Contemporary Problems of Management and Environmental Protection
Vol. 3, 2009. Natural and Cultural Transformation of Landscape: 67-82

CHAPTER 6

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INFLUENCE OF SOIL CONDITIONS ON LANDSCAPE SHAPING IN RURAL AREAS

Introduction

The issue of landscape shaping in rural areas in local planning documents – in local studies of conditions and directions of spatial planning, as well as in local development plans, is treated in a very general and superficial manner. Landscape shaping, which is one of the aims of multifunctional development of rural areas, should be effected during land consolidation processes. This paper focuses on the influence of soil conditions on the development of rural areas by stimulating non-agricultural functions (e.g. tourism development). Analysis of soil conditions, performed on the basis of cartographical and descriptive materials, should constitute the basis for working out a concept for landscape shaping in the guidelines for land consolidation plans.

The issue of landscape in local planning documents

The main instruments for performing the principles of local spatial policy are local development plans and, precedent to adoption thereof, local studies of conditions and directions of spatial planning. The scope of these documents is set forth in the act of March 27, 2003 on spatial planning, as well as in enforcement provisions. However, the documents referred to above deal with the issue of landscape shaping in a very superficial manner. Local development plans, which are local normative acts, are drafted solely for certain areas designated in the prior studies, which are usually built up areas. With respect to agricultural areas only very general recommendations are usually presented in local studies of conditions and directions of spatial planning, which do not set forth the principles of rural landscape shaping. This results from the range of the said studies. Many authors (e.g. RASZEJA, 2000, Kowicki 2005) express the view that within the collective consciousness there is no conviction that rural landscape constitutes a special value, worthy of protection and preserving, that

should be addressed and treated in a complex and integrated manner. The undertaken protective actions with respect to countryside landscape (expressed in planning documents) are usually limited to statutory protection of insular areas: historic buildings and complexes thereof, areas of great natural interest. The fact that little attention is paid to the issue of countryside landscape shaping results in gradual degradation of landscape. RASZEJA (2000) lists the following main adverse occurrences, which threaten spatial order of rural areas:

- deterioration of historical settlement structures (e.g. by incautious location of built up areas),
- deformation of historical planning of villages due to uncontrolled spatial development thereof, disappearance of landscape specificity of villages,
- appearance of new spatial forms in countryside landscape that are alien to such landscape (housing estates typical for towns/cities),
- unification of village architecture, implementation of town/city architectural standards, which are not adjusted to the rural way of life,
- devastation of historic buildings and complexes thereof, as well as of other distinctive elements of rural space (small architecture items: shrines, roadside crosses, etc.),
- unification of landscape structure resulting from modernisation of agricultural production (cutting down of trees and shrubs, draining, filling in of small water basins in the fields, etc.).

Modern land consolidation processes against a background of the concept of multifunctional development of rural areas

The main instrument for shaping spatial structure of rural areas is land consolidation process. Land consolidation is a cyclical process. Divisions of land in rural areas result mainly from the principles of inheritance law and cause gradual fragmentation of agrarian structure of Polish villages.

Land consolidation conducted in Poland and in other European countries has its tradition. The first consolidation processes in Poland took place over 700 years ago (TRAUTSOLT, 1985).

Consolidation process is regulated by the Act of March 26, 1982 on consolidation and exchange of lands. Consolidation and exchange proceedings are conducted by starost (*starosta*, head of second level

of local government administration in Poland) as a task within the scope of government administration. Consolidation plans are drafted by specialized geodetic units. The aim of land consolidation, as set forth in the act referred to above, is „to create more advantageous conditions for agriculture and forestry by improving spatial structure of farms, forests and afforested lands, rational shaping of cropland expanse, adjustment of boundaries of real estate to networks of irrigation facilities, roads and the lie of the land". The aim thus defined emphasizes the improvement of economic conditions for agricultural activity pursued in farms. Land consolidation processes, conducted on a large scale after World War II, and related liquidation of sites of no capacity for agricultural production (forestations, shrubs, waste lands), resulted in significant simplification of countryside landscape structure and consequent deterioration of biodiversity.

However, the influence of the sustainable development concept, which constitutes the basis for the majority of policies and programs that have been introduced in recent years, affected the approach to issues connected with transformation, by way of consolidation-exchange processes, of rural areas structure in Europe. The principles of sustainable development have important implications for perception, interpretation and shaping of the space: the space has been recognized as a limited value. It has been assumed that the needs of contemporary man have to be satisfied by use of the existing spatial reserves and sustainable management thereof. It has become necessary to change the way of perceiving rural areas only as a place for food production. In the European Union member states sustainable development of such areas as means of conveying nature, historical and cultural values is emphasized (PUŁECKA, 2004).

At present, the concept of multifunctional development of rural areas, as accepted in Europe, results in significant spatial transformations. Multifunctional development consists of skilful integration into the rural space of new, non-agricultural functions. However, this may result in gradual deterioration of landscape due to uncontrolled development of rural areas. It is agriculture, which has always had the main influence on the shape of rural areas. Traditional landscapes, shaped over centuries, have deteriorated over the last several dozens of years. The scope and pace of current and contemplated transformations of spatial, social, economical and

ownership structure of rural areas may result in diverse spatial-landscape conflicts. The object of contemporary anxieties is not the process of landscape transformation in itself, which is a natural consequence of social and economical development. However, there are warnings about the pace and scale of such transformations. In fact, the main function of rural areas, which is agricultural production, will be gradually diminished and will give way to other functions (e.g. to those connected with development of farm tourism). However, it is important that those new functions should not destroy the already upset landscape harmony and ecological balance. It is accepted that correctly shaped landscape may provide conditions for multifunctional development of rural areas and thus for creating additional sources of income for the population of such areas (recreation, tourism).

Consolidation and exchange of lands are supposed to be of great importance for contemplated concepts for multifunctional development of Polish countryside. It is estimated that 2 million hectares of land require consolidation. The greatest need for land consolidation processes may be observed in the south-eastern and central part of Poland.

Shaping of countryside landscape by way of land consolidation processes

Much attention has recently been paid to the influence of land consolidation processes on natural environment. The Act of October 3, 2008 on providing access to information on natural environment and its protection, on society participation in protection of natural environment and on assessment of the impact on natural environment, lists land consolidation among undertakings that may have significant impact on natural environment and provides for the obligation to obtain administrative decision on environmental factors prior to issuing a decision on approval of land consolidation or land exchange plan (Art. 72 Section 1 item 8). A list of actions that are taken during a land consolidation process and their potential impact on natural environment was presented by WOCH (2006).

Consolidation works, which change the ownership structure, provide exceptional possibility to take actions aimed at shaping countryside landscape. Shaping of landscape during the land

consolidation process is effected mainly by creating spatial and legal conditions for desired forms of land use.

The issue of landscape shaping during a land consolidation process may be understood very broadly. The scope of issues is determined by the assumed definition of landscape. If the landscape is perceived in line with the European Landscape Convention (2000), which defines landscape as an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors, thus emphasizing the value of landscape, as a result of natural and cultural phenomena of differentiated structure and dynamics of transformation, as perceived by individuals and societies from the perspective of diverse local, regional and national cultures, then the issue of landscape shaping during the land consolidation processes will not pertain solely to natural aspects of landscape functioning, as a natural system, but also to aesthetic, cultural, social and economical aspects of the space, connected with implementation of the sustainable development concept. Theoretical aspects of the issue of landscape shaping during the land consolidation process are discussed in detail by PUŁECKA (2004).

In this paper the authors focus on issues connected with influence of soil conditions on shaping structure of countryside landscape. The scope of issues covered by consolidation plans, which constitute elements of village development plans, includes *inter alia*:

- conservation of existing landscapes of special natural values and setting out of rules for their exploitation for tourist and recreation purposes,
- improvement of water conditions and water management in areas subject to consolidation (e.g. creation of small retention reservoirs),
- adjustment of the manner of land use to natural conditions (soil quality, the lie of the land),
- introduction of plots and fields structure, which enables cross-slope cultivation in areas threatened by water erosion,
- forestation of lands that are barely useful for agricultural production,
- introduction of forestations and shrubs into the agricultural production environment in order to prevent wind erosion of soil

and to protect biological diversity (creation of ecological patches and corridors),
- introduction of strip turfings and shrubs as biogeochemical barriers preventing eutrophication of waters,
- creation of road networks for the purpose of agricultural transport, taking into consideration the lie of the land (prevention of soil erosion).

Influence of soil conditions on landscape shaping

Quality of landscape is determined by a significant degree by soil factors, the lie of the land and hydrological conditions. Agricultural quality and suitability of soil impacts the development of rural areas and their functions. Therefore, diligent inventorying and evaluation of soil conditions is vital for the purposes of land consolidation process.

Sources of information about soil conditions

The basic cartographical and descriptive materials, which deal with soil conditions, include:
- soil classification (valuation) maps at a scale of 1 : 5,000,
- soil-agricultural maps at a scale of 1 : 5,000 and 1 : 25,000.

Most of the classification maps were drafted in the period from 1957 through 1964 for the whole territory of Poland, as a result of general classification of lands performed under uniform principles. Currently, soil scientific classification of soils is one of the main elements recorded in lands and buildings register documentation and is kept updated.

Besides the data comprised by classification maps (i.e. type, subtype and kind of arable land, soil quality class, family and textural group) soil-agricultural maps include substantial information about land capability units that constitute sites in the agricultural production environment. Regrettably, provisions of law currently in force do not provide for obligatory updates of soil-agricultural maps.

Both classification and soil-agricultural maps at a scale of 1 : 5,000 provide useful information about soils for the purposes of drafting local development plans and consolidation plans.

For the purposes of local studies of conditions and directions of spatial planning information about soil conditions may be derived

from soil-agricultural maps at a scale of 1: 25,000. The said scale facilitates general inventorisation and valuation.

Soil quality and conditions for multi-functional development

Adjustment of the desired manner of arable lands exploitation to natural conditions, so that the lands exploitation looses its negative impact on natural environment, is feasible after prior assessment of soil quality and agricultural suitability.

Soil conditions have impact on isolation of the following areas in agricultural production environment:

- areas of sustainable agricultural production, which takes into account ecological, economical and social conditions,
- areas periodically used for agricultural purposes,
- arable lands designated for transformation.

As a rule, areas of sustainable agricultural production should incorporate soils of quality classes I through IVa and of land capability units 1 through 4 (1 – very good wheat, 2 – good wheat, 3 – imperfect wheat, 4 – very good rye). In these areas combined fruit farming areas should be located, due to specific management and conservation methods applicable to such areas. Fertilizers and pesticides are supposed to be used in such areas and, therefore, it will be necessary to provide insulating strips along water-courses. Furthermore, lands should be protected against erosion by limiting surface flow and retention of water (WILKOWSKI, SOBOLEWSKA - MIKULSKA, 2002).

It is assumed that areas periodically used for agricultural purposes should incorporate soils of quality classes IVb through V and of land capability units: 6 – weak rye, 8 – good grain-fodder (over moist), 9 – weak grain-fodder (over moist). Farms that specialize in production of ecological food may be created in such areas. For the purposes of determining the manner of use for soils of 6th land capability unit several issues need to be considered, in particular localisation, agroecological conditions, structure of agricultural lands, especially relationship between arable lands and greenlands, influence of industrial pollution, soil improvement potential by way of agromelioration efforts, farming culture, demographic conditions and regional needs (SKŁODOWSKI, SZAFRANEK, BIELSKA, 2004). Research conducted over many years with respect to development prospects for farms in Kurpiowska Basin proves that cultivation of soils of quality

classes V and VI and of 6th (weak rye) and 7th (very weak rye) land capability units allows to have a satisfactory crop in those farms, in which the share of meadows and pastures in the structure of agricultural lands amounts to 30-50% (PROKOPOWICZ, 1997; (PROKOPOWICZ, OKRUSZKO, 1997). Assessment of recreational and tourist attractiveness of bigger areas is effected taking into account diversity of the lie of the land, forests, occurrence of waters, flora (HOPFER, CYMERMAN, NOWAK, 1982). For the purposes of evaluation of deforested areas the following should be considered: soil management, adjacent waters and the vertical lie of the land. Usefulness of the soil layer for tourist and recreational purposes was assessed taking into consideration soil class, family and textural group. Higher values have been attributed to light mineral soils, minimal – to organic soils, in particular hydrogenic ones, which are of little usefulness for tourism and recreation (HOPFER, CYMERMAN, NOWAK, 1982).

Transformation of agricultural lands is considered in two directions: arable lands into greenlands and arable lands into forests. If the structure of land development in a given area so requires, soils of 8th (good grain-fodder) land capability unit can be transformed into good quality greenlands, while soils of 9th (weak grain-fodder) into greenlands of poorer quality. Crops yielded by greenlands, after transformation from 9th unit, depend strongly on rainfall and fertilization intensity. In dry periods and in dry places such greenlands require irrigation, otherwise turf may rapidly dry up and growth of flora mass may drop (JASIŃSKI, PRZYBYŁOWSKI, 1995).

According to MRiRW guidelines with respect to determining rural-forest boundary (MRiRW, 2003) the following should be designated for forestation: arable lands of RVI class, classified into 7th land capability unit, as well as arable lands of R-V class, which do not allow for effective farming, classified into land capability unit, pastures of Ps-VI class, located in areas of low level of ground waters and adjacent to forest complexes.

Characteristic of the area subject to research

The subject of the research was Zaręby Kościelne commune (*gmina*, first level of local government administration in Poland) in Ostrów Mazowiecka *powiat* (second level of local government administration in Poland). The said commune is of agricultural

character, lies in drainage area of Bug River, where rivers and water courses flow from the north-east to the south-west. Waters from the southern part of this area flow directly to Bug River, while in the remaining part there are three rivers, Brok, Brok Mały and Wągrodka, which merge in the western part of the commune into one river, Uroczysko, a direct tributary of the Bug River. The southern part of the commune, which consists of grasslands and waste lands in immediate vicinity of river curves, is a part of Nadbużański Landscape Park.

Rusty soils, predominatingly formed from sands, with a shallower or deeper underlayer of loose sand, dominate in the commune area. Lessive soils constitute only 30% of the total area and are mainly located in the northern part of the commune. Furthermore, in smaller areas brown soils occur, appropriate and lixiviated, formed from loam or strong loamy sands on sandy clay loam. In topographic lows black earth soils and degraded black earth soils occur, formed from different materials. Finally, in river and water courses valleys alluvial, peat and half-bog soils occur in small amounts.

Land consolidation process in the area subject to research was effected in 1930-ties. Landownership structure of farms was arranged then and until now farms of several hectares (one or two plots) in area can be found. Nevertheless, due to a lapse of 50 years, changes in the agricultural policy and other factors, many small farms, particularly on poorer soils, gave up agricultural production and their lands are leased or lie fallow. Mechanization of agriculture and economical conditions result in decrease of the number of people directly involved in farming. Generally, villages in the area subject to research, like in whole Poland, cease to perform solely agricultural functions and gradually develop tourist, service and other functions. All these factors have impact on changes to the spatial structure of countryside. Evidently, there is need for complex consolidation processes, which should take into account not only arrangement of agricultural production environment, liquidation of the ensuing patchwork of fields and improvement of cropland expanse, but also (and particularly) improvement of work and living conditions of people living in the countryside, in close connection with protection of natural environment.

Influence of soil conditions on potential forms of spatial development

Evaluation of soils in the area subject to research was effected on the basis of analysis of soil conditions and existing cartographic and descriptive materials, as well as of field and laboratory investigations. In order to determine the optimal land use the following were taken into consideration: structure of use, structure of farms, as well as social and economical aspects. On this basis designation of lands for the following areas was suggested: areas of sustainable agricultural production, areas periodically used for agricultural purposes – lying fallow, areas designated for production of ecological food, agricultural lands designated for transformation of arable lands into forests and of arable lands into grasslands (SKŁODOWSKI, SZAFRANEK, BIELSKA, 2005).

For the purposes of landscape shaping it is important that development of sustainable agriculture, of intensive and developing production, should be concentrated in the northern part of the commune, while ecofarming combined with farm tourism should be concentrated in the southern part (illustration 1).

The northern part consists mainly of soils of 2nd (good wheat) and 4th (very good rye) land capability units – good soils – designated in the first place for integrated agricultural production. The 5th land capability unit (good rye) – medium soils – are distinguished by poorer fertility than units 2 and 4, but allow to have satisfactory crop if properly fertilized and skilfully cultivated. Soils of unit 8 constitute 5% and usually occur along rivers in the vicinity of greenlands, and, therefore, depending on the needs resulting from the structure of arable lands may be used for the purposes of sustainable production or designated for grasslands.

Areas designated for production of ecological food should comprise soils of 5th (good rye), 6th (weak rye) and 9th (weak grain-fodder) land capability units depending on agricultural market conditions. Physical and chemical properties of these soils indicate that use of organic fertilizers is sufficient to have a satisfactory crop.

In Zaręby Kościelne commune, in the southern part, adjacent to Bug River, around which Nadbużański Landscape Park has been established, it is possible to develop ecofarming, accompanied by farm tourism.

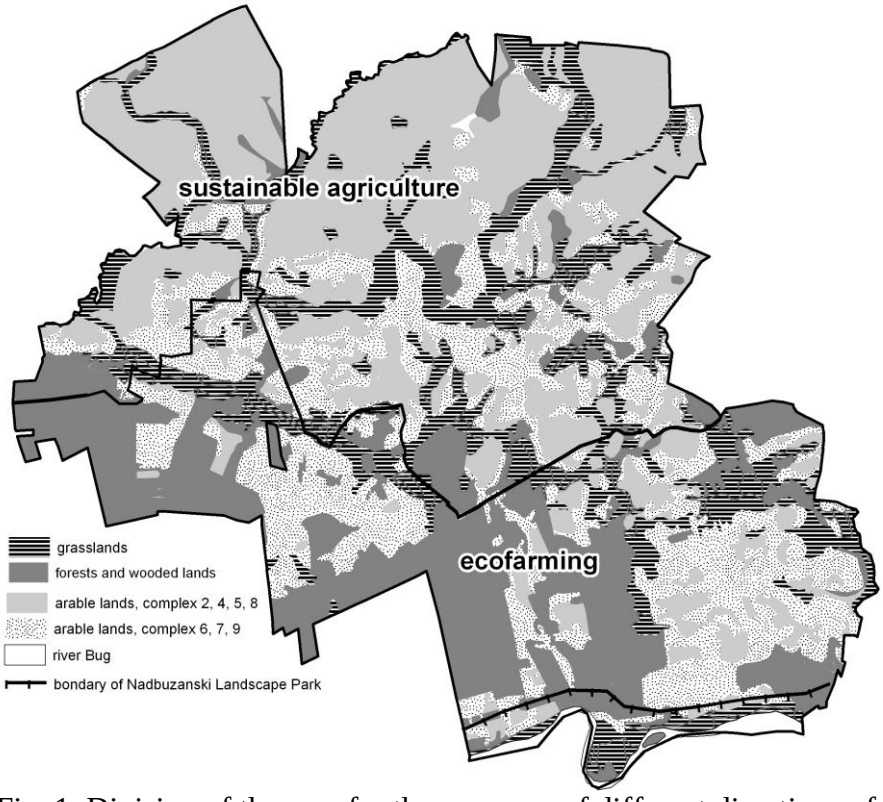

Fig. 1. Division of the area for the purposes of different directions of agriculture development

Source: Own data

For the purposes of the analysis 11 precincts have been chosen, of soil quality valuation and agricultural suitability ratio under 35. The said precincts are located in immediate vicinity of Bug River – Nadbużański Landscape Park, or among large (several dozen hectares in area) forest complexes. The manner of land use and spatial structure is showed in table 1.

The precincts subject to analysis are distinguished by high forestation, but low share of grasslands (up to 20%). Farms are small in area, usually more than 50% thereof and in some villages even more than 70% thereof are less than 10 hectares in area. Arable land is of poor and very poor quality. Theoretically, soils of unit 7 should be designated for forestation. However, due to the fact that in certain villages over 60% of arable lands are of unit 7, and notwithstanding this fact they are used for agriculture purposes, development of

ecofarming accompanied by farm tourism has been suggested for this area. In addition, gradual exclusion of soils of unit 7 from agricultural use and their designation for forestation or for the purposes of leisure and recreation has been suggested.

Table 1

Land use in the chosen geodetic precincts

District		Pow.	R	R	Ł	%Ł	Ls	% Ls	%<10	average
		1	2	3	4	5	6	7	8	9
1	Gąsiorowo	826.2	231.6	28	56.1	7	453.9	55	53	6.2
2	Kańkowo Piecki	149.5	54.4	36	0.0	0	93.2	62	76	5.2
3	Kępiste Borowe	477.1	256.0	54	61.5	13	115.4	24	50	6.6
4	Niemiry	382.0	171.8	45	50.8	13	144.2	38	76	5.2
5	Pętkowo Wielkie	379.0	173.6	46	50.1	13	137.9	36	55	6.0
6	Rostki Daćbogi	163.3	92.8	57	12.9	8	41.2	25	42	7.1
7	Zakrzewo Kopijki	494.7	264.7	54	100.1	20	78.3	16	60	6.4
8	Zakrzewo Wielkie	296.3	169.0	57	62.0	21	44.1	15	67	6.0
9	Zgleczewo Panieńskie	198.7	132.1	66	29.9	15	16.9	8	66	6.3
10	Zgleczewo Szlacheckie	212.5	138.4	65	16.3	8	35.9	17	85	4.9
11	Złotoria Stara	213.2	71.4	33	40.7	19	55.8	26	76	5.2

Pow. – total area of a precinct (*obręb*) *Source: Own data*
R – area of arable lands in a precinct
% R – percentage share of arable lands in total area of a precinct
Ł – area of grasslands in a precinct
% Ł – percentage share of grasslands in total area of a precinct
Ls – area of forests
% Ls – percentage share of forests in total area of a precinct
%<10 – percentage share of farms under 10 hectares in area
average – average area of a farm in a precinct

Nadbużański Landscape Park and its vicinity are distinguished by beautiful landscape, clear air and developing tourist accommodation. There are good conditions for development of farm tourism accompanied by ecofarming and, consequently, for creating job opportunities for local population.

Suggested guidelines for shaping structure of countryside landscape

Prior to commencement of a consolidation process, just like in other European Union member states, an inventory of landscape values of a given area has to be made. In such inventory natural landscape elements (e.g. plant communities and structures, escarpments, erratic boulders), as well as anthropogenic ones (buildings, edifices, small architecture items) should be listed. Natural or cultural borders, broader than administrative ones, which are borders of areas of land consolidation, as well as 'borders of perceived landscape', should constitute boundaries of areas subject to studies. The studies are aimed at recognition of natural structure of an area subject to consolidation and of natural connections of the said area with its broadly understood surroundings. A study should focus on those elements of natural environment, whose existence and development depend on decisions taken by a person, who drafts a plan of consolidation. It is also recommended to evaluate visual attractiveness of an area subject to consolidation by studying scenic connections and identifying "special places" in the landscape (Pułecka, 2004). Analysis of soil conditions, accompanied by inventory of landscape structures (e.g. roads, paths, roadside crosses, shrines) and of elements of significant natural value (e.g. field baulks with tall herb communities, existing strip forestations) and a study of scenic connections provide guidelines for landscape shaping within separate functions of a given area.

As regards areas of sustainable agricultural production, isolated within agricultural production environment, the most important actions with respect to landscape shaping comprise: replenishing of missing elements of ecological network, i.e. strip forestations of biocenotic and windbreaking functions, conservation of existing landscape structures of special natural value, introduction of strip turfings and shrubs as biogeochemical barriers preventing eutrophication of waters.

In areas designated for the production of ecological food, development of tourist function may additionally be stimulated, by introduction into the landscape structure of linear elements like foot, bike and horse hiking paths, as well as of spot elements like vantage points.

The following conclusions may be derived from the performed analysis:

1. Local development plans and local studies of conditions and directions of spatial planning deal with the issue of countryside landscape shaping in a manner that is too general and superficial.
2. Land consolidation process may constitute an effective way of shaping countryside landscape.
3. Existing soil conditions determine the forms of land use, which influences multifunctional development of rural areas.
4. Shaping of countryside landscape is dependent on existing functions of a given area.
5. Taking into account of soil conditions in guidelines for development of rural areas and for countryside landscape shaping facilitates sustainable development of a given area, improves its attractiveness and economical conditions.

Study financed from funds for scientific research for years 2007-2009 as a research project.

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