THE ANALYSIS OF CONTEMPORARY LAND TRANSFORMATIONS IN THE „SŁUPIA VALLEY” LANDSCAPE PARK: ITS APPLICATION FOR ENVIRONMENTAL MANAGEMENT

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Introduction

The research on changes in the natural environment, as well in the past as in the present time is a basis for defining its actual status and enables to predict the further landscape development which depends on the degree of increasing or decreasing anthropopression. The necessity of performing such studies is proven by numerous studies, e.g. Bartkowski (1977), Starkel (1988), Kostrowicki, Plit, Solona (1988) et al. These kinds of research, of different level of detail minuteness, usually cover one or a few components of the natural environment and depend on authors scientific aims.

One of the least stable elements of the natural environment, which are due to the fastest change, is land use. Knowledge of the spatial changes of the land use lets us to describe the dynamics and directions of transformations taking place in the natural environment as a result of human activity. Recognition of these changes provides an opportunity to create a reliable prediction of the status of the environment based on a certain scenario of the further anthropopression (compare Kozacki, Kowalewski, Matuszyńska, Rosik, 1994).

The use of land is highly dependent on arrangement of the natural environment components. According to Richling (1996), they should be regarded as an element modifying the natural, environmental systems and as the simplest indicator of the human influence upon the landscape.

A careful recognition of current changes in the ways the land is used, as well as the quantitative and qualitative analysis of them, combined with the knowledge of the natural determination of the areas, may be extremely useful in the process of shaping the environment and in planning of the future optimal way of using the space, in accordance with special functions of a given area.

Study area

The research object is the Landscape Park „Słupia Valley”, with its area of 370.4 km².
According to the physico-geographical division of Poland by Kondracki (1994), it covers fragments of three mezoregions: Polanów Upland Plaine, Słupsk Flat Plain and Bytów Lake District (see Fig. 1). The park’s aim of protection is the catchment area of the middle part of the Słupia river and the heads of the Łupawa river. The length of Słupia river that floats through the park is 64 km (its total length is 138.6 km).

Features of the analyzed research area are characteristic for the last glaciation, with a young glacial and very diversified relief, which determines its landscape and scenery attractiveness to a great extent. The absolute height varies within a range of 20 to 150 m above sea level.

The present organization of the area surface is an effect of ork of the continental glacier and of subsequent processes. The landscape is predominated by morainic plateau, cut with numerous glacial channels and denudation an erosion fissures (Florek, 1991). The Słupia Valley and the numerous channel lakes are accompanied with flat areas of sand and inland dunes. The northwestern and eastern parts are prevailed with flat and wavy plateaux of the ground moraine of little denivelation of the terrain. The highest culminations of frontal moraines are present in the south and middle parts,
where they are high up to 150 m above sea level.

The richness of fauna and flora are determined by the geomorphologic, soil and climate conditions. At present, over 73% of the area are covered with woods. The arable land took up 12%, grasslands 8.5%, marshy zones and water 6.3% and built-up zones 1.2% of the area.

**Aim and methods**

This paper is one of the stages of the study on the transformations of the structure of land use in the area of the Landscape Park „Śluśia Valley” in the past 120 years. Its aim is to present general tendencies of changes in the land use which appeared starting from the middle of the 19th century (since 1875) until the nineties of the 20th century, with special reference to contemporary transformations of the landscape of the examined area. The study attempts to indicate in what way the obtained information and the research results may be utilized for the landscape management and planning of various functions, resulting from natural conditions of the area, and the aims of the landscape park imposed by the law.

The analysis of the predominant changes in the chosen period of time, combined with careful characteristics of the current transformations, which appear as numerous and vast areas of uncultivated land and fallow on previously arable land, was used to formulate proposals for the development of these questionable areas.

Examining the dynamics of change in land use in the years 1875 – 1981, the method of cartographic analysis was used, which was a comparison of ranges of each type of land use as specified on old and contemporary topographic maps in the scale 1:25 000. The method of such a historical comparison analysis of old maps coming from various times but all in same scale has been used more and more extensively by many scientists (Plit, 1990; Tollin, 1996 et al). Due to this method, it is possible to reconstruct the preceding state of the landscape, to recognize direction of transformations and their dynamics, and subsequently to create a reliable prediction regarding the future development of the landscape.

The initial state chosen for the research on land use changes in the area of the Landscape Park „Śluśia Valley” was the second half of the 19th century, precisely - 1875. This year, Prussian topographic maps in the scale 1:25 000 were issued. These are the oldest maps of such a big scale and of such a high degree of detail minuteness, covering the whole examined area. The scale of 1:25 000 was adopted for analysis of the changes in land use within the area of the present landscape park in all examined time periods.

The next research material are German topographic maps issued in the first half of the 20th century, i.e. 1939 – 1942, also in the scale of 1:25 000. These maps have been prepared basing on the topographic base maps coming from 1875 – 1891 and subsequently updated, basing on the investigation on the location. As a result, these maps represent the state of land use of that time, much different from the preceding one (over 60 years earlier).

Another cartographic material were contemporary Polish maps 1:25 000,
dated 1981, presenting the state of the area in 1976. The accuracy of them is much lower than the previous ones because they had been made by technique of cartographic magnification of maps in the scale 1:50 000.

The most up-to-date source of information about present ways of land use was remote sensing. In this paper panchromatic and color aerial photos in the scale 1:26 000 in 1995 – 1997 were used. They were supplemented with color ground photographs, made on location for chosen segments of the research area. First of all, they document these segments that, as a result of the economy transformation after 1990, are about to be subject to changes in the way of use. At present, however, they remain temporarily unused as fallow and uncultivated land.

To satisfy the research aims, the following classes of land use have been distinguished: woods, marsh zones (swamps, peat bogs), permanent grassland (meadows and grassland), arable land, waters, built-up zones. Areas of all these types of land use have been measured on maps with polar compensation planimeter. The obtained results concern three periods of time: 1875 – 1939, 1939 – 1976, and 1976 – 1996.

**General trends of changes in land usage in 1875 – 1990**

In 1975 – 1996, in the territory of the today’s Landscape Park „Słupia Valley” on more than 65% of the area there were apparent changes in land use. The main direction which may be observed is transformation of agricultural area into woods (Flis, 1998). In 1877 within the current border of the landscape park, the woods were 44.9% of the total area. Between 1875 and 1939, there was an increase in woods area by 10.9%, between 1939 and 1976 – by another 9.8% and by 1981 – by 5.7%. Presently, the woodiness of the park amounts to more than 73% of the area and is increasing. Simultaneously, with the increase in the wooded area, a decrease in the agricultural area was observed: from 43.1% in 1875 to 31.7% in 1939, to 17.4% in 1976, and 12.3% in 1981 (see Fig. 2).

Furthermore, in the territory of the Landscape Park „Słupia Valley” in the examined period, there was a continuous decrease in marsh zones (swamps and peat bogs): from 3% in 1875 to 2.3% in 1939, then, to 1.6% in 1976, and 1.3% in 1981. Increase in meadow and grassland area was also observed. In 1875, permanent grassland occupied 4.3% of the territory while in 1981 – 8.5%. The reasons for such a direction of changes were undoubtedly numerous actions for land improvement carried out in all examined area before 1945. The aim for this was to obtain land for meadows and grasslands, which was related to changes in the economy directions in this area. As the natural conditions were unfavorable for plant production (varied relief, poor soil), the area of arable land was gradually decreasing, while simulta-neously, people searched for territories suitable for animal grazing (sheep, cattle, horses). That is why, as a result of drainage in the examined period, there existed an apparent increase in permanent grassland. At present, its area is similar to one in 1981.

Less intensive changes regard settlement in the examined area. Since 1875 little increase in settlement area has been observed: from 1.2% to 2% of the total area. In 1875 – 1939, this was related with development of existing households and farms.
and with raising of water power stations on the Słupia river. After the war, till 1976, the increase in built-up area was caused by creating of state-owned farms and by simultaneous development of recreational centers on lakes. Since the mid-eighties little decrease of built-up area may be observed.

The quantitative analysis of changes in the land use structure is presented in Table I. The predominating trends are shown on Fig. 2.

**The analysis of contemporary land transformations since 1990**

The tendency of increase in woods area, registered since the second half of the

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**Table I. Changes of land use during 1875-1939-1976-1981 in „Słupia Valley” Landscape Park ( percentage in total area )**

<table>
<thead>
<tr>
<th>Land use types</th>
<th>1875</th>
<th>1939</th>
<th>1976</th>
<th>1981</th>
<th>1875-1939 increase(+) decrease(-)</th>
<th>1939-1976 increase(+) decrease(-)</th>
<th>1976-1981 increase(+) decrease(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forests</td>
<td>44.86</td>
<td>55.75</td>
<td>66.81</td>
<td>72.0</td>
<td>+10.89</td>
<td>+11.06</td>
<td>+5.19</td>
</tr>
<tr>
<td>Swamps and peatbogs</td>
<td>2.95</td>
<td>2.25</td>
<td>1.32</td>
<td>1.6</td>
<td>-0.7</td>
<td>-0.93</td>
<td>+0.28</td>
</tr>
<tr>
<td>Meadows and grasslands</td>
<td>4.27</td>
<td>5.19</td>
<td>5.81</td>
<td>8.5</td>
<td>+0.92</td>
<td>+0.62</td>
<td>+2.69</td>
</tr>
<tr>
<td>Water areas</td>
<td>3.66</td>
<td>3.52</td>
<td>3.73</td>
<td>3.9</td>
<td>-0.14</td>
<td>+0.21</td>
<td>+0.17</td>
</tr>
<tr>
<td>Arable lands</td>
<td>43.08</td>
<td>31.74</td>
<td>20.41</td>
<td>12.3</td>
<td>-11.34</td>
<td>-11.33</td>
<td>-8.11</td>
</tr>
<tr>
<td>Build-up areas</td>
<td>1.18</td>
<td>1.55</td>
<td>1.92</td>
<td>1.7</td>
<td>+0.37</td>
<td>+0.37</td>
<td>-0.22</td>
</tr>
</tbody>
</table>

Based on the authors cartometric measures (with use of a polar compensation planimeter)
19th century in the area of contemporary landscape park, is still observed. In 1990/1991, as a result of transformation of economy and ownership of the state-owned farms, subsequent decrease in arable land was found in the park and its protection zone.

Due to abandoning cultivation and dropping out of many agricultural areas, fallow appeared (see Fig. 3). Since 1996, when the on-location observations were started, a systematic growth of such areas is observed. In proceeding years (up to and including 1999), gradual appearance of new fallow was observed, which occupied bigger and bigger areas of arable land. At present, they occupy approximately 2% of the research area, i.e. almost the same as the built-up or marsh zones (swamps, peat bogs).

Distribution of the registered fallow and uncultivated areas in the investigated

Fig. 3. Distribution of fallow lands on the area of „Slupia Valley” Landscape Park in 1999. 1- border of Landscape Park „Slupia Valley”, 2- border of its protection zone, 3-border of Slupsk Province, 4-main roads, 5-minor roads, 6-railway line, 7-forests, 8-build-up area, 9-running and standing water, 10- fallow and uncultivated lands, 11-recreation centers.
A. Flis

fragment of the Landscape Park „Slupia Valley” is presented on Fig 3.

Because of high number of fallow spots and their constant growth, it was decided to keep records of them. According to an agreed pattern, presented in Tab. II, these areas were described with regard to the following characteristics: area, location, relief, soil and agricultural features, type of plant cover and the way their surroundings are used. Basing on the above description, a way of their development was proposed and functions in the landscape were defined.

The size of registered fallow varies from 1.7 ha to 166 ha (see Tab. II). They appear on podsollic and brown soils (acid and leached). In most cases, they are related with the areas of the poorest soil complex (6 and 7). Partly, on few spots, there exist areas of good soil, of 4 and 5 soil complex. The analyzed fallow areas are located on uplands or slopes and they border directly with woods. A natural succession of greenery (grass, weeds, herbs) and woods is observed on them. In this case the pioneer species are pine and birch.

The process of natural flora succession, developing towards woods on some areas is quite intensive (see Fig. 4 A, B). On the spots where young seedlings of pine and birch appeared as soon as the cultivation was dropped, we may already see a few-year-old trees, unequally spread. The analysis of changes taking place on fallow land, in the initial phase and in consequent stages, is presented in Fig. 4. Depending on kinds and intensity of the wilding and other features, for each area optimal ways of development were proposed (see Tab. II).

The last column in Tab. II describes landscape functions which will be carried out by each area, after their ways of use are changed. Change of landscape functions is the combination of two approaches in landscape ecologoical research (compare Bastian, 1990):

- Landscape changes resulting e.g. from changes of land use. They concern elements of the landscape and may be observed visually. Because of them the individual, ecological properties of the landscape are changed.
- Natural potential, i.e. natural conditions, characteristic for a given area, its biotic and abiotic conditions.

The final function to be performed by a given segment of the area is a result of, firstly, changes which already exist, secondly, natural conditions of a given area which determine a way of natural development of the landscape and finally the economic and social needs of a man who shapes the landscape. The proposals of development of each fallow and uncultivated land, presented in Tab. II, were tried to take into account all elements listed above, as they decide on optimal functions of these areas.

Conclusions

The results of the research of the land use presented in this paper in the area of the Landscape Park „Slupia Valley”, with special emphasis on the currently happening landscape transformations made it possible to perform a quite detailed analysis of the areas that are most questionable - in terms of their future use - fallow and uncultivated land.
### Table II. Registration of fallow lands in the area of „Slupia Valley” Landscape Park in 1999 – description (examples)

<table>
<thead>
<tr>
<th>No.</th>
<th>Area size [ha]</th>
<th>Location</th>
<th>Soil and agricultural properties</th>
<th>Natural succession</th>
<th>Immediate surroundings</th>
<th>Suggestion of management</th>
<th>Immediate surroundings</th>
<th>Suggestion of management</th>
<th>Landscape function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20,1</td>
<td>Kwakowo village</td>
<td>Flat ground, gently sloping up S-E; height: 33-37 m above sea level., (s)</td>
<td>6 AB, 7AB</td>
<td>Short grasses, singular pine seedlings</td>
<td>N, W- forest; E - road, forest, buildings, S -buildings, grasslands</td>
<td>Farm buildings and residential housing ( rural settlement )</td>
<td>Settlement function</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>6,0</td>
<td>To the South of Kruszyna village</td>
<td>Lightly rolling country, medium height: 45 m above sea level (s)</td>
<td>7 AB</td>
<td>Short grasses, singular pine seedlings</td>
<td>N- buildings, forest E, S - forest, W – road, meadow, buildings,</td>
<td>Leaving vegetation succession</td>
<td>Ecological function</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>37,0</td>
<td>Near the road leading to Żelkówko village</td>
<td>Rolling country, sloping up N-W, height: 77-100 m above sea</td>
<td>6 AB, 5 Bw</td>
<td>Short and high grasses</td>
<td>fallow N- forest, field, E - field, wet scrub, S - forest, W – road, forest,</td>
<td>Restoration of agricultural production</td>
<td>Agricultural function</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>4,1</td>
<td>Near the road from Kruszyna to Suchorze village</td>
<td>level, (u) Rolling country, sloping up N-W, height: 80-87,5</td>
<td>6 AB</td>
<td>Short grasses</td>
<td>fallow N, S, W – forest, E-road, fallow</td>
<td>Reforestation</td>
<td>Ecological Soil-protective Water</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>15,5</td>
<td>Near the road from Dębnica Kaszubska to Niemczewo village</td>
<td>m above sea level (u) Flat ground, height: 85-110</td>
<td>7 AB</td>
<td>Short and high grasses, weeds, not numerous</td>
<td>N, E - forest, S – forest, meadow, W</td>
<td>Recreational</td>
<td>Recreation</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Code</td>
<td>Description</td>
<td>Feature</td>
<td>Function</td>
<td>Potential Use Case</td>
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<tr>
<td>6.</td>
<td>22,6</td>
<td>To the North-East of Niemczewo village</td>
<td>Rolling and hilly ground, sloping up S-E, height: 95-122 m above sea level, (u)</td>
<td>6 AB</td>
<td>Short and high grasses, singular pine seedlings</td>
<td>N, W - forest, S – road, forest, E - meadow</td>
<td>Reforestation</td>
<td>Ecological Soil-protective Water protective Erosional prevention</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>166,0</td>
<td>To the South-West of village and to the West of Goszczyno village</td>
<td>Rolling and hilly ground, height: 85-121 m above sea level, slopping up N-E, (u)</td>
<td>6 AB, 5 Bw</td>
<td>Short grasses, singular pine seedlings</td>
<td>N, W, S - forest; E – grasslands, fields, buildings</td>
<td>Restoration of agricultural production</td>
<td>Agricultural function</td>
<td></td>
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<tr>
<td>8.</td>
<td>19,1</td>
<td>To the North of Suchorze village</td>
<td>Rolling and hilly ground, height: 110-125 m above sea level, (u)</td>
<td>5 Bw</td>
<td>High grasses, intensive succession of several years old pines and birches, irregularly</td>
<td>N, E, S- forest, W – road, fallow</td>
<td>Restoration of agricultural production</td>
<td>Agricultural function</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>3,4</td>
<td>Mielno village</td>
<td>Flat ground, sloping up W, height:</td>
<td>4 Bw</td>
<td>distribution on the area</td>
<td>High grasses, intensive succession of several years</td>
<td>N- forest, E – field, S – orchard, meadow, W – road, orchard</td>
<td>Restoration of agricultural production</td>
<td>Agricultural function</td>
</tr>
<tr>
<td>10.</td>
<td>13,5</td>
<td>To the North-West of Gałąźnia Wlk. Village</td>
<td>Rolling ground, height: 135-140 m above sea level, (u)</td>
<td>6 AB</td>
<td>old birches</td>
<td>N – road, forest, E - scrub,</td>
<td></td>
<td>Ecological</td>
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<tr>
<td>11. 1,7</td>
<td>Near by the road from Gałąźnia Wlk. to Motarzyno village</td>
<td>Rolling ground, height: 135 m above sea level, (u)</td>
<td>6 AB</td>
<td>Short grasses</td>
<td>N, E - fields, S - grasslands, W - forest</td>
<td>Leaving vegetation succession</td>
<td>Ecological function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. 54,2</td>
<td>To the North-West of Gałąźnia Mł. Village</td>
<td>Rolling ground, height: 55-100 m above sea level, slopping up to Słupia river valley (s)</td>
<td>6 AB, 7 AB</td>
<td>Short and high grasses, weeds, herbs</td>
<td>N - grassland, forest, E – forest, S- scrub, grasslands, buildings, W – wet bushes</td>
<td>Restoration of agricultural production</td>
<td>Agricultural function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. 4,8</td>
<td>To the North-East of Darskowo village</td>
<td>Flat ground, gently slopping up E, height: 125-130 m above sea level (u)</td>
<td>6 AB</td>
<td>Short and high grasses, weeds and shrubs</td>
<td>N- forest, E - fields, S</td>
<td></td>
<td>Ecological Soil-protective Water -</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(u) - upland (s) – slope
soils: AB – podsolic and brown soils, Bw – brown soils (acid and leached), 4 – wheat and rye soil complex (very good ), 5 – rye and potato soil complex (good ), 6- rye and potato soil complex ( poor), 7 – rye and lupin soil complex (poorest)
Fig. 4. A. The example of the analysis of landscape in initial phase of transformation.
B. The following phase of formerly arable landscape transformation.
The research methodology, using for analyses archival and up-to-date cartographic materials plus on-site observations documented with numerous photographs, let us to recognize general tendencies of the land use transformations in a very broad time, i.e. within the past 120 years. The recognized trends constitute very important background of the current landscape transformations. First of all they inform us in what way the land was used in the past and what was the rate of the sequential changes.

These data proved to be extremely beneficial in establishing of an optimal future way of use and development of the analyzed segments and whole area of the „Słupia Valley” Landscape Park.

References


Mapa glebowo-rolnicza województwa słupskiego w skali 1:100 000 (1986). Zakład Gleboznawstwa i Ochrony Gruntów IUNG, Puławy.

