LANDSCAPE RESEARCH AND ITS APPLICATIONS IN ENVIROMENTAL MANAGEMENT

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LAND USE PLANNING POTENTIAL CONFLICTS AND LANDSCAPE STABILITY IN NORTH – EASTERN POLAND

Introduction

Landscape ecology methods have become more popular in environmental planning. In this particular project, methods of landscape potentials, assessments of potential landscape conflicts on a basis of potentials and methods of landscape structure analysis are used.

The author of this project has participated in the project of implementation of a sustainable development strategy for „Green Lungs of Poland." These „Green Lungs" consist of five voivodships (countries or states) of north-eastern Poland. The same area was also an example for the presentation of the methods described below.

Landscape Potential

The project area consists of roughly 20% of Poland. A basic assessment field had to be adopted either to its considerable size or to the basic scale of the project (1:200 000). An elementary catchment area was considered suitable for the purpose of future implementation of a planned environmental policy.

It is important that the area can be observed within relatively enclosed natural boundaries. Elementary catchment basins are ideal for these purposes. A watershed is this particular kind of zone where relations, occurred in a water cycle, are reduced and the water cycle is the most important factor in a lake district landscape (young glacial).

1325 elementary catchment basins have been identified within the area of „Green Lungs of Poland". Partial landscape potentials were assessed for all of these catchment areas. There are 4 classes of potential assessment, assumed as followed:

0 – no potential or a very low one,
1 – low potential,
2 – moderate potential,
3 – high potential.

Three groups of partial potentials, significant for further consideration have been distinguished, referring to potential conflicts in the landscape.

The first group consists of usable potentials like biotic yield, resources, settlement and recreational activities. The second group includes auxiliary potentials: water supply and atmospheric. The third consists of potentials conditioning a natural balance: biotic regulation and self-purification capacity.

The criteria or partial potential assessment are presented on the fig. 1.

Generally, the majority of units with high evaluated potentials appear in a zone of young glacial lake districts as opposed to older glacial districts. Only partly denudated highlands are evaluated with higher potential within the old glacial district. The lowest potentials occur on sandr plains, basin-bottoms and prevalley bottoms (Kurpiowska Plain and Biebrza Basin).

Potential Landscape Conflicts

A partial potential value is a point of departure for a potential conflicts power evaluation. Certain values of partial potentials' co-existing within the same elementary catchment basin can cause possibile landscape conflicts among objectives aimed at using landscape resources and values. The author of these studies adheres to the theory that the kind of conflicts where man is the main subjective to use a landscape as a conflict object and the main subject of applied landscape ecology research. Of course there are conflicts where man and the environment can both be subjects (i.e. a locust, as an element of biotic environment, destroys corn that has been planted by man), but they are rather objects of biological formulation of ecology researches.

These particular studies distinguished three types of potential landscape conflicts.:

1. situations which result from aiming at utilizable potentials exploitation and an awareness of the importance of the potentials for landscape balance;
2. situations which result from aiming at exploitation of different utilizable potentials;
3. situations which result from aiming at exploitation of recreational or settlement potentials not supported by relevant high auxiliary potentials (water supply and atmospheric).

A scheme of potential landscape conflicts power evaluation is presented on the fig. 2.

This power is dependent on the types and values of potentials, which eventually can be in collision. An increasing value of utilizable and biotic regulation potentials combined with a decreasing value of auxiliarity and self-purification capacity causes the strongest potential conflicts.

At this point a question can be asked. Why haven't potential conflicts between biotic yield and auxiliary potentials been analyzed? This could be quite reasonable on smaller areas in great scales. But in this case, the criteria of auxiliary potential evaluation were too general to enable an estimation of limits for agriculture and forestry management caused by these potentials.

As it is shown on the fig. 3, the frequency of elementary catchment basins with certain kinds of potential conflicts is differentiated. More often, conflicts can appear between a biotic regulation and a biotic yield potential, in other words there, where agriculture, forestry and fishery utilization of landscape can decrease its self-regulation abilities. More seldom potential conflicts are characteristic for pairs of potentials:

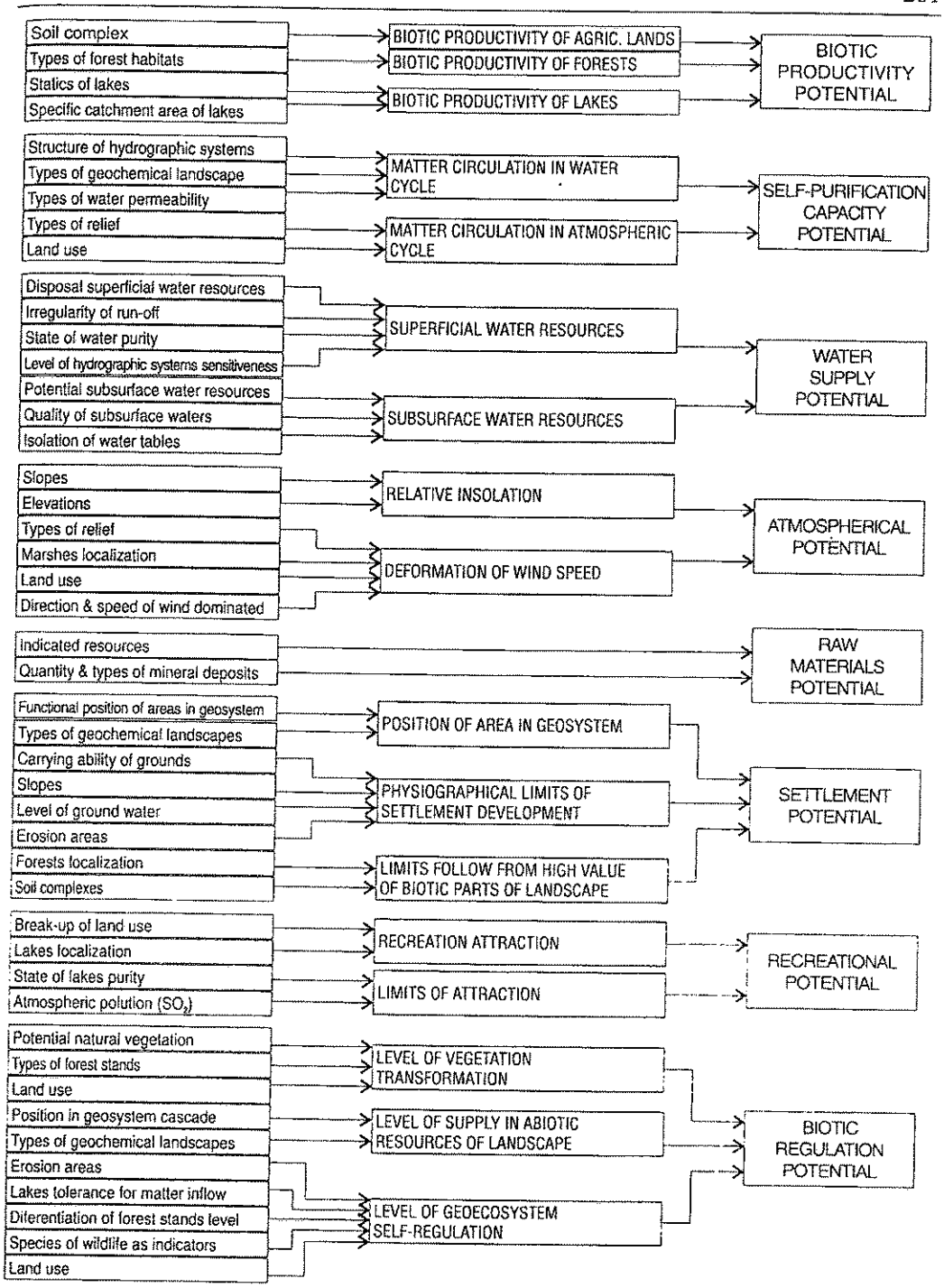

Fig. 1. Criteria of partial landscape potential assessment.

GROUP OF POTENTIALS			POTENTIALS FOR ENVIRONMENTAL EQUILIBRIUM				UTILITY POTENTIALS						AUXILIARY POTENTIALS			
PARTIAL POTENTIALS			BIOTIC REGULATION		SELF-PURIFICATION CAPACITY		BIOTIC PRODUCTIVITY		RAW MATERIALS		SETTLE-MENT		WATER SUPPLY		ATMOSPHE-RICAL	
			3	2	0	1	3	2	3	2	3	2	0	1	0	1
UTILITY POTENTIALS	BIOTIC PRODUCTIVITY	3	12	9	9	6										
		2	9	6	6	3										
	RAW MATERIALS	3	12	9	12	9	8	6								
		2	9	6	9	6	6	6								
	SETTLE-MENT	3	12	9	12	9	8	6	8	6			4	3	3	2
		2	9	6	9	6	6	6	6	6			3	2	2	1
	RECREATIO-NAL	3	12	9	9	6	6	4	8	6	6	4	3	2	3	2
		4	9	6	6	3	4	4	6	6	4	4	2	1	2	1

1 2 3

Fig. 2. A scheme of potential landscape conflicts power evaluation.
1. First type of potential landscape conflicts (see text),
2. Second type of potential landscape conflicts,
3. Third type of potential landscape conflicts.

GROUP OF POTENTIALS	POTENTIALS FOR ENVIRONMENTAL EQUILIBRIUM		UTILITY POTENTIALS			AUXILIARY POTENTIALS	
PARTIAL POTENTIALS	BIOTIC REGULATION	SELF-PURIFICATION CAPACITY	BIOTIC PRODUCTIVITY	RAW MATERIALS	SETTLE-MENT	WATER SUPPLY	ATMOSPHE-RICAL
UTILITY POTENTIALS: BIOTIC PRODUCTIVITY	855	245					
RAW MATERIALS	47	10	45				
SETTLE-MENT	313	66	311	27		271	171
RECREATIO-NAL	168	21	161	13	52	138	138

1 2 3

Fig. 3. A frequency of elementary catchment basins of particular kinds of landscape conflicts in the north-eastern Poland.
1. Big frequency of potential landscape conflicts,
2. Moderate frequency of potential landscape conflicts,
3. Small frequency of potential landscape conflicts.

– biotic regulation – settlement,
– biotic yield – settlement,
– settlement – water supply,
– biotic yield – self-purification.

An atmospheric potential is relatively less problematic and resource potential is lower. A spatial differentiation of potential landscape conflicts power (the minimum – 0, the maximum – 71; referring to the area of studies), is presented on the fig. 4.

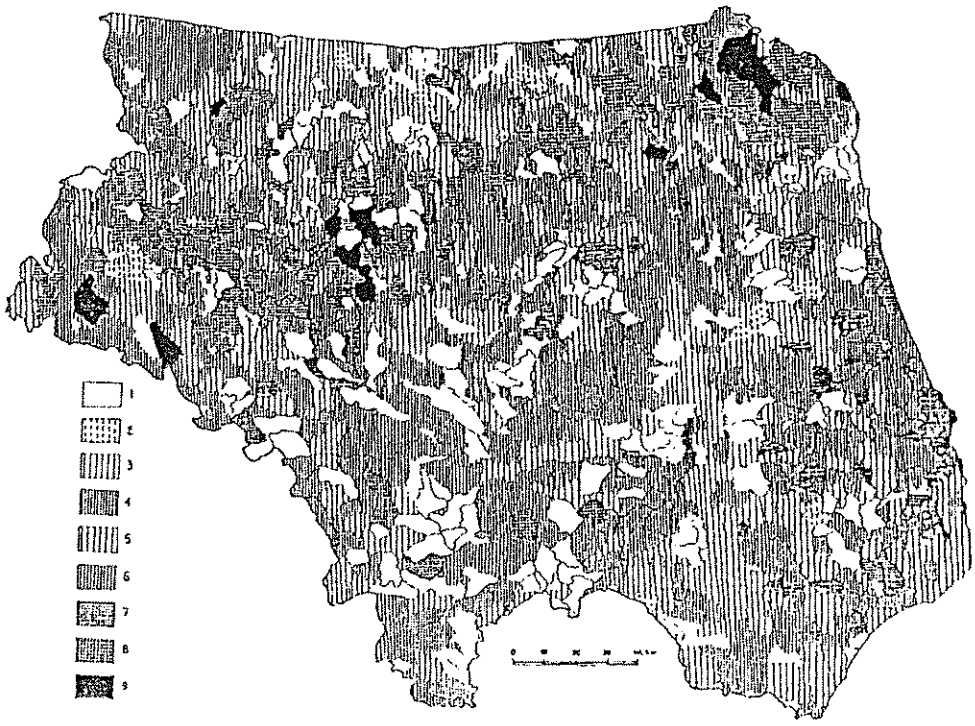

Fig. 4. A map of potential landscape conflicts power in the north – eastern Poland;
Values of potential landscape conflicts power: 1 – no potential conflicts (0), 2 – 1-3, 3 – 4-6, 4 – 7-10, 5 – 11-15, 6 – 16-21, 7 – 22-33, 8 – 34-50, 9 – 51-71.

Compared to the spatial differentiation of partial landscape potentials is is much more varying and it can not be so simply explained by a landscape genesis. However, the strongest potential conflicts appear in the lake district zone (the strongest on Suwałki and Olsztyn Lakelands and in the region of Great Masurian Lakes). Quite strong potential conflicts appear on the old glacial areas, as well Międzyrzecze Łomżyńskie, Kolno Highland, Bielsk Plain, Białystok Highland.

The weakest potential conflicts occur on an area of sandr plains (Kurpie), big river valleys and glacial accumulation plains (Sępopolska Plain).

Lanscape stability

The second level of lanscape research was an analysis of functional structure within elementary catchment basins. According to functional characteristics, certain types of geocomplexes have been distinguished. Criteria for geocomplexes delimination are as followed:
1. a relief influence on a matter circulation in superficial water cycle, expressed by a type of an elementary landscape (types: autochtonus, transit, multiple, comparatively closed deposition, closed deposition, aquatic);
2. a superficial geological formation (lithology) influence on water circulation in a subsurface cycle expressed by so called „type of water circulations" (types: infiltration, infiltration in valleys, retention, evaporation);

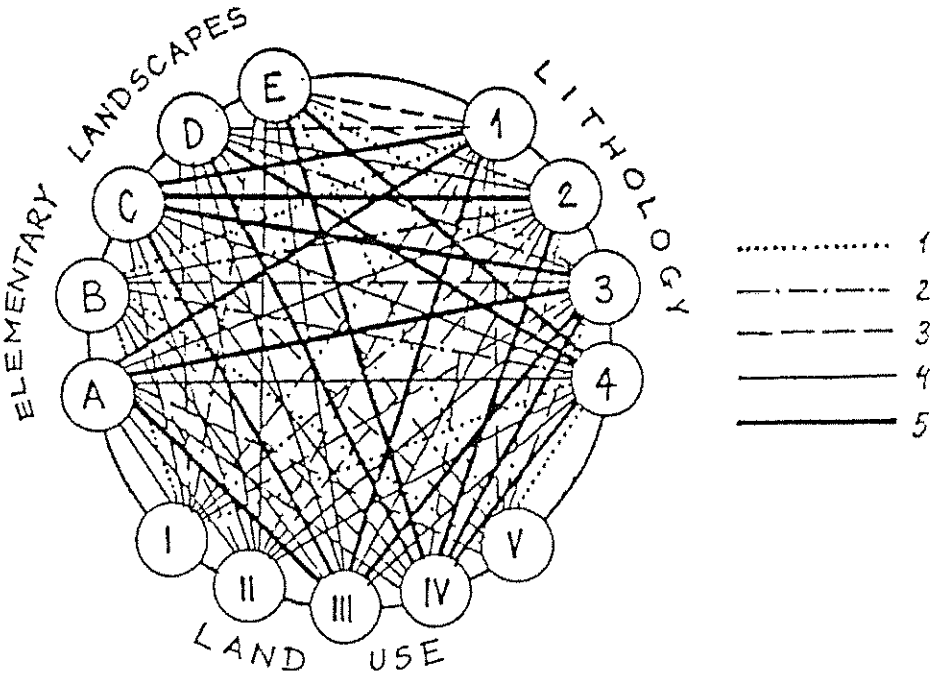

Fig. 5. A scheme of a landscape stability assessment.
Elementary landscapes: A – autochtonus, B – transit, C – multiple, D – comparatively closed deposition, E – closed deposition,
Lithology: 1 – infiltrations, 2 – infiltration in valleys, 4 – retention, 5 – evaporation,
Land use: I – farmlands, II – green crops, III – peatbogs, IV – forests, V – bult-up areas.
Landscape stability: 1 – very bad, 2 – bad, 3 – moderate, 4 – good, 5 – very good.

3. a type of area utilization (farmlands, green crops, peatbogs, forests, built-up areas).

The basis for the rate of landscape stability evaluation was an analysis of geocomplexes structure and function. A scheme of this evaluation is presented on the fig. 5.

Pairs of components featuring co-occurrence (considering a stability of their relation) were evaluated in a scale 1-5. Every single type of geocomplex consists from 3 such pairs. And a median of these 3 evaluations became the final note. A moderate evaluation of landscape stability for the elementary catchment basin was given by an analysis of particular types of geocomplexes occurence frequency on its area.

The landscape stability in the method presented was identified mainly by „agreement" between area utilization and its natural features (relief, lithology). This occurs with morphodynamic processes intensity, less with a landscape's ability to remove anthropogenic substances (it was called earlier self-purification potential). Some assumptions can be taken, as followed:

- autochtonic and multiple landscapes are more stable than deposition and transit landscapes;
- stability evaluation is connected with superficial geological sediments occurrence and co-occurrence with a type of relief and utilization;
- landscape stability decreases with increasing grade of antropization (except some cases when plant coverage is discordant with a habitat but it is very close to a natural one).

A picture of landscape stability in the north-eastern Poland is presented on the fig. 6.

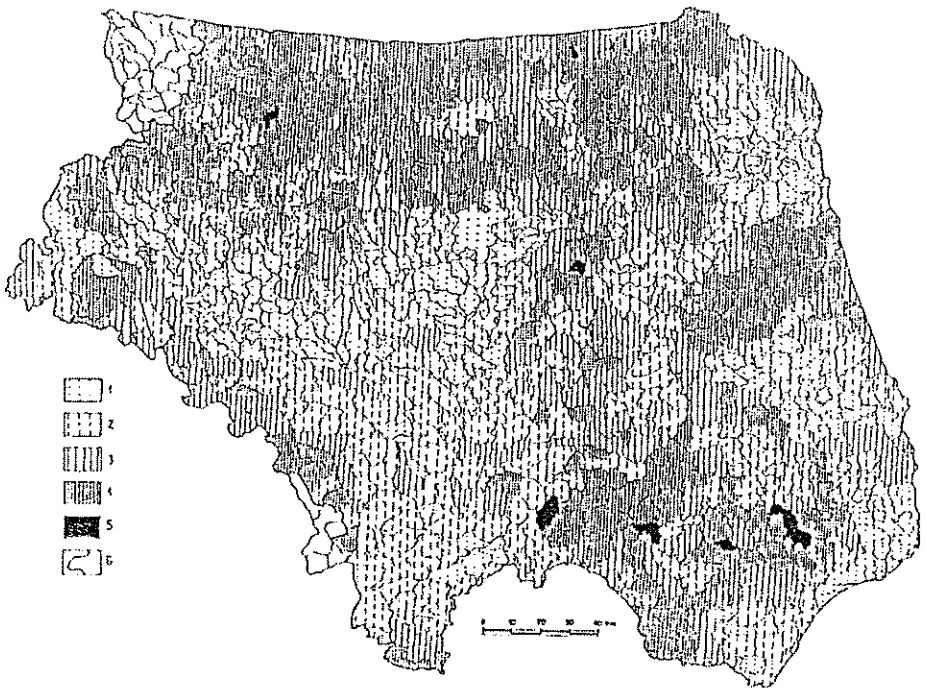

Fig. 6. A map of landscape stability in the north – eastern Poland.
Landscape stability: 1 – very good, 2 – good, 3 – moderate, 4 – bad, 5 – very bad.

A zone of very good and good landscape stability, which includes a central belt of the studied area, is the most distinct. It consists of the southern part of the lakelands and sandr plains. The eastern part of the studied area is a second good stability zone, which includes the Augustowska Plain, southern part of Białystok High Plain and Białowieża Primeval Forest. Multiple and autochthonus landscapes as well as extensive forest, lake and peatbog areas have a fabourable influence on the landscape stability in these areas. Farmlands, often connected with transit landscapes and sediments with poor ground permeability (clay, silt), are characterized by bad landscape stability (Sępolska Plain, Ełk and Western Suwałki Lakelands). A bad landscape stability occur in the southwestern and soútheastern part of the studied area as well (Ciechanów High Plain, Międzyrzecze Łomżyńskie and Bielsk Plain).

Potential Conflicts and Landscape Stability as Factors Limiting Utilization.

A landscape's partial potentials evaluation is the first step of environmental resources and values utilization planning and management.

At makes it possible to ascertain which areas can be taken under a more detailed analysis of particular management policies. However an occurrence of high potentials does not guarantee that this area can be intensively utilized in every case according to a policy directed by a particular high potential. The most important factors for a limiting potential utilization are as followed:

– an occurrence of potential landscape conflicts;
– a level of landscape stability.

A power and a kind of potential landscape conflicts assessment should appear in every planning studies. However, it is subjective evaluation depending on an assumed strategy of area development. Strategies where sustainable development is the first priority conditioning a landscape balance, exert a significant influence on the power of potential landscape conflicts. This project belongs to these strategies.

However, these potentials should be addressed in approaches aiming at intensive economic growth. But their influence on a potential conflict power assessment could be a little bit smaller. Considerations that refer to landscape stability are definitely different, because it is assessed according to present functional characteristics of landscapes. This factor should be assessed according to similar methods in every case. Nevertheless, extensive forms of management should be introduced in unstable areas and eventually some forms of management should be fiven up. An intensive management can further decrease the stability of these areas and potentials reduction can occur as a consequence.

In north – eastern Poland, both factors simultaneously cause the highest limits on Western Suwałki Lakeland, the northern part of Great Masurian Lakeland, the western part of Olsztyn Lakeland and Partly Lubawski Hummock and Bielsk Plain. In comparison, the lowest limits occur on Kurpiowska Plain, Augustowska Plain, the southern part of Bielsk Plain and Biebrza Basin.