GEOGRAFICKÝ ČASOPIS

54 2002 3

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LANDSCAPE CHANGES IN CENTRAL POLAND

B. Degórska: Landscape changes in Central Poland. Geografický časopis, 54, 2002, 3, 9 figs., 17 refs.

This paper presents a study of the landscape changes in three regions of Central Poland (Kujawy Plain, Chodecz Lakeland, Włocławek Basin), over a 200-year period (1770-1970). The main aims of the work are: to determine the magnitudes to the transformations in landscape structure and establish the mean periods of changes in rural landscape, also explain the causes of this changeability**.**

Key words: landscape change, topographical map, settlement network, Poland

INTRODUCTION

Research into the transformation of rural landscapes over the 200-year period (1770-1970) was carried out in three regions of Central Poland bordering onto one another, namely the Kujawy Plain, Chodecz Lakeland and Włocławek Basin (Fig. 1).

The main inspirations behind the undertaking of this work in these regions were the following cognitive aspects:

- the opportunity to study an area of Poland relatively poorly researched from the point of view of the recognition of long-term changes in landscape structure;
- the opportunity to engage in comparative field research in neighbouring regions of differing natural conditions representative of three types of natural

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landscape: spillway (Włocławek Basin), lakeland (Chodecz Lakeland), morainic plateau (Kujawy Plain), in order that the results might be extrapolated to areas with similar conditions of the geographical environment.

The main aims of the work were:

- to determine the magnitudes of the transformations in landscape structure over the 200-year period (1770-1970);
- to define the pressure imposed by population and settlement in rural areas, as well as to define their interdependence with forest cover by means of statistical assessment;
- to establish the mean periods of transformation in the rural landscapes and explain the causes of this changeability.

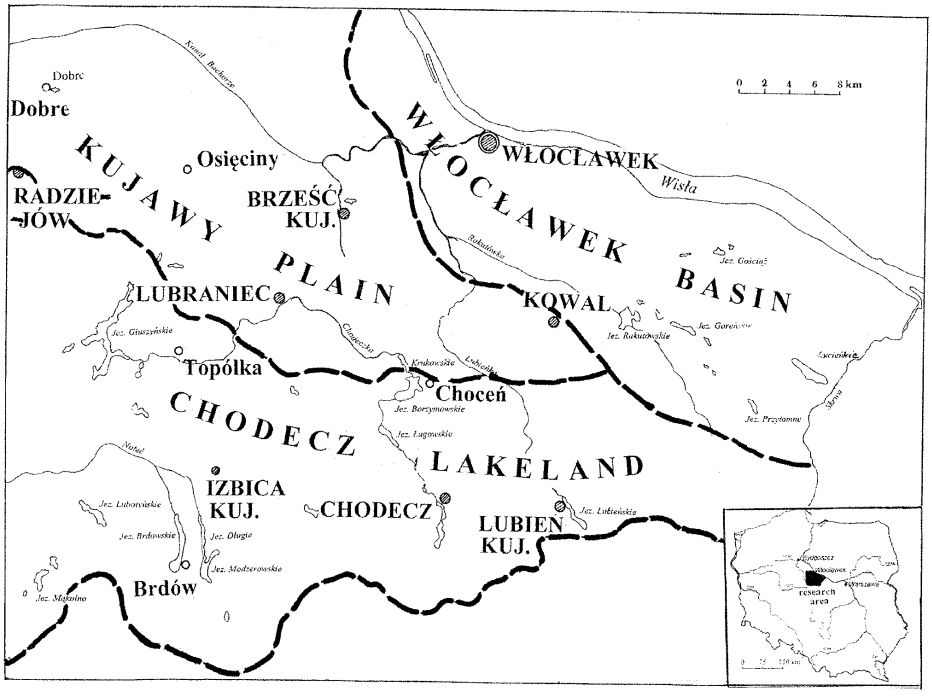

Fig. 1. Localization of the research area

METHODS

The present study – linking as it does the issues of physical geography, phytosociology, socio-economic geography and history – requires the application of methodologies from the "borderline" between the natural and historical sciences. Transformations in the structure of the rural landscape were analyzed on the basis of changes in the areas of forests, arable lands and grasslands. With a view to obtaining data on land use and the intensification of anthropopressure that were as precise as possible, use was made of retrospective methodology entailing the analysis of materials in order from the most recent to the oldest. In

contrast, however, the results have been presented in chronological order, beginning with 1770. Similar methods were used by Hładyłowicz (1932), Maruszczak (1951), Ślaski (1951), Szymański (1984), Plit (1996 and 1998), Degórska (1996).

The analytical resources needed to address the research problems posed were obtained from statistical and cartographic source materials, field research and the available literature.

The basic analysis of landscape changes and the density of the settlement network was carried out using topographical maps from the 18th, 19th and 20th centuries at scales of 1:100,000 or similar and presenting the state of affairs in 1770, 1800, 1830, 1890, 1930, 1950 and 1970. The following maps were used for the analysis:

- Special Karte von Pohlen, T. P. von Pfau, in scale 1:87,000, Berlin, 1778.
- Special Karte von Südpreussen, D. Gilly, Cron, Langner, in scale 1:150,000, Berlin, 1802-1803;
- Topographical Map of Polish Kingdom, K. Richter, in scale 1:126,000, Warsaw, 1843;
- Nowaja topograficzeskaja karta Zapadnoj Rossii, in scale 1:84,000, Petersburg, 1909-1917;
- Topographical Map of Poland, in scale 1:100,000, Warsaw, 1930-1938;
- Topographical Map of Poland, in scale 1:100,000, Warsaw, 1952;
- Topographical Map of Poland, in scale 1:100,000, Warsaw, 1981.

The adoption of this period – and its division into time intervals for study – was conditioned by the availability of topographical maps on similar scales.

The basic research units were the natural regions. These were designated using the division of Kujawy into regions after Galon (1973). Each region was divided into the smaller units of the so-called scaling gminas (in line with the borders of these local-level administrative units that were in force at the end of 1988). An important assumption was that analysis should be done for spatial units that were identical for the whole of the research period.

With a view to gaining the best possible comparability of cartographic materials, all maps from the 18th and 19thh centuries were brought to the unified scale of 1:100,000. Nevertheless, the only element allowing for the application of range methodology comprised forests. Detailed spatial analysis of changes in the boundaries of forest complexes was carried out using cartographic materials from the 19th and 20th centuries, beginning from the year 1830.

The areas of forests, arable lands, grasslands and density of settlement network were calculated for the regions, beginning with the year 1770 and next 1800, 1830, 1890, 1930, 1950, 1970, and the density of dwelling houses and density of population beginning from 1830 Calculations were also made within the gminas, but only for change to the areas of forests and population, dwelling houses and settlement network density, for each of the 5 instances in time (1830, 1890, 1930, 1950, 1970). In creating the database, use was made of both direct information contained on maps and statistical materials concerning population sizes and the numbers of homes in each locality, as well as of estimates.

On account of the fact that forests represented the present study's best-recognized element in terms of area and extent, it was interdependencies between forest cover and the densities of population, dwelling houses and the settlement network that were determined. This was done for each of the 5 instances in time (1830, 1890, 1930, 1950 and 1970) using the Pearson index for linear correlation. Statistical significance was sought at the 5 % level, with calculations being performed using the STATGRAPHICS program. Spatial linkages between the permanence of the analysed forms of land use and the habitat areas of potential natural plant communities, as well as soils, relief and lithology were evaluated by comparing maps of these elements on a unified scale of 1:100,000.

CHANGES IN THE STRUCTURE OF THE RURAL LANDSCAPE OVER THE STUDY PERIOD

Analysis of topographical maps from the 18th, 19th and 20th centuries revealed that the greatest changes to the landscape in the period 1770-1970 occurred in the Chodecz Lakeland (Fig. 2), with much more minor ones taking place in the Włocławek Basin (Fig. 3) and Kujawy Plain (Fig. 4). The Chodecz Lakeland stood out from the other regions as regards the greatest changes in forest areas (from 570 km^2 to 99 km^2) and in the arable lands (from 318 km^2 to 849 km^2). At the beginning of the study period forest landscape was dominant in this region, but fields predominated from 1800 (Fig. 2). The greatest loss of grasslands (from 168 km^2 to 34 km^2) – as well as the greatest dynamic to such change – was characteristic for the Kujawy Plain (Fig. 4). The Włocławek Basin is the only region where forests actually cover a slightly smaller area (347 km^2) than existed 200 years ago (316 km^2) – Fig. 3.

In the total study area field landscape started to dominate over forest between 1770 and 1780 (Fig. 5). The approximate ratios for these main forms of land uses (forest areas: arable lands: grasslands) were: 6:3:2 in 1770 and 1:9:1 after 200 years.

Analysis of changes in rural landscapes in the study periods revealed that the fastest rate concerned the shares of forest and arable land in the period 1830-1890, as well as those of grasslands between 1950 and 1970.

Up to the mid 20th century, the areas of forest and arable land showed identical trends for the transformations within regions (decrease of the forest areas, increase of the arable land). In contrast, the post-war period saw inter-regional differentiation to the changes in the areas of arable land, especially arable land (a decline in the Włocławek Basin and Chodecz Lakeland, and an increase on the Kujawy Plain). In the mid of 20th century the trend direction of forest areas changed from decrease to increase. The only component of the landscape showing an unvarying trend over all regions and time intervals was that comprising grasslands.

While regional and local differentiation was observable, the general trends to the long-term transformations of landscapes in the study area can be linked with those ongoing in Poland (Romanowska 1934; Więcko 1948; Kostrowicka 1961; Maruszczak 1988, 1998 and 1999), and Central Europe as a whole (Bastian 1987, Bastian and Bernhardt 1993, Lasák et al. 1999).

	forest	arable land	grassland	other areas
1770	50.4	28.1	18.0	3.5
1800	38.0	40.5	17.0	4.5
1830	29.4	50.6	15.0	5.0
1890	8.0	73.0	12.0	7.0
1930	6.6	75.8	9.5	8.1
1951	6.1	76.4	9.0	8.5
1970	8.8	75.0	7.0	9.2

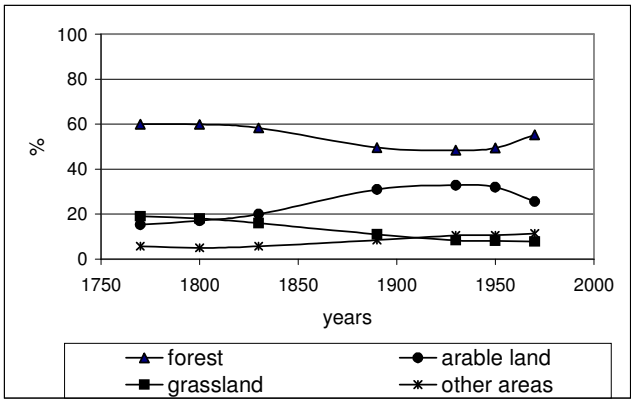

Fig. 2. Changes in the landscape structure of the Chodecz Lakeland in the period 1770-1970

MAIN PERIODS OF LANDSCAPE TRANSFORMATION AND THEIR CAUSES

Since the division into research periods adopted in this study was conditioned by the available cartographic material, and since this was unfortunately characterized by rather different time intervals, an attempt was made to divide the studied two centuries into periods. Four main periods of transformation in rural landscape were discerned.

A period of intensive changes (1770-1860)

The main directions to landscape change entailing:

- a decrease of forest area from 40 % to 25 % of total area – average 41 km^2/10 years,
- an increase of arable land from 37 % to 55 % – average 49 km^2/10 years,
- a decrease of grassland area from 19 % to 14 %) – average 14 km^2/10 years**.**

In this period the development of rural settlement and increase of the population density of rural areas were the main factors underpinning this change in the landscape from forest and grassland to fields. Increasing demand for new land for settlement and arable soil generated by the colonization policy of Prussia during the partitions of Poland and manifesting itself, for example, in a very rapid development of the "Olender's settlement". The most visible effect of this situation can be seen in the Chodecz Lakeland. The 19th century was the begin-

ning of industrial development with the sale of some forests for timber as a fuel. With regard to agriculture, the spread of the cultivation of potatoes in the Duchy of Warsaw period, increased the profitability of production on poorer soils. The renting of land and separation of peasant and manorial property were also intensifying in the years 1831-1845 and this was associated with the cutting-down of some forests.

	forest	arable land	grassland	other areas
1770	60.0	15.3	19.0	5.7
1800	59.9	17.1	18.0	5.0
1830	58.3	20.0	16.0	5.7
1890	49.6	31.0	11.0	8.4
1930	48.4	32.8	83.0	10.5
1950	49.4	32.0	8.0	10.6
1970	55.3	25.6	7.7	11.4

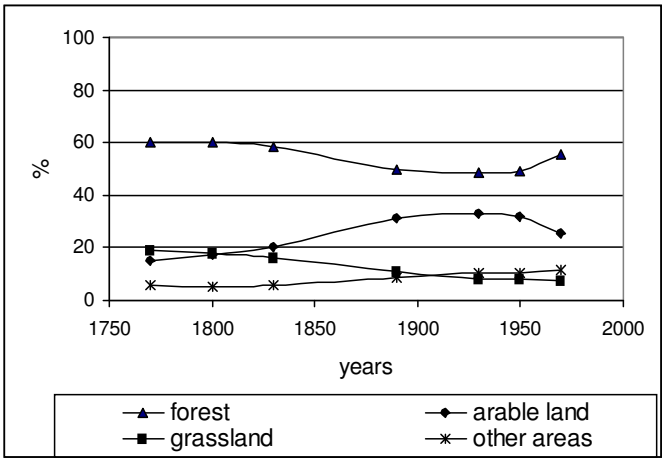

Fig. 3. Changes in the landscape structure of the Włocławek Basin in the period 1770-1970

A period of very intensive changes in the landscape (1860-1900)

The main directions to landscape change entailing:

- a decrease of forest area from 25 % to 15 % – average 63 km^2/10 years,
- an increase of arable land from 55 % to 67 % – average 75 km^2/10 years,
- a decrease of grassland area from 14 % to 11 % – average 20 km^2/10 years.

Very fast increase of the rural population density, demand for new land for settlement and cultivation and increasing demand for timber as a building material and a fuel were the main causes of the disappearance of forest and meadow landscapes.

The important causes of these changes were connected with regulations issued by the government of the Congress Kingdom of Poland. In 1862 – an obligatory requirement that land be subject to rental, while grange and peasant

lands were separated, as well as the building of villages carried out in a dispersed manner meant that forest land was designated for dispersed peasant settlement and arable land. In 1864 – the enfranchisement of peasants, and the regulation of land largely in parallel with it, entailed the designation of forest land for peasant farms. The post enfranchisement period brought the wholesale selling-off of forests. In 1869 – the Polish administration in government-owned forests were liquidated and they were taken over by the office in St. Petersburg. Some government forests were transferred as donations.

A rapid growth in industrialization, especially the development of the timber, food and machine industries in Włocławek, and elsewhere of the sugar and textile industries based on timber as a fuel and/or raw material were the main cause of the deforestation processes in the second part of the 19th century. However the development of melioration technologies allowing for the utilization of wetlands as arable land was the main cause of the decrease of the meadows, especially the wet meadows.

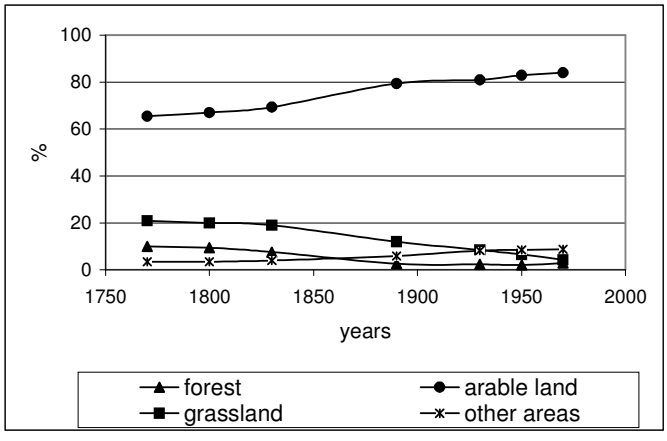

Fig. 4. Changes in the landscape structure of the Kujawy Plain in the period 1770-1970

A period of relative stabilization (1900-1945)

The main directions to landscape change entailing:

- a decrease of grassland area from 11 % to 8 % – average 15 km^2/10 years,
- an increase of arable land from 66 % to 68 % – average 9 km^2/10 years,
- a decrease of forest area from 15.5 % to 15 % – average 1.5 km^2/10 years.

This relative stabilization of landscapes was obtained as a result of a slowing of the process of deforestation due to the exhaustion of the supply of forest land on soils suitable for the development of agriculture that was in private hands. In this there period was a balancing of the increase in the area of arable land and the loss of such areas due to reforestation (further forests and grasslands were still taken over for arable agriculture, while reforestation of the poorest land began).

	1770	1800	1830	1890	1930	1950	1970
forest	39.9	33.9	29.1	15.8	14.8	14.7	17.5
arable land	37.1	43.6	49.6	65.4	67.6	68.3	66.6
grassland	19.2	18.2	16.5	12.0	8.9	8.0	6.3
other areas	3.8	4.3	4.8	6.8	8.7	9.0	9.6

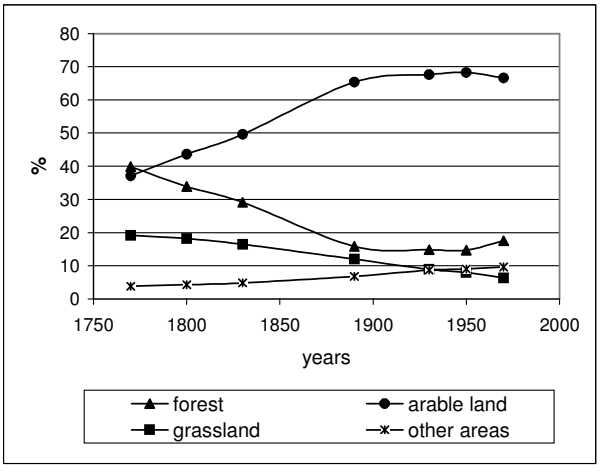

Fig. 5. Changes in the landscape structure of the study area, in the period 1770-1970

The process of deforestation and changeover of the land obtained to cultivation can be principally associated with the so-called "land hunger" due to an abrupt rise in rural population density (62 persons per sq. km in 1930 – a value greater than at any other point in the studied 200-year period).

The process of the transformation of grassland into arable land may be linked to the highest level of rural population density. The exhaustion of the privately-owned forest land in habitats suitable for the development of agriculture, as well as the development of melioration techniques were the other causes of decrease of the grassland areas.

The beginning of the process of reforestation may be first and foremost linked with the entry into force of the "Forest Saving" Act of 1898, and with of the administration of government-owned forests by the State Forests organization following Poland's regaining of independence, and its subsequent engagement in reforestation.

A period of moderate changes (1945-1970)

The main directions to landscape change entailing:

- an increase of forest area from 15 % to 18 % – average 28 km^2/10 years,
- a decrease of arable land from 68 % to 67 % – average 18 km^2/10 years,
- a decrease of grassland area from 8 % to 6 % – average 17 km^2/10 years.

The main causes of the increase in forest cover and the decrease of field areas were provisions of the agricultural reform concerning the taking-over by the

State Forests of most of the forest land of the landed estates, thereby entailing a hindering of the easy conversion of forest into arable land, also the inclusion under the forest administration of the so-called peasant forests, and the simultaneous introduction of compulsory reforestation of clear-cuts, as well as tax breaks for the reforestation of the poorest soils. Reduced interest in the utilization of less-fertile soils and increased emphasis on those that are good is or very good seen in the decline in the area of arable land in the Włocławek Basin and Chodecz Lakeland, and its simultaneous increase on the Kujawy Plain.

The main cause of the disappearance of meadow landscape have been intensified melioration measures, mainly entailing the draining of land and consequent possibility of further transformation of grasslands into arable land.

INTERDEPENDENCIES BETWEEN FOREST COVER AND ANTHROPOPRESSURE

The present work treats of the population density (Fig. 6), dwelling houses density (Fig. 7) and settlement network density (Fig. 8) as measures of anthropopressure. Changes in land use were related to changes in anthropopressure in rural areas. This was confirmed by significant correlation between forest cover and changeable features (Fig. 9). In most periods, the highest values for the Pearson linear correlation coefficients were obtained between forest cover and population density. The strongest link between these features was noted in 1930 ($r = -0.84$). A rather weaker correlation was noted with the density of dwelling houses (strongest in 1970, for which $r = -0.72$). The weakest linkage was noted between forest cover and the density of the settlement network.

NATURAL FACTORS UNDERPINNING THE PERSISTENCE OF LANDSCAPE

The analysis mainly concentrated on describing the linkage between natural conditions and the persistence of forests and arable land over a 200-year period.

Relationship between the potential natural vegetation and the usefulness of soils for agriculture and landscape changes

The greatest persistence of landscapes is that characterizing the habitats of potential plant communities shaped on good and very good soils of the greatest suitability for agriculture in the region; as well on poor and the poorest soils that are least suitable. Fields were mainly present in areas of habitat of the potential oak-lime-hornbeam forest community *Galio silvatico-Carpinetum* in its Kujawy variant of the fertile series, as well as in lowland elm-oak riparian forest (*Ficario-Ulmetum chrysoplenietosum*). Coniferous forests first and foremost cover habitats of the potential continental inland pine forest *Peucedano-Pinetum*, as well as dry pine forest *Cladonio-Pinetum* and moist pine forest *Molinio-Pinetum.*

Across the 200-year study period, the greatest variability in the field-forest boundary was that characterizing the habitat areas of potential Central European oak-lime-hornbeam forest *Galio silvatici-Carpinetum* in its Kujawy variant of the poor series, light-loving oak woodland *Potentillo albae-Quercetum*, and the

potential community of continental mixed/pine forest *Pino-Quercetum* shaped mainly on soils of average quality for agriculture.

	1770	1800	1822	1890	1930	1950	1970
Chodecz Lakeland			32.3	47.4	68.4	60.7	58.7
Włocławek Basin			18.6	31.4	40.6	33.9	35.0
Kujawy Plain			26.5	42.4	68.3	65.8	71.0
mean value			27.4	42.2	62.2	56.3	57.5

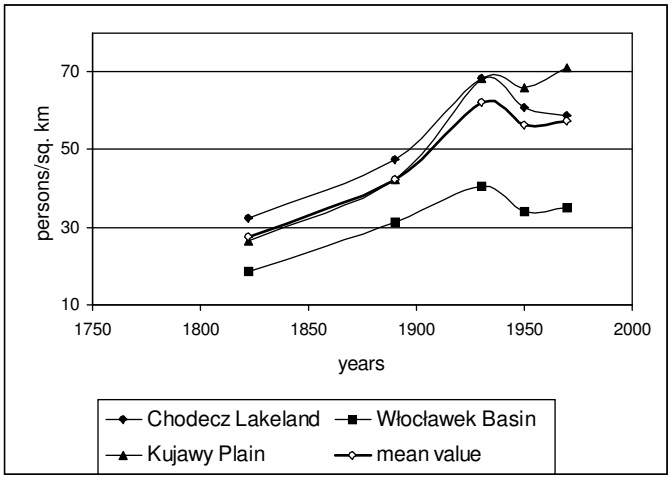

Fig. 6. Changes of population density in the period 1770-1970

In 1770, forests still covered a whole spectrum of habitats shaped on soils ranging from the good (for agriculture) to the weakest. Nevertheless, the spatial distribution of arable land was mainly associated with the region's most fertile soils. By the 20th century, the distribution of forests almost entirely coincided with the habitats shaped on poor or the poorest soils (and hence those of limited or zero suitability for agriculture). At the same time, arable land occupied a rather wide habitat spectrum (from very good to very poor soils). The landscape changes arising in the second half of the 18th century, in the 19th century and at the beginning of the 20th (and entailing an increase in arable land at the expense of forests) took in ever poorer soils, and at times even those unsuitable for agriculture. It was only a shortage of land which could be designated for the removal of forest to develop agriculture that held back the deforestation process. The post-war period saw reforestation of most of the land on which forest cover has been curtailed in the late 19th and early 20th centuries – mainly in connection with the low profitability of agricultural production in these areas. The disappearance of meadow landscapes continued uninterrupted throughout the 200-year study period in all regions and through each of the studied time intervals.

	1770	1800	1830	1890	1930	1950	1970
Chodecz Lakeland			3.6	5.4	8.4	10.0	11.9
Włocławek Basin			2.1	3.9	5.4	6.0	6.6
Kujawy Plain			2.9	4.4	7.5	9.5	12.9
mean value			3.0	4.8	7.4	8.9	11.0

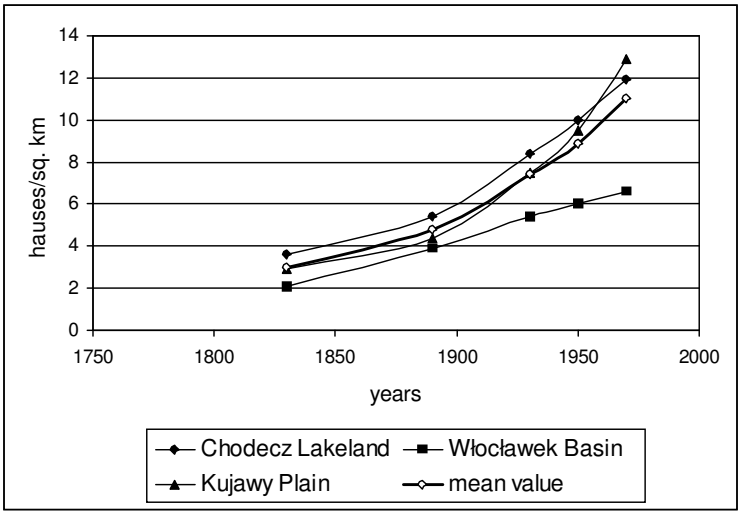

Fig. 7. Changes of dwelling house density in the period 1770-1970

Relationship between the relief and landscape changes

The greatest permanence to the occurrence of arable land was that characterizing flat ground moraine. Over the 200-year period, forests were associated with dune areas, parts of the outwash plains and sand and gravel cover. The greatest changes in use concerned:

- the final phase of the 18th century, and beginning of the 19th – especially on patches of undulating ground moraine (with the main change being from forest to arable land);
- the middle and late parts of the 19th century – above all as regards the diverse zones of hilly moraine (with the main kind of transformation being from forest to arable land) and valley forms in which wetland areas constituting non-utilizable areas for agriculture were converted into grasslands or arable land;
- the 20th century – hills and hummocks of moraine and kame, slope zones, marginal parts of outwash plains, sand and gravel cover and parts of terraces (where deforestation continued up to the Second World War, while reforestation began shortly after its end – following a brief period of agricultural use), as well as within valley forms (where an ever greater area was transformed into arable land).

	1770	1800	1830	1890	1930	1950	1970
Chodecz Lakeland	1.5	2.8	3.7	4.4	5.3	5.4	5.6
Włocławek Basin	0.8	1.2	2.0	2.6	2.8	2.8	2.8
Kujawy Plain	1.8	2.1	2.4	3.2	3.8	3.9	4.4
mean value	1.5	2.2	2.9	3.6	4.2	4.3	4.6

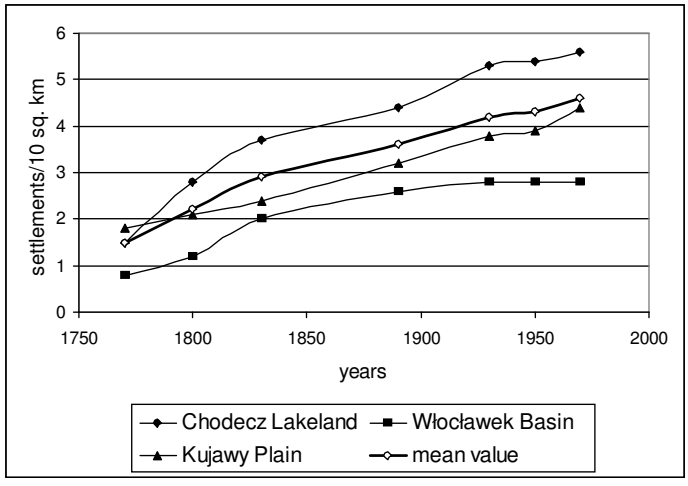

Fig. 8. Changes of settlement network density in the period 1770-1970

Relationship between hydrological conditions and landscape changes

Links between the permanence of forest areas and arable land and hydrological conditions were best seen between the uninterrupted presence of forests and the infiltrative type of water regime, in areas with a deep-lying water table more than 3-4 m down, and especially where the water table is more than 4 m below the surface. The greatest frequency of changes in the field-forest boundary (and hence the most limited permanence of forms of land use) was characteristic of areas with a runoff regime.

Relationship between the climate and landscape changes

A climatic factor exerting an indirect influence on the area of forests and agricultural land is the study area's situation in the zone of lowest precipitation in Poland, as well as unfavourable mutual relations between precipitation and temperature (manifesting themselves in the rather frequent occurrence of dry periods or droughts, especially in the first half of the growing season where an infiltrative type of water regime predominates). This factor also had a major influence on the frequent changes in the field-forest boundary where the water regime was of the runoff type. On the Vistula flood terraces, the periodic abandonment of cultivation mainly reflected the occurrence of catastrophic floods (more frequent in periods with a wetter and cooler climate).

	1	2	3
1890	-0.69	-0.53	-0.44
1930	-0.84	-0.65	-0.48
1950	-0.73	-0.57	-0.50
1970	-0.72	-0.73	-0.50

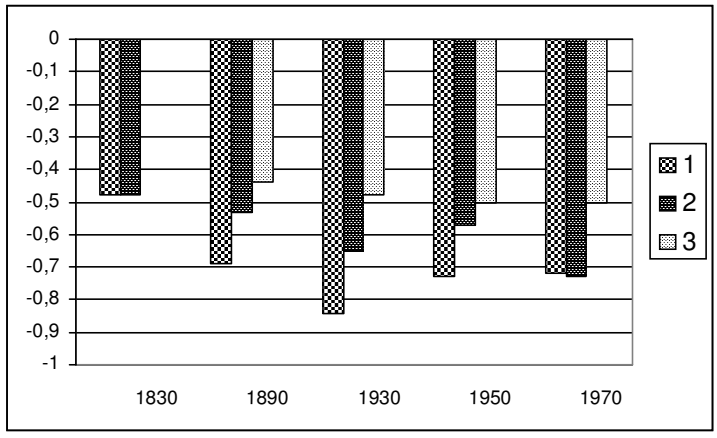

Fig. 9. Values of the Pearson index

1 – interdependencies between forest areas and densities of population in rural areas, 2 – interdependencies between forest areas and densities of residential construction in rural areas, 3 – interdependencies between forest areas and densities of the settlement network in rural areas

CONCLUSIONS

Research into the transformation of rural landscapes in the 200-year period 1770-1970, carried out in three regions of Central Poland, discerned four main periods of transformation in the rural landscape:

- a period of intensive changes (1770-1860),
- a period of very intensive changes (1860-1900),
- a period of relative stabilisation (1900-1945),
- a period of moderate changes (1945-1970).

The most importance conclusions about main period and trends of rural landscape changes are as follows:

- In the designated periods the fastest rate of change concerned the shares of forest and cultivated or settled areas in the period 1860-1900, as well as those of grasslands between 1945 and 1970.
- Up to the mid 20th century, all the analysed forms of land use showed identical trends for the transformations within regions. In contrast, the post-war period saw inter-regional differentiation to the changes in the arable land (a decline in the Włocławek Basin and Chodecz Lakeland, and an increase on the Kujawy Plain).

- The only component of the landscape showing an unvarying trend over all regions and time intervals was that comprising grasslands.

Among the analysed habitat conditions, sites of natural potential vegetation and usefulness soils for agriculture**,** have been the main influence in changing rural landscape. In addition to the indisputable links between the greatest permanence of forest areas and the poorest habitats, as well arable land and the most fertile habitats, it was also possible to observe that the most intensive changes in the areas of forests and arable land took place in areas with habitats of intermediate fertility.

The main socio-economic factors underpinning this change in the landscape from forest and grassland – to fields were increase of the population density of rural areas and the development of rural settlement. The most statistically-significant correlation was that between forest cover and human population density.

The greatest permanence of forest area was found to be that characterizing forests under royal or ecclesiastical ownership prior to the partitions, then in government hands up to Poland's regaining of her independence, and under the management of the State Forests between the Wars and after World War II. In contrast, private ownership was seen to be associated with the greatest permanence of arable lands.

The present study provides confirmation of the thesis that human activity was the main factor behind changes in rural landscapes in the studied 200-year period. However, natural conditioning has had a major impact in modifying (limiting or intensifying) the ongoing changes.

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Božena D e g ó r s k a

ZMENY KRAJINY V STREDNOM POĽSKU

V troch regiónoch stredného Poľska, ktoré navzájom susedia, konkrétne Kujawská plošina, Chodeczské jazerá a Włocławecká kotlina, sa skúmali zmeny vidieckej krajiny, ku ktorým došlo za posledných 200 rokov (1770-1970).

Hlavnými cieľmi tejto práce bolo:

- určiť veľkosť a dynamiku zmien v krajinnej štruktúre juhovýchodnej časti Kujawskej plošiny za 200 ročné obdobie,
- stanoviť priemerné obdobia zmien vidieckej krajiny a vysvetliť ich príčiny.

Analýza topografických máp z 18., 19., a 20. storočia ukázala, že najväčšie zmeny krajiny v období 1770-1970 nastali v oblasti Chodeczských jazier, kým zmeny, ktoré sa odohrali na Kujawskej plošine a vo Włocławeckej kotline, boli oveľa menšie. V oblasti Chodeczských jazier sa menila lesná pokrývka na ornú pôdu. Najväčší úbytok trávnych porastov, ako aj najvyššia dynamika tejto zmeny charakterizuje Kujawskú plošinu.

Táto štúdia potvrdzuje tézu, že hlavným nositeľom zmien vidieckej krajiny v študovanom 200-ročnom období bol človek a jeho činnosť. Štatisticky najvýznamnejšia korelácia je medzi lesnou pokrývkou a hustotou osídlenia. Zistila sa väzba medzi existenciou lesov, ornej pôdy a vlastníctvom pôdy: lesy prežívajú najmä na pôde, ktorá bola v kráľovskom, cirkevnom a štátnom vlastníctve, kým orná pôda bola hlavne v súkromnom vlastníctve.

Rozhodujúci vplyv na modifikáciu (zníženie alebo zintenzívnenie) prebiehajúcich zmien mali však prírodné podmienky. Hlavnými faktormi zmeny vidieckej krajiny boli prirodzený vegetačný potenciál a využiteľnosť pôdy v poľnohospodárstve. Okrem zjavných väzieb medzi najväčšími oblasťami výskytu lesa a najnepriaznivejšími podmienkami, ako aj väzieb medzi ornou pôdou a najpriaznivejšími podmienkami, sa zistilo, že najintenzívnejšie zmeny v rozložení lesov a ornej pôdy nastali v oblastiach s priemernými prírodnými podmienkami.

V tejto štúdii sme rozlíšili štyri hlavné obdobia premien vidieckej krajiny:

- obdobie intenzívnych zmien (1770-1860),
- obdobie veľmi intenzívnych zmien (1860-1900),

- obdobie relatívnej stabilizácie (1900-1945),
- obdobie miernych zmien (1945-1970).

Najvýznamnejšie závery o hlavnom období a trendoch zmien vidieckej krajiny sú:

- najväčšou rýchlosťou/intenzitou sa menil les a kultivované alebo osídlené oblasti v období 1860-1900 a trávnaté oblasti v období 1945-1970,
- do polovice 20. storočia vykazovali všetky analyzované formy využitia zeme rovnaké trendy zmien v regiónoch. Naproti tomu v povojnovom období došlo k medziregionálnym rozdielom v zmenách ornej pôdy (pokles vo Włocławeckej kotline a Chodeczskej jazernej oblasti, nárast na Kujawskej plošine),
- jedinou zložkou krajiny, ktorá vykazovala nemenný trend vo všetkých regiónoch a časových obdobiach, boli trávnaté porasty.

Hlavným socio-ekonomickým faktorom, ktoré vplývali na zmenu krajiny z lesa a trávnatých porastov na polia, bol nárast hustoty obyvateľstva na vidieku a hustoty vidieckeho osídlenia. Najvýznamnejšia štatistická korelácia bola medzi lesnou pokrývkou a hustotou obyvateľstva.

Najväčšia stabilita rozlohy lesa bola charakteristická pre lesy v kráľovskom alebo cirkevnom vlastníctve pred delením Poľska, potom pre lesy v štátnom vlastníctve kým Poľsko znovu nezískalo samostatnosť a pre štátne lesy v medzivojnovom období a po druhej svetovej vojne. Naproti tomu sa zdá, že súkromné vlastníctvo bolo spojené s najväčšou stabilitou rozlohy ornej pôdy.

Táto štúdia potvrdzuje tézu, že ľudská činnosť bola hlavným faktorom zmien vidieckej krajiny v študovanom 200-ročnom období. Najväčší vplyv na modifikáciu (zníženie alebo zintenzívnenie) prebiehajúcich zmien mali však prírodné podmienky.

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