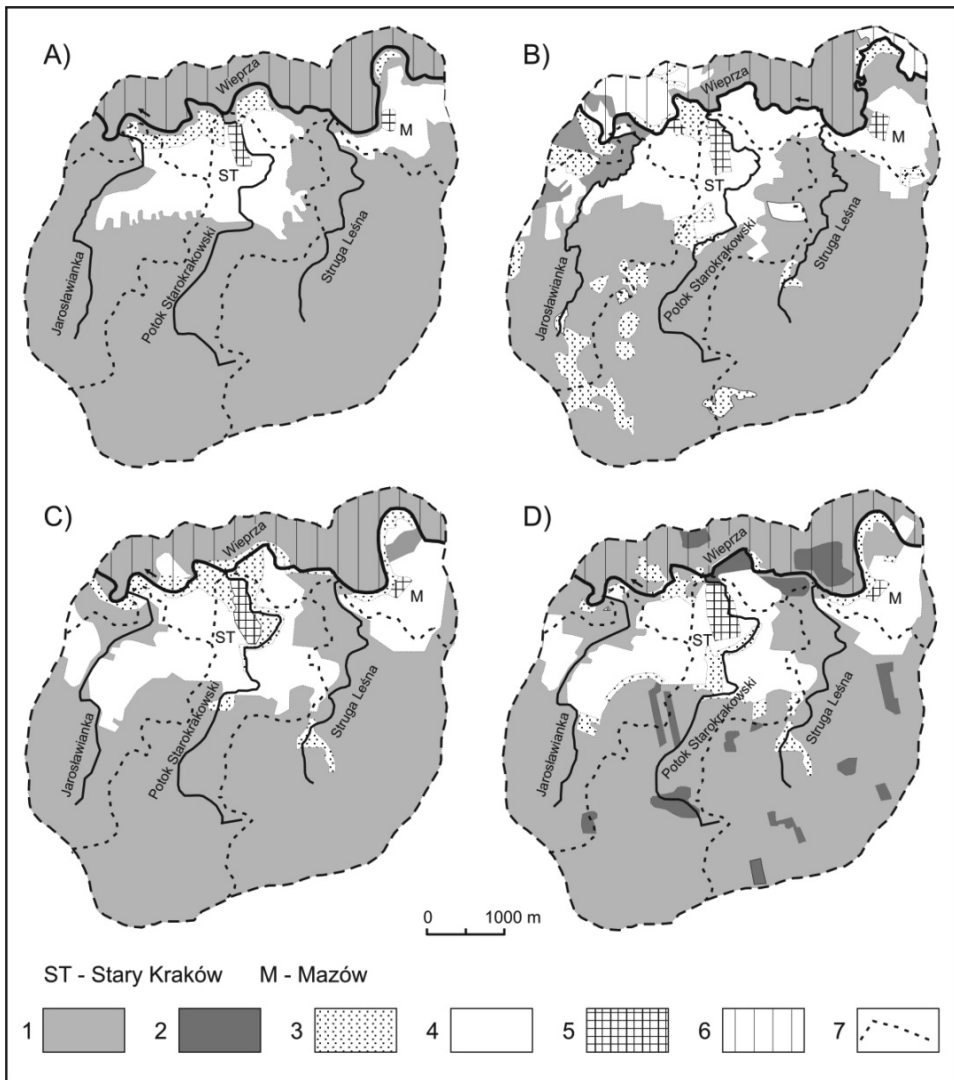


Fig. 3. Changes in land use in the studied area in the years 1780-2008;

A – 1780, B – 1834, C – 1934, D – 2008

1 – forests, 2 – coniferous forests, 3 – meadows and pastures, 4 – farmlands, 5 – built-up areas with orchards, 6 – right-handed direct catchment of the Wierza River, 7 – catchment boundaries

The course of the southern border of the forest changed noticeably; its leveling and significant geometrisation took place, which is considered as an indicator of the synanthropisation of the landscape (Macias and Szymczak 2012).

We can observe that the area of arable fields in the years 1836-1934 was subject to minor changes (increase by about 29 ha) while meadows and pastures would undergo moderate changes – fall by nearly 60 ha to the value of 143 ha. Larger com-

plexes of meadows and pastures used to lay then in the neighbourhood of the villages of Stary Kraków and Mazów, which facilitated the grazing of cattle and horses near farms and in the areas drained in the vicinity of the Wieprza River bed. In relation to 1834, the meadows and pastures located at a considerable distance, south and south-west of the village, were abandoned (Fig. 3C).

Land use in 2008

Big changes came with the outbreak of World War II. Looting and displacement of the population resulted in economic slump. The inflow of the less numerous populations from the east after the war (e.g. the number of inhabitants of Stary Kraków fell by almost half) caused the slowdown of the development after the Second World War. During this period the left-bank terraces of the Wieprza River and the valleys of its left-bank tributaries were afforested which was additionally associated with the liquidation of water mills operating there for hundreds of years. Despite the interruption of cultural continuity in the post-war period, the main directions of economic activity in forestry and agriculture in the studied area were continued. In recent years, the situation of the forest complex adjacent to Stary Kraków and Mazów has not changed significantly. In 2008, forests occupied 2,174.9 ha, or 78.8% of the analysed area. There is a noticeable slight increase in the forests coverage, mainly in areas not used for agriculture and located in close proximity to the village (Fig. 3D). It can also be said that in many areas the role of agricultural monocultures has increased, and in the forests the share of fast growing pine and spruce which are less resistant to pests, has risen. This causes increased mortality of these trees.

The distribution of meadows and pastures has evidently changed in comparison with the situation in 1934. Their area was reduced to 100.2 ha and they are more fragmented and lie on the edge of forests. The reason for the decrease in the area of meadows and pastures may be reduction in cattle population, greater mechanization in agriculture, as well as the fact that some of grasslands were not used for a long time and as a result they overgrew with bushes and trees. The process of overgrowing is most visible along the Wieprza River, north of Stary Kraków.

Table 1
Changes in the area of land use in the studied area in the period 1618-2008

Type of use	Map of land use (in ha)				
	year 1618	year 1780	year 1836	year 1934	year 2008
Forest:			2010.1		
- coniferous	72*	–		–	85.9
- deciduous	2,374*	–		–	2,089.0
- mixed	–	2,282.0		2,036.8	–
Farmlands		372.1	514.6	543.7	457.9
Meadows and pastures		86.0	202.7	143.0	100.2
Built-up areas with orchards	315*	21.5	34.1	38.1	28.6

* estimated data

The area of arable lands is 457.9 ha. It constantly decreases as some of the land spontaneously overgrows with bushes, while other uncultivated fields belonging to the former production cooperative were taken over by state forests for afforestation. This phenomenon can be seen in the upper reaches of Jarosławianka stream and north of Mazów.

One can also notice significant decrease in the housing areas of Stary Kraków and Mazów from 38.1 ha in 1934 to 28.6 ha in 2008 (Table 1), i.e. by 25%. It is caused by the abandonment of some farms and their devastation.

DISCUSSION

Historical sources and archived statistical data indicate that in the examined period the afforestation of the area of the Grand Duchy of Poznań and Western Prussia, i.e. area including also Western Pomerania, was very stable; in the period 1815-1913, the forest cover index decreased by 0.8% (from 21.5 to 20.7%) (Miklaszewski 1928). There were several reasons for this: intensive deforestation was associated with high demand for grain in Western Europe in the second half of the fifteenth and sixteenth centuries, while two subsequent centuries were the time of agricultural and forestry stabilization (Nyrek 1997). More varied values come from cartometric analyses made by Kunz (2012) for the part of Pomerania covered by the map by Lubinus. According to the author's data, the forest cover of Pomerania was the lowest in the seventeenth century, amounting to 16%. In 1789 it increased to 20%, and in 1870 to 24%, to fall to 21% in 1902, and in the period after World War II it exceeded 30% (Kunz 2012). Against this background, the stabilization of the share of forest cover in the area of the analysed catchments (Table 2) and, more broadly, of the entire Sławieńska Plain (Sławieńska Land), previously signalled by the Plit (2009), is puzzling.

Table 2

Changes in forest cover in the studied area (in %)

Share of forest area	Year				
	1618	1780	1834	1934	2008
%	88.6	82.6	72.8	73.8	78.8

In addition to political factors (constancy of ownership of the Stary Kraków Forests), it was probably harder to undertake cultivation of land on heavy, clayey-loamy soils during so-called small ice age that characterized in the studied area by cold winters and cool, wet summers (W. Florek 2009, Plit 2009). The precipitous decline in forest cover of the area (from 82.6 to 72.8%, Table 2) should be related to granting property rights to peasants which resulted in the creation of new, small peasant colonies on the outskirts of Stary Kraków and the settlements of forestry workers in Stary Kraków and Przemysław (Witek and Walasek 2003). Non-forest areas developed at that time (arable land, meadows and pastures, as well as built-up areas) survived unchanged until the end of World War II. Reducing the population, liquidation of part of

the building in small rural settlements outside main villages and changes in the nature of land management led to increase in the afforestation of the catchment areas, mainly through afforestation of areas more distant from the centre of the village.

Thus, worth emphasizing is the very high stability of land use in the studied area: as much as 70% of the area is occupied by forest areas used in this way for at least 400 years. Only a small part of the studied area would repeatedly change its plant cover, which promoted stabilization of soil, hydrological and hydrogeological conditions. The latter, however, were changed by drainage meliorations which covered at various times part of the forest and agricultural areas. It seems that this situation may be typical for lowland areas with large and dense forest complexes; this is evidenced by, for example, the Krotoszyński Forests located in the south of Wielkopolska (Macias and Szymczak 2012).

CONCLUSIONS

The main purpose of the work was to identify changes in land use, with particular emphasis on changes in forest cover and forest boundaries over the last 400 years. The research area covered the catchments of the left-bank tributaries of the lower Wieprza River: Struga Leśna, Potok Starokrakowski and Jarosławianka streams, flowing in the area of the villages of Stary Kraków and Mazów, as well as neighbouring direct left-bank catchments of the Wieprza River. The analysis of available maps, predominantly large-scale ones, made it possible to observe the progressive changes. In the dammed area of the Sławieńska Plain, the border between forest and non-forest areas was established in the Middle Ages, during the settlement of villages belonging to monasteries. Left-bank terraces of the Wieprza River and the beds of its left-bank tributaries repeatedly changed the nature of land use: periods of deforestation coincided with the periods of intensification of agricultural economy and the existence of water mills based on the Jarosławianka and Potok Starokrakowski water resources. Changes in forest cover in the research area can be divided into two periods. The first period lasted until the middle of the 19th century – it was characterized by a progressing significant decrease in the forest cover with slight changes in the species composition. In the period 1780-1834, the forest cover of the area decreased from 82.6% to 72.8%. The second period, the later one, was characterized first by a significant increase in the share of coniferous species: spruce and pine, and then progressive slight increase in the share of area occupied by forests.

The changes that took place in recent years consisting first of all in spontaneous entering the forest into fallow fields, and then its clearing (conditioned by economic and political reasons) resemble the effects of wars (e.g. the Thirty Years' War) recorded on the maps and significant economic and political changes from the past (e.g. colonization policy of Frederick the Great).

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LIST OF USED MAPS

- Nova Illustrissimi Principatus Pomeraniae Descriptio cum adiuncta Principum Genealogia et Principum veris et potiorum Urbium imaginibus Nobilium Insignibus, Amsterdam, Eilhardt Lubben (Lubinus), 1618, scale approx. 1:227 000.
- Kabinettskarte Preußischen Provinze, Friedrich Wilhelm Carl Schmettau, created between 1767 and 1787, scale 1:50 000; used Rügenwalde sheet.
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- Maps of the Cadastral Office in Sławno (*Gemarkung Alt Krakow*, *Gemarkung Meitzow*) from 1937, scale 1:3000.
- Land Registry maps from 2008, scale 1:5000.
- General Map of the Sławno Forest Division, forest circle Stary Kraków, from 2007, scale 1:25 000.

ZMIANY ZASIĘGU LASÓW I UŻYTKOWANIA GRUNTÓW W CZASACH HISTORYCZNYCH W ZLEWNIACH MAŁYCH DOPŁYWÓW DOLNEJ WIEPRZY

Streszczenie

Przedmiotem opracowania były zmiany użytkowania gruntów w ciągu ostatnich 400 lat. Badania objęły obszar, zasięg którego wyznaczają zlewnie trzech lewobrzeżnych dopływów Wieprzy oraz jej zlewni bezpośrednich. Stwierdzono, że na badanym terenie granica las – obszary nieleśne ustaliła się już w średniowieczu, a późniejsze zmiany jej przebiegu miały charakter ewolucyjny. Do połowy XIX wieku był widoczny wyraźny spadek powierzchni leśnej, co powiązane było z pozyskiwaniem obszarów głównie dla pól uprawnych oraz łąk i pastwisk. Kolejne zmiany terenów leśnych prześledzone dla okresów 1836-1934 i 1934-2008 były stosunkowo niewielkie, ale towarzyszyły im wyraźne modyfikacje składu gatunkowego lasu – wzrost udziału świerka i sosny. Relatywnie największe przemiany w ostatnim wyróżnionym okresie (1934-2008) objęły obszary zabudowane z sadami, dla których zanotowano spadek zajmowanych powierzchni wynoszący blisko 25%. Tendencja ta związana była głównie z wyludnianiem się wsi w ostatnich dekadach.

